IEEE P802.11  
Wireless LANs

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| LB187 Clause 22.3.21 and PMD SAP Comment Resolution | | | | |
| Date: 2012-05-02 | | | | |
| Author(s): | | | | |
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Abstract

This document provides resolutions for LB187 comments in Clause 22.3.21 and those related to the PHY PMD.

Eldad wrote the resolutions to most of the Clause 22.3.21 comments and Adrian to the PMD comments; but because they interact, these resolutions are presented in a single submission.

R1: CID 4754, updated location of PMD-DATA.indications.

CID 4113, updated terminology and language.

CID 4116, added instructions to also update Figure 22-1.

+ typos corrected

**Note to TGac PHY ad-hoc database owner:**

In what follows, please replace <this-document> with the actual document reference and version in which the comment resolution was discussed and approved.

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| **CID** | **Commenter** | **Page** | **Clause** | **Comment** | **Proposed Change** | **Resn Status** | **Resolution** |
| 4772 | Mark RISON | 263.10 | 22.3.21 | PMD\_CHAN\_MAT.ind, PMD\_NON\_HT\_CH\_BANDWIDTH ind and PMD\_CBW ind are missing | Add to text, procedure and flowchart | R | Revised.  The use of the highlighted PMD parameters are already described in Clause 22.6, so it is not necessary to repeat the description. This is the same approach as in Clause 20. However, following Clause 20, the parameters will be included in the PLCP receive procedure figure. Only PMD\_CHAN\_MAT.ind and PMD\_CBW.ind will be added, as PMD\_NON\_HT\_CH\_BANDWIDTH.ind is not in VHT packet.  Make changes under heading Figure 22-30 in <this-document> |

Note – see discussion on comment 5236 before approving.

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| 4109 | Adrian Stephens | 263.11 | 22.3.21 | "Further, through station management (via the PLME) the PHY is set to the appropriate frequency, as specified in 22.4 (VHT PLME)."  This is OK as far as it goes. Group membership plays a big part in the MAC-PHY interaction, so it might be good to mention here. | Add a sentence to follow cited one: "The PHY has also been configured with group information (i.e., group membership and position in group) so that it can receive data intended for the STA." | A | Accepted. |
| 5301 | Vinko Erceg | 263.38 | 22.3.21 | Equation number missing in "defined by RXTIME in Equation ().." | As in comment. | R | Revised.  TGac editor: Add an equation number to RXTIME in D2.1 P262L20. Insert that equation number in D2.1 P261L34. |
| 4111 | Adrian Stephens | 263.41 | 22.3.21 | "An invalid L-SIG Length field value is defined as a value not following Equation (35)."  This is utterly meaningless. Cited equation determines how to calculate the length given the TXTIME. The receiver is not party to the TXTIME value and cannot therefore validate the L-SIG Length against this value.  Instead the receiver uses the L-SIG length to determin the RXTIME, from which the symbol count is determined. | Alternative suggestions: 1. Add an out-of-band communication of TXTIME so that the receiver can validate it. Possible out-of-band mechanisms include: a) Write it on the back of a post card; b) encode in smoke signals; c) telepathy. 2. Remove cited sentence. 3. Correct sentence to refer to something the receiver can validate. | J | Rejected.  The meaning of the statement is for future-proofing the CCA.  As currently defined in D2.1 (Equation 35), Length is modulo 3. Without the cited sentence an implementer would have been able to treat a packet with Length not modulo 3 as an invalid 802.11 signal and switch to weaker energy detect for CCA as was done with previous amendments (e.g. invalid Rate in 802.11a). With the cited sentence, a future amendment may use non-modulo 3 Length values and 802.11ac devices will still defer based on Length.  The receiver does not need “out-of-band communication of TXTIME”, as it does not need to calculate TXTIME. It merely extracts Length from L-SIG. |

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| 4112 | Adrian Stephens | 263.56 | 22.3.21 | "If the received Group ID in VHT-SIG-A has a value indicating an SU PPDU (see 9.17a (Group ID and Partial AID in VHT PPDUs)), the PHY entity may choose not to decode VHT-SIG-B."  This breaks layering. The PHY should not need to understand any meaning defined in the MAC, unless the MAC tells it. If there was a single fixed "SU" value, then it should be defined in the PHY - but that is not the case. | Add to the PHYCONFIG\_VECTOR (22.26) a parameter SU\_GROUP\_ID", with description: "The SU\_GROUP\_ID parameter specifies a value that is used by the receiver to determine that a VHT PPDU is an SU PPDU, and that the PPDU is to be received." and modify this description to refer to it: "If the received Group ID in VHT-SIG-A has a value indicating an SU PPDU (i.e., matching the SU\_GROUP\_ID of the PHYCONFIG\_VECTOR), the PHY entity may choose not to decode VHT-SIG-B." | J | Rejected.  The PHY has the Group ID information from VHT-SIG-A. Layering is not broken by referring a person reading a PHY clause to a definition in a MAC clause. |

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| 4113 | Adrian Stephens | 264.07 | 22.3.21 | There's no notion in the 22.3.21 description of what to do when we don't care about the received PPDU. | Add a statement along these lines: (264.06 may be a suitable location) "The PLCP determines whether the PPDU shall be admitted, based on Group ID as follows: 1. If the Group ID does matches the SU\_GROUP\_ID, or 2. If the Group ID in the Membership Status Array and the appropriate NSTS field is non-zero. If the PPDU is not admitted, the PLCP shall issue a PHY-RXEND.indication(NotAdmitted) primitive.  Modify Figure 22-28 to show this test, and a branch to the circle-A lable.  Modify 7.3.5.13.2 to add "NotAdmitted" to the list of RXERRORS, with description: "This value is used to indicate that the PPDU was not received due to a condition (e.g., Group ID membership) set in the PHYCONFIG\_VECTOR." | J | Revised. Make changes as shown in <this-doc> under CID 4113 and Figure 22-31. These changes show the effect of filtering by Group ID. |

Changes:

***To the list of RXERROR codes in REVmb 7.3.5.13.2 D12 p377, after “Unsupported Rate” add:***

* *Filtered*. This value is used to indicate that during the reception of the PPDU, the PPDU was filtered out due to a condition set in the PHYCONFIG\_VECTOR.

NOTE – this case might occur in a VHT STA due to GROUP\_ID or PARTIAL\_AID filtering in the PHY layer.

***Modify 22.3.21 as follows:***

**22.3.21 PLCP receive procedure**

**…**

If Group ID in VHT-SIG-A has a value indicating an MU PPDU (see 9.17a (Group ID and Partial AID in

VHT PPDUs)), the PHY shall decode VHT-SIG-B. If the VHT-SIG-B indicates an unsupported mode, the

PHY shall issue the error condition PHY-RXEND.indication(UnsupportedRate).

If VHT-SIG-B was decoded the PHY may check the VHT-SIG-B CRC in the SERVICE field. If the VHTSIG-

B CRC in the SERVICE field is not checked a PHY-RXSTART.indication(RXVECTOR) shall be issued.

The RXVECTOR associated with this primitive includes the parameters specified in Table 22-1 (TXVECTOR

and RXVECTOR parameters).

The PLCP filters out the PPDU unless:

-- If the Group ID indicates an SU PPDU, or

-- MembershipStatusInGroupID[GroupID] is equal to 1 and the MU[UserPositionInGroupID[Group ID]] NSTS field in VHT-SIG-A1 is non-zero.

If the PPDU is filtered out, the PLCP shall issue a PHY-RXEND.indication(Filtered) primitive."

Following training and signal fields, the coded PSDU (C-PSDU) (which comprises the scrambled and coded

PLCP SERVICE field, PSDU and pad) shall be received. The number of symbols in the C-PSDU is determined

by Equation (115).

…

*See also changes for figure 22-30 (rx procedure)*

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| 5223 | Sigurd Schelstraete | 264.63 | 22.3.21 | There could be more than one BCC encoder | Replace "A BCC encoder" with "BCC encoding" | R | Revised.  As this is the receive procedure, we’re dealing with decoders.  TGac editor: in D2.1 P262L48, replace “a BCC decoder” with “BCC decoding”. in D2.1 P262L52, replace “A BCC decoder” with “BCC decoding” |
| 5491 | Ziv Avital | 265.06 | 22.3.21 | Error with the Nsym\_init equation at the receive procedure in the case of STBC | Replace "Nsym\_init = Nsym - 1" with  "Nsym\_init = Nsym - m\_stbc" in the case of Extra OFDM symbol = 1 in VHT-SIG-A2. We must have even number of symbols in the case of STBC. | R | Revised.  Make changes as shown in 11-12/0313r1 slide 9.  (These changes have already been actioned in D2.1, and are effectively a duplicate of the resolution to comment 5310.) |

Note, Eldad had previously suggested the following resolution:

Revised.

Agree in principle. This has already been corrected in D2.1 P262L62, whereby in Eq. 22-103 for the case of Extra OFDM symbol = 1 and STBC = 1, N\_sym,init is equal to N\_sym-2.

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| 5224 | Sigurd Schelstraete | 265.29 | 22.3.21 | Move paragraph | Paragraph starting at line 29 seems out of place here. Move it to line 6 of page 264. | A | Accepted. |
| 4778 | Mark RISON | 266.00 | 22.3.21 | What first? | If this is the first symbol, doesn't it arrive after the L-SIG? | J | Rejected.  The comment and the proposed change are both unclear and not actionable. |
| 4116 | Adrian Stephens | 266.10 | 22.3.21 | Figure 22-27 Related to "PHY-CCA.ind(STATUS=busy)" 1. There is no such primitive as a ".ind" 2. The first parameter in the PHY-CCA.indication is STATE, not STATUS 3. The VHT format of the PHY-CCA.indication primitive includes a channel-list parameter.  Apart from these, there's nothing much wrong with it. | Change to "PHY-CCA.indication (busy,primary)"  Change any other ".ind" in Figures 22-27 and 22-28 to ".indication". | V | Revised.  Make changes under heading Figure 22-30 and Figure 22-31 in <this-document>.  Also update Figure 22-1 replacing “.ind” with “.indication”, “.req” with “.request”, “.conf” with “.confirm”. |
| 4119 | Adrian Stephens | 267.09 | 22.3.21 | The PLCP receive state machine and the PMD interface are inconsistent. 1. In Figure 22-28, there is a box labelled "Determine type of SIG field", which has the ability to detect L-SIG vs HT-Greenfield. 2. In 22.6.5.12.2, the PMD\_FORMAT.indication occurs "after the reception of the VHT training fields.", which is way too late. | Extend the PMD interface with appropriate indications so that the following conditions: 1. "Determine type of SIG field": L-SIG | HT\_GF 2. "Determine whether HT-SIG follows L-SIG" 3. "Determine whether VHT-SIG-a follows L-SIG"  And reference from Figure 22-28. It | J | Rejected.  It is only necessary for PMD\_FORMAT.ind to occur after the training fields as described 22.6.5.12.2. The incremental steps in the PLCP receive state machine are to determine whether to switch to a receive procedure in another Clause or for decoding errors. |
| 5226 | Sigurd Schelstraete | 267.37 | 22.3.21 | Action on VHT-SIG-A unsupported mode not fully reflected in text | Figure 22-28 shows that for VHT-SIG-A unsupported mode, the PLCP issues a PHY\_RXSTART.ind., followed by a PHY\_RXEND.ind. This is not reflected in the text (see line 46 on page 263). Correct either text or figure. | R | Revised.  TGac editor: In D2.1 P261L41, change “If the VHT-SIG-A indicates an unsupported  mode, the PHY shall issue the error condition PHY-RXEND.indication(UnsupportedRate).”  to  “If the VHT-SIG-A indicates an unsupported  mode, the PHY shall set issue PHY\_RXSTART.ind  (RXVECTOR)  then PHY shall issue the error condition PHY-RXEND.indication(UnsupportedRate).” |

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| 4122 | Adrian Stephens | 267.57 | 22.3.21 | The PMD interface is inadequate to receive an MU PPDU.  For the PMD to demodulate a symbol and extract the appropriate user's data requires that it understand which of the STS to demodulate, and which user-specific MCS to expect.  However, this information is held in the signal fields, which are comprehended only in the PLCP. | 1. Add a new PMD request: PMD\_SET\_RX\_PARAMETERS with parameters MCS, START\_STS, NUM\_STS (Add to table 22-62 and new subclauses 22.6.5.x). 2. Update 22.3.21 and figure 22-28 showing generation of this primitive in "Setup PSDU RX". |  | Rejected.  Precedent in Clause 18 (802.11a) and Clause 20 (802.11n) is that the PMD has the information from the signal field, e.g. Rate or MCS. No new PMD request is necessary. |

Discussion:

The purpose of an architecture is “divide and conquer” – by dividing a behaviour into smaller pieces with well, documented interfaces, the individual pieces are simpler.

The implication of this resolution is that we have two receive state machines:

1. A State machine that is in the PLCP
   1. it interfaces between the PMD and MAC-SAP
   2. it’s operation is described in text and figures
2. A State machine in the PMD
   1. It interfaces between the PLCP and the hardware
   2. it’s operation is not described anywhere
   3. it is of more-or-less equivalent complexity to the PLCP state machine because it is required to detect the different types of signal field in order to decode their contents, which are used to determine how to interpret the rest of the packet.

Such an implication is an indictment of our architecture – i.e., it has failed to provide the necessary simplifications.

However, I (Adrian) am willing to accept that most folks in TGac don’t care about the architecture. Therefore I will limit any proposed changes in this document to those easily made. Actioning this particular comment would result in new primitives and interaction with the PLCP rx state machine text and diagrams; these changes are too extensive to be considered “easily made”. Therefore I’m OK with rejecting the comment as shown.

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| 5227 | Sigurd Schelstraete | 268.01 | 22.3.21 | PHY-RXEND takes two parameters | PHY\_RXEND has been redefined to take two parameters (see 7.3.5.13.2 in mb). This should be reflected here. | J | Rejected.  7.3.5.13.2 in 802.11-2012 states “RXVECTOR is an  included parameter only when dot11RadioMeasurementActivated is true.” We have assumed in the PLCP receive state machine that dot11RadioMeasurementActivated is false. |

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| 4754 | 175.50 | 22.3 | There are several inconsistencies between Figure 22-25 (PLCP tx) and Figure 22-27 (PLCP rx):- In tx, the PSDU gets "Bit Padding if needed" and "Tail Bits (if BCC)" before it is scrambled and encoded to a C-PSDU. In rx, they're apparently always present- In tx, the MAC passes an A-MPDU while in rx the MAC is passed an MPDU- There is no PMD data indication or data end indication- This is covered by the NOTE, but in rx the VHT-SIG-B does not make it to the PLCP- In rx it's just VHT-Training but in tx it's VHT Training Symbols, and neither says what these are- In rx it's L-STF and L-LTF but in tx it's just Non-VHT Training Symbols- There are some dots between start and end in tx, but not rx | Align and complete the two figures:- Say "Bit padding (if needed)" and "Tail bits (if BCC)" in rx- Pass an A-MPDU up to the MAC in rx- Put in the appropriate PMD data signals in rx- Include VHT-SIG-B handling in the PLCP in rx and remove the second sentence of the NOTE- Show how the PARTIAL\_AID/GROUP\_ID are passed down for tx- Rename "VHT-Training" in rx and "VHT Training Symbols" in tx to "VHT-STF/LTF" or "VHT-STF" and "VHT-LTF"- Rename Non-VHT Training Symbols from the PLCP and rename it to "L-STF/L-LTF" or "L-STF" and "L-LTF" in tx- Remove the line of dots at the top of tx |

Discussion, 22.6.5.2 indicates that DATA.indications are for each bit of SIGNAL or data, after decoding. Another comment changes the unit to the symbol, so we should have a data.indication in the rx procedure for each signal field or data field symbol.

Proposed resolution:

Revised.

1. In figure 22-25 (tx procedure). Change “Tail Bits (if BCC)” to “Tail Bits”. This is because the note indicates that operational features are not described, so we can assume BCC.
2. In figure 22-27 (rx procedure). Change “Pad and Tail …” to “Pad (if present) and Tail…”
3. In figure 22-27 (rx procedure). Change “MPDU” to “A-MPDU”.
4. In figure 22-27 (rx procedure):
   1. Move the PMD\_Data.indication to the end of the L-SIG
   2. Rename it PMD\_DATA.indication
   3. Add (See NOTE 2)
   4. Add NOTE 2 “Repeated for each symbol of the PPDU” and renumber NOTE to NOTE 1.
5. In figure 22-25 (tx procedure): To PMD\_DATA.request
   1. Add “(See NOTE 2)”
   2. Add NOTE 2 “Repeated for each symbol of the PPDU that contains all or part of a signal field or the data field.” and renumber NOTE to NOTE 1.
6. No change related to: “Include VHT-SIG-B handling in the PLCP in rx and remove the second sentence of the NOTE”. The diagrams are already complex enough, the decision to omit optional MU processing is deliberate.
7. In figure 22-27 (rx procedure): Change “VHT-Training” to “VHT-Training Symbols”
8. In figure 22-25 (tx procedure): Change PHY PMD “Non-VHT Training Symbols” to separate L-STF and L-LTF boxes (like on rx procedure).
9. No change related to: “Rename Non-VHT Training Symbols from the PLCP and rename it to "L-STF/L-LTF" or "L-STF" and "L-LTF" in tx”. This box is not present on rx procedure, so there is no precedent to call it one thing or the other.
10. In figure 22-27 (rx procedure): Add a PHY-DATA.indication at the end of the A-MPDU and a row of dots between this and the previous PHY-DATA.indication.

# Changes to PLCP state machine figures

**TCac editor: modify in D2.0 Figure 22-25 as follows:**

The changes comprise:

* Remove “(if BCC)” after “Tail Bits”
* To PMD\_DATA.request
  + Add “(See NOTE 2)”
  + Add NOTE 2 “Repeated for each symbol of the PPDU” and renumber NOTE to NOTE 1.
* Change PHY PMD “Non-VHT Training Symbols” to separate L-STF and L-LTF boxes (like on rx procedure).
* Change any “.ind” primitives to “.indication”



The changes to (D2.1) Figure 22-30 are the following:

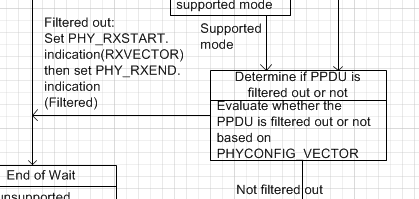
* Addition of PMD\_FORMAT.indication
* Addition of PMD\_CBW.indication
* Addition of PMD\_RCPI.indication(RCPI)
* Change “Pad and Tail…” to “Pad (if present) and Tail…”
* Change “MPDU” to “A-MPDU”
* Move the PMD\_Data.indication to the end of the first symbol
  + Rename it PMD\_DATA.indication
  + Add (See NOTE 2)
  + Add NOTE 2 “Repeated for each symbol of the PPDU” and renumber NOTE to NOTE 1.
  + Change “VHT-Training” to “VHT-Training Symbols”
  + Add a PHY-DATA.indication at the end of the A-MPDU and a row of dots between this and the previous PHY-DATA.indication.
* Change PHY-CCA.ind(STATUS=busy) to PHY-CCA.indiation(busy,primary)
* Change any “.ind” primitives to “.indication”

**TGac editor: modify in D2.1 Figure 22-30 as follows:**



Changes to 22-31:

* Addition of “Determine if PPDU is filtered out or not” state and 2 transitions.



**TGac editor: modify in D2.1 Figure 22-31 as follows:**



# Comments on PMD

| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| --- | --- | --- | --- | --- |
| 4770 | 160.05 | 22 | PMD\_RCPI.ind is defined in 22.6.5.9 but not used in 22.3.20 | Either show PMD\_RCPI.ind in 22.3.20 (rx text, rx procedure, rx flowchart) or delete it |

Discussion: This is another case where VHT is follow a precedent. .11k did an incomplete job when RCPI was added, and we have propagated this in D2.0, although we have addressed the “continuously available” issue in D2.1.

Proposed Resolution:

Revised.

Modify Figure 22-30 (rx procedure) as shown in <this-document>. This adds a PMD\_RCPI.indication(RCPI) primitive at the end of the received PPDU.

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| 4118 | 291.54 | 22.6.4.3 | Table 22-62 shows only a PMD\_TXEND primitive. Figure 22-25 shows more than this. (I have another comment to change Figure 22-24 PMD\_TXEND.indication to PMD\_TXEND.confirm). | Add a PMD\_TXEND.confirm in table 22-62. |

Proposed Resolution:

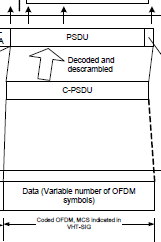
Accepted. (Note the text already includes a description of the PMD\_TXEND.confirm).

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| 5231 | 292.13 | 22.6.4.4 | Definition of TXD\_UNIT | TXD\_UNIT is supposed to be one OFDM symbol of bits. If coding happens in the PLCP and PMD\_DATA.request is exchanged between PLCP and PMD (as shown in Figure 22-25), the number of bits should be N\_CBPS, not N\_DBPS. |

Discussion. If we take figure 22-25 (D2.0) as definitive, then the PLCP performs these operations, and the appropriate number of bits is the coded bits.

Note that we have a worse problem with the RX data (PMD\_DATA.indication). This includes the following: “The RXD\_UNIT parameter shall be 0 or 1 and shall represent either a SIGNAL field bit or a data field bit after the decoding of the FEC by the PMD entity.”

But Figure 22-27 (D2.0) includes:



These are inconsistent. I propose it is easier to fix the PMD interface (which nobody cares about) than try and move decoding in figure 22-27 (D2).

Proposed Resolution:

Revised. Make changes as indicated. Also modify PMD\_DATA.indication and RX UNIT to transport coded bits as shown in <this-document> under “PMD Changes”.

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| 4121 | 292.18 | 22.6.4.4 | The PMD parameters are inadequate to transmit multi-user PPDUs. | Add a "NUM\_USERS" parameter for the PMD\_TX\_PARAMETERS.request.Modify description of MCS and NUM\_STS parameters to refer to the following new table NOTE:"NOTE -- These parameters are present for one user if an SU PPDU and present per user for an MU PPDU.They are conceptually supplied as an array of values indexed by u, where u takes values 0 to NUM\_USERS-1." |

*These changes are shown under PMD Changes.*

Proposed Resolution: Revised.

Make change as indicated (except use range 1 to NUM\_USERS in NOTE), and also cite NOTE from TXD\_UNIT parameter.

Add at the end of 22.6.5.2.2: “The TXD\_UNIT parameter is present for one user for an SU PPDU and present per user for an MU PPDU. It is conceptually supplied as an array of values indexed by *u*, where u takes values 1 to NUM\_USERS.”

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| 5457 | 295.50 | 22.6.5.7.2 | "aNumberSupportedPowerLevels" is defined in neither REVmb D12.0 nor TGac D2.0. The correct MIB attribute is "dot11NumberSupportedPowerLevels." | As in comment. |

*This change is shown under PMD Changes.*

Proposed Resolution

Revised.

Change cited “aNumberSupportedPowerLevels” to “dot11NumberSupportedPowerLevelsImplemented”.

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| 4124 | 298.11 | 22.6.5.13 | "PMD\_NON\_HT\_CH\_BANDWIDTH.indication"How does this work? Given that the information is in the service field, it is known to the PLCP, not the PMD. | Remove this subclause. Update 293.28. |

Discussion:

The service field is available only after decoding, which according to figure 22-27 (D2) occurs in the PLCP.

Proposed Resolution:

Make changes as shown in <this-document> under PMD Changes.

These remove the cited primitive.

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| 5236 | 298.61 | 22.6.5.14.3 | Clarify availability of PMD\_CBW.indication | The text states that "This primitive shall be available continuously to the PLCP". It would appear this is not possible, since it relates directly to reception of a packet. What happens if PHY is in receive state and no packet is detected? |

Discussion:

We should consider whether this primitive should exist at all. It is essentially reporting the contents of the signal field to the PLCP.

But the PLCP is the “owner” of the format of the PPDU. It’s the thing that defines the interpretation of what goes in signal fields – so it certainly doesn’t need any help from the PMD to do this.

Worse, it is the PLCP that does the decoding (according to Figure 22-27 (D2)). The SIGNAL field is encoded. So unless our PMD runs a parallel set of decoders, it can’t know what’s in the SIGNAL field.

In an earlier comment, we identified that our partition and interfaces require the PMD to run a state machine that parallels that of the PLCP. Now we discover it also has a parallel set of decoders – at least for the SIGNAL fields. It’s just as well nobody builds hardware like this.

We have one related comment (4772).

Note related spec issues:

1. Primitive does not occur in Table 22-63
2. Table 22-64 cites a PMD\_CBW\_OFFSET.indication (CID 4764 resolution renames this to PMD\_CBW.indication)

We have several options:

1. Remove this primitive (and adjust any other comment resolutions, CIDs 4772 and 4764)
2. Leave this primitive here (and fix Table 22-63).

Straw Poll: Should we:

* Remove this primitive
* Keep the primitive (and fix up related errors)

# Changes to PMD

***Change 22.6 (D2.1) as follows:***

* VHT PMD sublayer
* PMD\_SAP sublayer-to-sublayer service primitives

Table 22-63 (PMD\_SAP sublayer-to-sublayer service primitives) indicates the primitives for sublayer-to-sublayer interactions.

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| * PMD\_SAP sublayer-to-sublayer service primitives | | | | |
| Primitive | Request | Indicate | Confirm | Response |
| PMD\_TXSTART | X | — | — | — |
| PMD\_TXEND | X | — | X | — |
| PMD\_TXPWRLVL | X | — | — | — |
| PMD\_TX\_PARAMETERS | X | — | — | — |
| PMD\_RSSI | — | X | — | — |
| PMD\_RCPI | — | X | — | — |
| PMD\_CHAN\_MAT | — | X | — | — |
| PMD\_FORMAT | — | X | — | — |

* PMD\_SAP service primitive parameters

Table 22-64 (List of parameters for PMD primitives) shows the parameters used by one or more of the PMD\_SAP service primitives.

|  |  |  |
| --- | --- | --- |
| * List of parameters for PMD primitives | | |
| Parameter | Associate primitive | Value |
| TXD\_UNIT | PMD\_DATA.request | One OFDM symbol value, *NCBPS* bits  See NOTE. |
| RXD\_UNIT | PMD\_DATA.indication | One OFDM symbol value, *NCBPS* bits |
| TXPWR\_LEVEL | PMD\_TXPWRLVL.request | 1 to 128 (maximum of 128 levels) |
| MCS | PMD\_TX\_PARAMETERS.request | 0 to 9, MCS index defined in 22.5 (Parameters for VHT MCSs  )  See NOTE. |
| NUM\_STS | PMD\_TX\_PARAMETERS.request | Indicates the number of space-time streams  Range 1-8 for SU, 0-4 for MU  See NOTE. |
| CH\_BANDWIDTH | PMD\_TX\_PARAMETERS.request  PMD\_CBW\_OFFSET.indication | The CH\_BANDWIDTH parameter indicates the channel width of the transmitted PPDU:  Enumerated type:  CBW20 for 20 MHz  CBW40 for 40 MHz  CBW80 for 80 MHz  CBW160 for 160 MHz  CBW80+80 for 80+80 MHz |
| STBC | PMD\_TX\_PARAMETERS.request | Set to 0 indicates no STBC (*NSTS*=*NSS*)  Set to 1 indicates *NSTS*=2*NSS* |
| GI\_TYPE | PMD\_TX\_PARAMETERS.request | Set to 0 indicates short GI is not used in the PPDU  Set to 1 indicates short GI is used in the PPDU and the Short GI NSYM Disambiguation field in VHT-SIG-A2 is 0  Set to 2 indicates short GI is used in the PPDU and the Short GI NSYM Disambiguation field in VHT-SIG-A2 is 1 |
| FEC\_CODING | PMD\_TX\_PARAMETERS.request | Indicates which FEC encoding is used.  Enumerated type:  BCC\_CODING indicates binary convolutional code.  LDPC\_CODING\_0 indicates low-density parity check code and the LDPC Extra OFDM Symbol field in VHT-SIG-A2 is 0.  LDPC\_CODING\_1 indicates low-density parity check code and the LDPC Extra OFDM Symbol field in VHT-SIG-A2 is 1. |
| GROUP\_ID | PMD\_TX\_PARAMETERS.request | 0-63; value indicates SU or MU (see 9.17a (Group ID and partial(#4829) AID in VHT PPDUs)) |
| PARTIAL\_AID | PMD\_TX\_PARAMETERS.request | Provides an abbreviated indication of the intended recipient(s) of the frame (see 9.17a (Group ID and partial(#4829) AID in VHT PPDUs)).  Integer: range 0-511. |
| CHAN\_MAT | PMD\_CHAN\_MAT.indication | *NSD* complex matrices of size *NRX* × *NSTS*(#5232) |
| RSSI | PMD\_RSSI.indication | 0 to 255 |
| RCPI | PMD\_RCPI.indication | 0 to 255; see 20.3.21.6 (Received channel power indicator (RCPI) measurement) for definition of each value. |
| FORMAT | PMD\_FORMAT.indication | Set to 0 for NON\_HT  Set to 1 for HT\_MF  Set to 2 for HT\_GF  Set to 3 for VHT |
|  |  |  |
|  |  |  |
| EXPANSION\_MAT | PMD\_TX\_PARAMETERS.request | *NSD* complex matrices of size *NTX* × *NSTS*(#5234) |
| NUM\_USERS | PMD\_TX\_PARAMETERS.request | 1 to 4 |
| NOTE -- These parameters are present for one user for an SU PPDU and present per user for an MU PPDU.They are conceptually supplied as an array of values indexed by *u*, where u takes values 1 to NUM\_USERS | | |

* PMD\_SAP detailed service specification
* PMD\_DATA.request
* Semantics of the service primitive

This primitive shall provide the following parameters: PMD\_DATA.request (TXD\_UNIT)

The TXD\_UNIT parameter shall be the n-bit combination of 0 and 1 for one symbol of OFDM modulation. If the length of a coded PSDU (C-PSDU) is shorter than n bits, bits with value 0 are added at the end of the coded PSDU to form an OFDM symbol.(#5235) This parameter represents a single block of data that, in turn, shall be used by the PHY to be encoded into an OFDM transmitted symbol.

The TXD\_UNIT parameter is present for one user for an SU PPDU and present per user for an MU PPDU. It is conceptually supplied as an array of values indexed by *u*, where u takes values 1 to NUM\_USERS.

* PMD\_DATA.indication
* Semantics of the service primitive

This primitive shall provide the following parameter: PMD\_DATA.indication(RXD\_UNIT)

The RXD\_UNIT parameter shall be the n-bit combination of 0 and 1 for one received symbol of OFDM modulation.

* PMD\_TXPWRLVL.request
* Semantics of the service primitive

This primitive shall provide the following parameter: PMD\_TXPWRLVL.request (TXPWR\_LEVEL)

TXPWR\_LEVEL selects which of the transmit power levels should be used for the current PPDU transmission. The number of available power levels shall be determined by the MIB parameter dot11NumberSupportedPowerLevelsImplemented. See 20.3.20.3 (Transmit power) for further information on the OFDM PHY power level control capabilities.

* PMD\_CBW.indication
* Function

This primitive, generated by the PMD sublayer, provides the bandwidth of the received PPDU to the PLCP and MAC entity.

NOTE—The bandwidth is typically determined from the PLCP header of HT\_GF (if supported), HT\_MF, and VHT PPDUs(#4734), and by estimation for HT\_GF (if unsupported) and NON\_HT PPDUs(#4734).

* Semantics of the service primitive

This primitive shall provide the following parameter: PMD\_CBW.indication(CH\_BANDWIDTH)

CH\_BANDWIDTH represents the channel width (CBW20, CBW40, CBW80, CBW160 or CBW80+80 for 20 MHz, 40 MHz, 80 MHz, 160 MHz or 80+80 MHz respectively) in which the data are transmitted.

* When generated

This primitive shall be generated by the PMD when the VHT PHY is in the receive state. This primitive shall be available continuously to the PLCP that, in turn, shall provide the information to the MAC entity via the CH\_BANDWIDTH parameter and (for NON\_HT PPDUs(#4734)) the NON\_HT\_MODULATION parameter.

* Effect of receipt

The PLCP sublayer passes the data to the MAC sublayer as part of the RXVECTOR.