IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| D0.1 Comment Resolution, brianh, part 4 | | | | |
| Date: 2011-04-26 | | | | |
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##### Baseline is 11ac D0.3. Changes indicated by a mixture of Word track-changes and instructions. For equation changes, Latex notation is sometimes used. E.g. a\_{xyz}^b denotes axyzb

PHY CIDs addressed: 513, 530, 547

##### PHY

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 513 | Hart, Brian | 22.3.21 | 145 | 61 | "clear channel" seems to simple | "clear channel for the intended bandwidth" |

**Proposed resolution: Accept in principle**

**Discussion 1**: The current language could be improved (in three ways) since is does not well-address the following concerns:

1. “A clear channel shall be indicated by PHY-CCA.indication(IDLE)” is not a testable “shall” since there is no definition of “clear channel”. Note: A busy channel is defined in 22.3.20.5 (CCA sensitivity). But that definition depends on thresholds which cannot be met exactly, so implementations may be slightly more conservative than the thresholds. Then “Clear channel” is not the complement of 22.3.20.5 – i.e. 22.3.20.5 does not provide a definition.

If the channel is determined as clear, then there is nothing to prohibit the PHY-CCA.indication(IDLE) from being sent, and indeed any other behavior would only hurt the device. So no normative language is required - really the quoted sentence above can just be informative.

1. Things are more complicated than indicated by the quoted sentence. Consider a 160 MHz BSS where secondary80 is busy but the primary, secondary[20], and secondary40 are clear. Since secondary80 is busy, the PHY issues PHY-CCA.indication(BUSY, {secondary80}), thereby allowing the transmission of 20/40/80 MHz PPDUs (assuming sensing is called for by the MAC, as in 10.24.2 (STA CCA sensing in a VHT BSS)).

Takeaway observation: in this example, it is not very useful for the TX procedure to simply say “A clear channel shall be indicated by PHY-CCA.indication(IDLE)” since PHY-CCA.indication(IDLE) != PHY-CCA.indication(BUSY, {secondary80}).

**Change 1:**

The PHY indicates the state of the primary channel and other channels (if any) via PHY-CCA.indication (see 22.3.20.5 (CCA sensitivity) and 7.3.5.11 (PHY-CCA.indication)). Note that under some circumstances, the MAC uses the latest value of PHY-CCA.indication before issuing the PHY-TXSTART.request (see 10.24.2 (STA CCA sensing in a VHT BSS)).

**Discussion 2:**

Also “uses the latest value of PHY-CCA.indication” is not quite right. E.g. per 9us slot, there is 4us to detect a busy channel, 2us of MAC processing (invisible to the PHY, so CCA continues to be calculated), then 2us of RX-TX turnaround, then a packet is sent using PHY-TXSTART.request. That is, the CCA value used by the MAC could be 0-2us old, depending on whether the MAC uses it at the start or the end of its MAC processing. In the MAC section, the more usual language is “at specific slot boundaries”.

**Change 2:**

A clear channel shall be indicated by PHY-CCA.indication(IDLE). Note that under some circumstances, the MAC uses the value of PHY-CCA.indication at specific slot boundaries before issuing the PHY-TXSTART.request.

**Discussion 3:**

“uses … CCA … before issuing the TXSTART.request” doesn’t leave much opportunity for CCA to be used since it seems to say that inevitably TXSTART.request will be issued.

**Change 3:**

A clear channel shall be indicated by PHY-CCA.indication(IDLE). Note that under some circumstances, the MAC uses the latest value of PHY-CCA.indication before (and if) issuing the PHY-TXSTART.request.

**All changes in one place:**

The PHY indicates the state of the primary channel and other channels (if any) via PHY-CCA.indication (see 22.3.20.5 (CCA sensitivity) and 7.3.5.11 (PHY-CCA.indication)). Note that under some circumstances, the MAC uses the value of PHY-CCA.indication at specific slot boundaries before (and if) issuing the PHY-TXSTART.request.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 530 | Hart, Brian | 22.3.22 | 150 | 36 | Wording could be improved. "If the VHT-SIG-B field is decoded and the VHT-SIG CRC field is checked and valid, the PHY shall issue a PHY-RXSTART.indication(RXVECTOR) . | As in comment |

**Proposed resolution: Accept**

**Discussion:**

Just a rewording.

**Change:**

If VHT-SIG-B is decoded and the VHT-SIG-B CRC in the SERVICE field is checked and not valid, the PHY

shall issue the error condition PHY-RXEND.indication(FormatViolation). If the VHT-SIG-B field is decoded and the VHT-SIG CRC field is checked and valid, a PHY-RXSTART.indication(RXVECTOR) shall be issued.

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 547 | Hart, Brian | 22.5 | 164 | 41 | TR | Tables from here onwards are hole-ier than Swiss cheese. This arises from the choice of #encoders and the mod(..,DR) condition. | Redefine the number of encoders for these higher rates. Where NES is currently set to 1,2,3,4,5,6,7,8,9,10,11,12, change NES to 1,2,3,4,6,6,8/9,8/9,9/12,12,12,12 or similar - e.g. instead of 5 encoders, use 6, and so forth. This will fill in most of the holes, and for a device implementing 5 encoders, going to 6 is not much of a burden (and right now, 5 encoders is only used for 2 table entries only - i.e. 5 is a pretty useless special case) |

**Proposed resolution: Accept in principle**

**Discussion**: There is a balance between filling in MCS holes and unduly adding to the number of encoders (and hence Viterbi decoders). The proposed resolution adds up to 3 encoders, which is an expensive way to add an MCS. However, a subset of the MCSs can be added without any increase in product complexity, or only a very modest change in product complexity that may even be zero if we can assume that:

* Devices implementing 7SS will also implement 8SS
* Devices implementing >= 4SS will also implement the digital signal processing to support MCSs 8 and 9 (even if the analog may struggle).

***Change section 22.5:***

Table 22‑43--VHT MCSs for optional 80 MHz, *NSS* = 3

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MCS Index | Modulation | R | NBPSCS | NSD | NSP | NCBPS | NDBPS | NES | Data rate (Mb/s) | |
| 800ns GI | 400ns GI |
| 0 | BPSK | 1/2 | 1 | 234 | 8 | 702 | 351 | 1 | 87.8 | 97.5 |
| 1 | QPSK | 1/2 | 2 | 234 | 8 | 1404 | 702 | 1 | 175.5 | 195.0 |
| 2 | QPSK | 3/4 | 2 | 234 | 8 | 1404 | 1053 | 1 | 263.3 | 292.5 |
| 3 | 16-QAM | 1/2 | 4 | 234 | 8 | 2808 | 1404 | 1 | 351.0 | 390.0 |
| 4 | 16-QAM | 3/4 | 4 | 234 | 8 | 2808 | 2106 | 1 | 526.5 | 585.0 |
| 5 | 64-QAM | 2/3 | 6 | 234 | 8 | 4212 | 2808 | 2 | 702.0 | 780.0 |
| 6 |  |  |  |  |  |  |  |  |  |  |
| 7 | 64-QAM | 5/6 | 6 | 234 | 8 | 4212 | 3510 | 2 | 877.5 | 975.0 |
| 8 | 256-QAM | 3/4 | 8 | 234 | 8 | 5616 | 4212 | 2 | 1053.0 | 1170.0 |
| 9 | 256-QAM | 5/6 | 8 | 234 | 8 | 5616 | 4680 | 3 | 1170.0 | 1300.0 |
| NOTE: MCS 6 is invalid due to mod(NCBPS/NES, DR) not being equal to 0 for reasonable values of NES. | | | | | | | | | | |

Table 22‑46--VHT MCSs for optional 80 MHz, *NSS* = 6

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MCS Index | Modulation | R | NBPSCS | NSD | NSP | NCBPS | NDBPS | NES | Data rate (Mb/s) | |
| 800ns GI | 400ns GI |
| 0 | BPSK | 1/2 | 1 | 234 | 8 | 1404 | 702 | 1 | 175.5 | 195.0 |
| 1 | QPSK | 1/2 | 2 | 234 | 8 | 2808 | 1404 | 1 | 351.0 | 390.0 |
| 2 | QPSK | 3/4 | 2 | 234 | 8 | 2808 | 2106 | 1 | 526.5 | 585.0 |
| 3 | 16-QAM | 1/2 | 4 | 234 | 8 | 5616 | 2808 | 2 | 702.0 | 780.0 |
| 4 | 16-QAM | 3/4 | 4 | 234 | 8 | 5616 | 4212 | 2 | 1053.0 | 1170.0 |
| 5 | 64-QAM | 2/3 | 6 | 234 | 8 | 8424 | 5616 | 3 | 1404.0 | 1560.0 |
| 6 | 64-QAM | 3/4 | 6 | 234 | 8 | 8424 | 6318 | 3 | 1579.5 | 1755.0 |
| 7 | 64-QAM | 5/6 | 6 | 234 | 8 | 8424 | 7020 | 4 | 1755.0 | 1950.0 |
| 8 | 256-QAM | 3/4 | 8 | 234 | 8 | 11232 | 8424 | 4 | 2106.0 | 2340.0 |
| 9 |  |  |  |  |  |  |  |  |  |  |
| NOTE: MCS 9 is invalid due to mod(NCBPS/NES, DR) not being equal to 0 for reasonable values of NES. | | | | | | | | | | |

Table 22‑47--VHT MCSs for optional 80 MHz, *NSS* = 7

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MCS Index | Modulation | R | NBPSCS | NSD | NSP | NCBPS | NDBPS | NES | Data rate (Mb/s) | |
| 800ns GI | 400ns GI |
| 0 | BPSK | ½ | 1 | 234 | 8 | 1638 | 819 | 1 | 204.8 | 227.5 |
| 1 | QPSK | ½ | 2 | 234 | 8 | 3276 | 1638 | 1 | 409.5 | 455.0 |
| 2 | QPSK | 3/4 | 3 | 234 | 8 | 3276 | 2457 | 3 | 614.3 | 682.5 |
| 3 | 16-QAM | ½ | 4 | 234 | 8 | 6552 | 3276 | 2 | 819.0 | 910.0 |
| 4 | 16-QAM | 3/4 | 4 | 234 | 8 | 6552 | 4914 | 3 | 1228.5 | 1365.0 |
| 5 | 64-QAM | 2/3 | 6 | 234 | 8 | 9828 | 6552 | 4 | 1638.0 | 1820.0 |
| 6 |  |  |  |  |  |  |  |  |  |  |
| 7 | 64-QAM | 5/6 | 6 | 234 | 8 | 9828 | 8190 | 6 | 2047.5 | 2275.0 |
| 8 | 256-QAM | 3/4 | 8 | 234 | 8 | 13104 | 9828 | 6 | 2457.0 | 2730.0 |
| 9 | 256-QAM | 5/6 | 8 | 234 | 8 | 13104 | 10920 | 6 | 2730 | 3033.3 |
| NOTE: MCS 6 is invalid for BCC due to mod(NCBPS/NES, DR) not being equal to 0 for reasonable values of NES. | | | | | | | | | | |

Table 22‑48--VHT MCSs for optional 80 MHz, *NSS* = 8

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MCS Index | Modulation | R | NBPSCS | NSD | NSP | NCBPS | NDBPS | NES | Data rate (Mb/s) | |
| 800ns GI | 400ns GI |
| 0 | BPSK | 1/2 | 1 | 234 | 8 | 1872 | 936 | 1 | 234.0 | 260.0 |
| 1 | QPSK | 1/2 | 2 | 234 | 8 | 3744 | 1872 | 1 | 468.0 | 520.0 |
| 2 | QPSK | 3/4 | 2 | 234 | 8 | 3744 | 2808 | 2 | 702.0 | 780.0 |
| 3 | 16-QAM | 1/2 | 4 | 234 | 8 | 7488 | 3744 | 2 | 936.0 | 1040.0 |
| 4 | 16-QAM | 3/4 | 4 | 234 | 8 | 7488 | 5616 | 3 | 1404.0 | 1560.0 |
| 5 | 64-QAM | 2/3 | 6 | 234 | 8 | 11232 | 7488 | 4 | 1872.0 | 2080.0 |
| 6 | 64-QAM | 3/4 | 6 | 234 | 8 | 11232 | 8424 | 4 | 2106.0 | 2340.0 |
| 7 | 64-QAM | 5/6 | 6 | 234 | 8 | 11232 | 9360 | 6 | 2340.0 | 2600.0 |
| 8 | 256-QAM | 3/4 | 8 | 234 | 8 | 14976 | 11232 | 6 | 2808.0 | 3120.0 |
| 9 | 256-QAM | 5/6 | 8 | 234 | 8 | 14976 | 11232 | 6 | 3120.0 | 3466.7 |
|  | | | | | | | | | | |

Table 22‑51--VHT MCSs for optional 160 MHz, *NSS* = 3

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MCS Index | Modulation | R | NBPSCS | NSD | NSP | NCBPS | NDBPS | NES | Data rate (Mb/s) | |
| 800ns GI | 400ns GI |
| 0 | BPSK | 1/2 | 1 | 468 | 16 | 1404 | 702 | 1 | 175.5 | 195.0 |
| 1 | QPSK | 1/2 | 2 | 468 | 16 | 2808 | 1404 | 1 | 351.0 | 390.0 |
| 2 | QPSK | 3/4 | 2 | 468 | 16 | 2808 | 2106 | 1 | 526.5 | 585.0 |
| 3 | 16-QAM | 1/2 | 4 | 468 | 16 | 5616 | 2808 | 2 | 702.0 | 780.0 |
| 4 | 16-QAM | 3/4 | 4 | 468 | 16 | 5616 | 4212 | 2 | 1053.0 | 1170.0 |
| 5 | 64-QAM | 2/3 | 6 | 468 | 16 | 8424 | 5616 | 3 | 1404.0 | 1560.0 |
| 6 | 64-QAM | 3/4 | 6 | 468 | 16 | 8424 | 6318 | 3 | 1579.5 | 1755.0 |
| 7 | 64-QAM | 5/6 | 6 | 468 | 16 | 8424 | 7020 | 4 | 1755.0 | 1950.0 |
| 8 | 256-QAM | 3/4 | 8 | 468 | 16 | 11232 | 8424 | 4 | 2106.0 | 2340.0 |
| 9 |  |  |  |  |  |  |  |  |  |  |
| NOTE: MCS 9 invalid due for BCC due to mod(NCBPS/NES, DR) not being equal to 0 for reasonable values of NES. | | | | | | | | | | |

Table 22‑52--VHT MCSs for optional 160 MHz, *NSS* = 4

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MCS Index | Modulation | R | NBPSCS | NSD | NSP | NCBPS | NDBPS | NES | Data rate (Mb/s) | |
| 800ns GI | 400ns GI |
| 0 | BPSK | 1/2 | 1 | 468 | 16 | 1872 | 936 | 1 | 234.0 | 260.0 |
| 1 | QPSK | 1/2 | 2 | 468 | 16 | 3744 | 1872 | 1 | 468.0 | 520.0 |
| 2 | QPSK | 3/4 | 2 | 468 | 16 | 3744 | 2808 | 2 | 702.0 | 780.0 |
| 3 | 16-QAM | 1/2 | 4 | 468 | 16 | 7488 | 3744 | 2 | 936.0 | 1040.0 |
| 4 | 16-QAM | 3/4 | 4 | 468 | 16 | 7488 | 5616 | 3 | 1404.0 | 1560.0 |
| 5 | 64-QAM | 2/3 | 6 | 468 | 16 | 11232 | 7488 | 4 | 1872.0 | 2080.0 |
| 6 | 64-QAM | 3/4 | 6 | 468 | 16 | 11232 | 8424 | 4 | 2106.0 | 2340.0 |
| 7 | 64-QAM | 5/6 | 6 | 468 | 16 | 11232 | 9360 | 6 | 2340.0 | 2600.0 |
| 8 | 256-QAM | 3/4 | 8 | 468 | 16 | 14976 | 11232 | 6 | 2808.0 | 3120.0 |
| 9 | 256-QAM | 5/6 | 8 | 468 | 16 | 14976 | 12480 | 6 | 3120.0 | 3466.7 |
|  | | | | | | | | | | |

Table 22‑53--VHT MCSs for optional 160 MHz, *NSS* = 5

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MCS Index | Modulation | R | NBPSCS | NSD | NSP | NCBPS | NDBPS | NES | Data rate (Mb/s) | |
| 800ns GI | 400ns GI |
| 0 | BPSK | 1/2 | 1 | 468 | 16 | 2340 | 1170 | 1 | 292.5 | 325.0 |
| 1 | QPSK | 1/2 | 2 | 468 | 16 | 4680 | 2340 | 2 | 585.0 | 650.0 |
| 2 | QPSK | 3/4 | 2 | 468 | 16 | 4680 | 3510 | 2 | 877.5 | 975.0 |
| 3 | 16-QAM | 1/2 | 4 | 468 | 16 | 9360 | 4680 | 3 | 1170.0 | 1300.0 |
| 4 | 16-QAM | 3/4 | 4 | 468 | 16 | 9360 | 7020 | 4 | 1755.0 | 1950.0 |
| 5 | 64-QAM | 2/3 | 6 | 468 | 16 | 14040 | 9360 | 5 | 2340.0 | 2600.0 |
| 6 | 64-QAM | 3/4 | 6 | 468 | 16 | 14040 | 10530 | 5 | 2632.5 | 2925.0 |
| 7 | 64-QAM | 5/6 | 6 | 468 | 16 | 14040 | 11700 | 6 | 2925.0 | 3250.0 |
| 8 | 256-QAM | 3/4 | 8 | 468 | 16 | 18720 | 14040 | 8 | 3510.0 | 3900.0 |
| 9 | 256-QAM | 5/6 | 8 | 468 | 16 | 18720 | 15600 | 8 | 3900.0 | 4333.3 |
|  | | | | | | | | | | |

Table 22‑54--VHT MCSs for optional 160 MHz, *NSS* = 6

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MCS Index | Modulation | R | NBPSCS | NSD | NSP | NCBPS | NDBPS | NES | Data rate (Mb/s) | |
| 800ns GI | 400ns GI |
| 0 | BPSK | 1/2 | 1 | 468 | 16 | 2808 | 1404 | 1 | 351.0 | 390.0 |
| 1 | QPSK | 1/2 | 2 | 468 | 16 | 5616 | 2808 | 2 | 702.0 | 780.0 |
| 2 | QPSK | 3/4 | 2 | 468 | 16 | 5616 | 4212 | 2 | 1053.0 | 1170.0 |
| 3 | 16-QAM | 1/2 | 4 | 468 | 16 | 11232 | 5616 | 3 | 1404.0 | 1560.0 |
| 4 | 16-QAM | 3/4 | 4 | 468 | 16 | 11232 | 8424 | 4 | 2106.0 | 2340.0 |
| 5 | 64-QAM | 2/3 | 6 | 468 | 16 | 16848 | 11232 | 6 | 2808.0 | 3120.0 |
| 6 | 64-QAM | 3/4 | 6 | 468 | 16 | 16848 | 12636 | 6 | 3159.0 | 3510.0 |
| 7 | 64-QAM | 5/6 | 6 | 468 | 16 | 16848 | 14040 | 8 | 3510.0 | 3900.0 |
| 8 | 256-QAM | 3/4 | 8 | 468 | 16 | 22464 | 16848 | 8 | 4212.0 | 4680.0 |
| 9 | 256-QAM | 5/6 | 8 | 468 | 16 | 22464 | 18720 | 9 | 4680.0 | 5200.0 |
|  | | | | | | | | | | |

Table 22‑55--VHT MCSs for optional 160 MHz, *NSS* = 7

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MCS Index | Modulation | R | NBPSCS | NSD | NSP | NCBPS | NDBPS | NES | Data rate (Mb/s) | |
| 800ns GI | 400ns GI |
| 0 | BPSK | 1/2 | 1 | 468 | 16 | 3276 | 1638 | 1 | 409.5 | 455.0 |
| 1 | QPSK | 1/2 | 2 | 468 | 16 | 6552 | 3276 | 2 | 819.0 | 910.0 |
| 2 | QPSK | 3/4 | 2 | 468 | 16 | 6552 | 4914 | 3 | 1228.5 | 1365.0 |
| 3 | 16-QAM | 1/2 | 4 | 468 | 16 | 13104 | 6552 | 4 | 1638.0 | 1820.0 |
| 4 | 16-QAM | 3/4 | 4 | 468 | 16 | 13104 | 9828 | 6 | 2457.0 | 2730.0 |
| 5 | 64-QAM | 2/3 | 6 | 468 | 16 | 19656 | 13104 | 7 | 3276.0 | 3640.0 |
| 6 | 64-QAM | 3/4 | 6 | 468 | 16 | 19656 | 14742 | 7 | 3685.5 | 4095.0 |
| 7 | 64-QAM | 5/6 | 6 | 468 | 16 | 19656 | 16380 | 9 | 4095.0 | 4550.0 |
| 8 | 256-QAM | 3/4 | 8 | 468 | 16 | 26208 | 19656 | 12 | 4914.0 | 5460.0 |
| 9 | 256-QAM | 5/6 | 8 | 468 | 16 | 26208 | 21840 | 12 | 5460.0 | 6066.7 |
|  | | | | | | | | | | |

Table 22‑56--VHT MCSs for optional 160 MHz, *NSS* = 8

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MCS Index | Modulation | R | NBPSCS | NSD | NSP | NCBPS | NDBPS | NES | Data rate (Mb/s) | |
| 800ns GI | 400ns GI |
| 0 | BPSK | 1/2 | 1 | 468 | 16 | 3744 | 1872 | 1 | 468.0 | 520.0 |
| 1 | QPSK | 1/2 | 2 | 468 | 16 | 7488 | 3744 | 2 | 936.0 | 1040.0 |
| 2 | QPSK | 3/4 | 2 | 468 | 16 | 7488 | 5616 | 3 | 1404.0 | 1560.0 |
| 3 | 16-QAM | 1/2 | 4 | 468 | 16 | 14976 | 7488 | 4 | 1872.0 | 2080.0 |
| 4 | 16-QAM | 3/4 | 4 | 468 | 16 | 14976 | 11232 | 6 | 2808.0 | 3120.0 |
| 5 | 64-QAM | 2/3 | 6 | 468 | 16 | 22464 | 14976 | 8 | 3744.0 | 4160.0 |
| 6 | 64-QAM | 3/4 | 6 | 468 | 16 | 22464 | 16848 | 8 | 4212.0 | 4680.0 |
| 7 | 64-QAM | 5/6 | 6 | 468 | 16 | 22464 | 18720 | 9 | 4680.0 | 5200.0 |
| 8 | 256-QAM | 3/4 | 8 | 468 | 16 | 29952 | 22464 | 12 | 5616.0 | 6240.0 |
| 9 | 256-QAM | 5/6 | 8 | 468 | 16 | 29952 | 24960 | 12 | 6240.0 | 6933.3 |
|  | | | | | | | | | | |