IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| VHT Supported Rates | | | | |
| Date: 2012-03-15 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Brian Hart | Cisco Systems | 170 W Tasman Dr, San Jose, CA 95134, USA |  | [brianh@cisco.com](mailto:brianh@cisco.com) |

##### Abstract:

##### Addresses CIDs 4164, 4319 using 11acD2.0 as the baseline. 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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 4164 | Ahmadreza Hedayat | 8.4.160.3 | 70.04 | 4 | It'd be benefitial to BSS if AP has the means to exclude some low rate MCSs from the list of basic MCS. The benefits of this feature would be fot high-density environments where an AP needs to provide high throughput to many clients in a limitted coverage. Also, due to link adaptation, a STA would use lower and lower rate MCS when collision happens causing the same PPDU to span over a longer time and potentially be prone to more collosion. | Provide the means for AP to raise the bar on the minimum MCS that can be used. | Accept in principle: see changes marked under alternate change set 2 in 12/0295r3 |
| 4319 | Brian Hart | 8.4.2.160.3 | 70.26 | 26 | This encoding, although elegant, regretfully provides no means to delete the lowest MCSs in dense environments such as lecture theaters, stadiums, conferences etc to improve roaming and spectral efficiency | Use some reserved bits in VHT Supported MCS Set field to allow the deletion of spectrally inefficient MCSs | Accept in principle: see changes marked under alternate change set 2 in 12/0295r3 |

**Discussion:** See 12/0293r0

***Change Set 1***

***Change:***

**6.3.3.3.2 Semantics of the service primitive**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| VHTBasicMCSSet | Set of integers | As defined for the  VHT Basic MCS Set field in 8.4.2.161 (VHT Operation element) | The MCS values for each number of spatial streams that must be supported by all VHT STAs that join this BSS, minus selected (MCS,NSS,Bandwidth)-tuples as allowed by the format of the VHT Basic/Supported MCS Subtracted Set field. The STA that is creating the BSS shall be able to receive and  transmit at each of the MCS values listed in the set. | Adopt |
| VHTOperationalMCSSet | Set of integers | As defined for the Rx MCS Map and Rx Highest  Supported  Data Rate fields in 8.4.2.160.3 (VHT Supported MCS Set field) and the VHT Basic/Supported MCS Subtracted Set field in 8.4.2.161 (VHT Operation element) | The MCS values for each number of spatial streams that the peer STA desires to use for communication within the BSS, minus selected (MCS,NSS,Bandwidth)-tuples as allowed by the format of the VHT Basic/Supported MCS Subtracted Set field. The STA shall be able to receive at each of the data rates listed in the set. These values are a superset of those contained in the VHTBSSBasicMCSSet parameter. | Do not adopt |

**6.3.4.2 MLME-JOIN.request**

|  |  |  |  |
| --- | --- | --- | --- |
| VHTOperationalMCSSet | Set of integers | As defined for the Rx MCS Map and Rx Highest  Supported  Data Rate fields in 8.4.2.160.3 (VHT Supported MCS Set field) and the VHT Basic/Supported MCS Subtracted Set 8.4.2.161 (VHT Operation element) | The MCS values for each number of spatial streams that the peer STA desires to use for communication within the BSS, minus selected (MCS,NSS,Bandwidth)-tuples as allowed by the format of the VHT Basic/Supported MCS Subtracted Set field. The STA shall be able to receive at each of the data rates listed in the set. These values are a superset of those contained in the VHTBSSBasicMCSSet parameter. |

**6.3.11.2 MLME-START.request**

|  |  |  |  |
| --- | --- | --- | --- |
| VHTBasicMCSSet | Set of integers | As defined for the  VHT Basic MCS Set field in 8.4.2.161 (VHT Operation element) | The MCS values for each number of spatial streams that must be supported by all VHT STAs that join this BSS, minus selected (MCS,NSS,Bandwidth)-tuples as allowed by the format of the VHT Basic/Supported MCS Subtracted Set field. The STA that is creating the BSS shall be able to receive and  transmit at each of the MCS values listed in the set. |
| VHTOperationalMCSSet | Set of integers | As defined for the Rx MCS Map and Rx Highest  Supported  Data Rate fields in 8.4.2.160.3 (VHT Supported MCS Set field) and the VHT Basic/Supported MCS Subtracted Set 8.4.2.161 (VHT Operation element) | The MCS values for each number of spatial streams that the peer STA desires to use for communication within the BSS, minus selected (MCS,NSS,Bandwidth)-tuples as allowed by the format of the VHT Basic/Supported MCS Subtracted Set field. The STA shall be able to receive at each of the data rates listed in the set. These values are a superset of those contained in the VHTBSSBasicMCSSet parameter. |

**Table 8-54—Element IDs**

|  |  |  |  |
| --- | --- | --- | --- |
| **Element** | **Element ID** | **Length of indicated element (in octets)** | **Extensible** |
| VHT Capabilities (see 8.4.2.160 (VHT Capabilities element)) | 191 | 14 | Yes |
| VHT Operation (see 8.4.2.161 (VHT Operation element)) | 192 | 7 or 8 | Yes |

The Rx MCS Map subfield and the Tx MCS Map subfield have the structure shown in Figure 8-401bt.

Table 8-183v—VHT Supported MCS Set subfields

|  |  |  |
| --- | --- | --- |
| Subfield | Definition | Encoding |
| Rx MCS Map | Indicates the set of MCSs for each number of spatial streams that, minus the (MCS,NSS,Bandwidth)-tuples identified by the VHT Basic/Supported MCS Subtracted Set Rate field, can be received for communication within the BSS | The 2-bit Max MCS For n SS field for each number of spatial streams n = 1, ..., 8 is encoded as follows (see NOTE):  0 indicates support for MCSs 0-7  1 indicates support for MCSs 0-8  2 indicates support for MCSs 0-9  3 indicates that n spatial streams is not supported |

**8.4.2.166 VHT Operation element**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Element ID | Length | VHT Operation Information | VHT Basic MCS Set |
| Octets: | 1 | 1 | 3 | 2 or 3 |

Figure 8-401ca—VHT Operation element format

The VHT Basic MCS Set field indicates the VHTBSSBasicMCSSet as a set of MCSs for each number of spatial streams in VHT PPDUs that are supported by all VHT STAs in the BSS (including IBSS and MBSS). The format of the VHT Basic MCS Set field is shown in Figure8-xxxx-new97.

|  |  |  |
| --- | --- | --- |
|  |  | Optional |
|  | VHT Basic MCS Superset | VHT Basic/Supported MCS Subtracted Set |
| Octets | 2 | 0 or 1 |

Figure 8-xxxx-new96: VHT Basic MCS Set field format

The VHTBSSBasicMCSSet is expressed as the set of MCSs, sent in VHT PPDUs, for each number of spatial streams and bandwidths indicated by the VHT Basic MCS Superset field minus the set of (MCS, number of spatial streams, CH\_BANDWIDTH)-tuples, sent in VHT PPDUs, indicated by the VHT Basic/Supported MCS Subtracted Set field.

The VHT Basic MCS Superset field is a bitmap of size 16 bits; each 2 bits indicates support for a range of MCSs for Nss from 1 to 8, where the support is qualified by exclusions indicated by the VHT Basic/Supported MCS Subtracted Set field. The VHT Basic MCS Set field format is defined as the Rx MCS Map subfield format in 8.4.2.165.3 (VHT Supported MCS Set field).

The VHT Basic/Supported MCS Subtracted Set field is defined in Table 8-xxxx-new99.

Table 8-xxxx-new99: VHT (MCS,NSS,Bandwidth)-tuples and HT MCSs excluded by the VHT Basic Rx Lowest Supported Data Rate field

|  |  |  |
| --- | --- | --- |
| VHT Basic/Supported MCS Subtracted Set field | VHT (MCS,NSS, CH\_BANDWIDTH)-Tuples Excluded (see Note) | HT MCSs Excluded |
| 0 | - | - |
| 1 | Set A | 0 |
| 2 | Set A and B | 0, 1, 8 |
| 3 | Set A, B and C | 0, 1, 2, 8, 16 |
| 4 | Set A, B, C and D | 0, 1, 2, 3  8, 9, 16, 24 |
| 5 | Reserved | |
| Note: Sets A, B, C and D are defined in Table 8-xxx-new-98 | | |

Table 8-xxxx-new98: VHT (MCS,NSS,CH\_BANDWIDTH)-Tuple Sets

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Set | CBW20 | | CBW40 | | CBW80 | | CBW160 or CBS80+80 | |
| Number of spatial streams | MCS | Number of spatial streams | MCS | Number of spatial streams | MCS | Number of spatial streams | MCS |
| A | 1 | 0 | 1 | 0 |  |  |  |  |
| B | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 2 | 0 | 2 | 0 |  |  |  |  |
| C | 1 | 2 | 1 | 2 |  |  |  |  |
| 3 | 0 | 3 | 0 |  |  |  |  |
| D | 1 | 3 | 1 | 3 | 1 | 1 | 1 | 1 |
| 2 | 1 | 2 | 1 | 2 | 0 | 2 | 0 |
| 4 | 0 | 4 | 0 |  |  |  |  |

***Note to reader: I don’t believe changes are needed here, since we’re only cropping the desire to use the lowest mandatory (NSS,MCS)-tuples***

**8.4.2.3 Support Rates element**

***Change Table 8-55 as follows (inserting a new row for the VHT PHY):***

**Table 8-55—BSS membership selector value encoding**

|  |  |  |
| --- | --- | --- |
| **Value** | **Feature** | **Interpretation** |
| 127 | HT PHY | Support for the mandatory features of Clause 20 is required in order to join the BSS that was the source of the Supported Rates element or Extended Supported Rates element containing this value. |
| 126 | VHT PHY | Support for the mandatory features of Clause22 is required in order to join the BSS that was the source of the Supported Rates element or Extended Supported Rates element containing this value. |

**9.7.5.6 Rate selection for other data and management frames**

A data or management frame not identified in 9.7.5.1 (Rate selection for non-STBC Beacon and non-STBC

PSMP frames(11n)) through 9.7.5.5 (Rate selection for +CF-Ack frames(11n)) shall be sent using any data rate

or MCS subject to the following constraints:

— A STA shall not transmit a frame using a rate or MCS that is not supported by the receiver STA or

STAs, as reported in any Supported Rates element, Extended Supported Rates element,

Supported MCS Set field or VHT Supported MCS Set field in management frames transmitted by the receiver STA.

**9.7.11.1 VHT Rx Supported MCS Set**

The VHT Rx Supported MCS Set of a VHT STA is determined for each MCS, number of spatial streams

*n* = 1,…, 8 and bandwidth (20 MHz, 40 MHz, 80 MHz and 160 MHz or 80+80 MHz) from its VHT Supported

MCS Set field as follows:

— If the Max MCS For *n* SS subfield in the Rx MCS Map subfield indicates support, and the (MCS, *n* SS, bandwidth)-tuple is not excluded by the VHT Basic/Supported MCS Subtracted Set subfield of the VHT Basic MCS Set field of the VHT Operation element for the BSS, and the integer part

of the data rate (expressed in megabits per second) for long GI of the MCS for *n* SS at that bandwidth

is less than or equal to the rate represented by the Rx Highest Supported Long GI Data Rate subfield,

then the MCS for *n* SS at that bandwidth is supported by the STA on receive.

— If the Max MCS For *n* SS subfield in the Rx MCS Map subfield indicates support, and the (MCS, *n* SS, bandwidth)-tuple is not excluded by the VHT Basic/Supported MCS Subtracted Set subfield of the VHT Basic MCS Set field of the VHT Operation element for the BSS, and the Rx Highest

Supported Long GI Data Rate subfield is equal to 0, then the MCS for *n* SS at that bandwidth is supported

by the STA on receive.

— If support for the MCS for *n* SS at that bandwidth is mandatory (see 22.5 (Parameters for VHT

MCSs)), then the MCS for *n* SS at that bandwidth is supported by the STA on receive.

— Otherwise the MCS for *n* SS at that bandwidth is not supported by the STA on receive.

A VHT STA shall not, unless explicitly stated otherwise, transmit a VHT PPDU unless the MCS, number of

spatial streams and bandwidth used are in the VHT Rx Supported MCS Set of the receiving STA(s).

NOTE—Support for a MCS for a given number of spatial streams at a given bandwidth implies support for both long GI

and short GI on receive, if short GI is supported at that bandwidth.

**10.39.1 Basic VHT BSS functionality**

A VHT STA sets the Rx MCS Bitmask of the Supported MCS Set field of its HT Capabilities element according to the setting of a) the Rx MCS Map subfield of the VHT Supported MCS Set field of its VHT Capabilities element and b) the VHT Basic/Supported MCS Subtracted Set subfield of the VHT Basic MCS Set field of the VHT Operation element for the BSS as follows: for each subfield Max MCS For *n* SS, , of the Rx MCS Map field with a value other than 3 (no support for that number of spatial streams), the STA shall first indicate support for MCSs 8(*n*-1) through 8(*n*-1)+7 in the Rx MCS Bitmask, where *n* is the number of spatial streams; then second the STA shall indicate no support for MCSs in the Rx MCS Bitmask that are excluded by the VHT Basic/Supported MCS Subtracted Set subfield, as defined by the HT MCSs Excluded column of Table 8-xxxx-new99.

***Note to reader, not for inclusion in the draft***

***“Support” is this para really refers to “implemented” and defines the min HW capabilities of the device. This proposal only intends to change the PHY rates that are “desired” within a BSS, so I believe that only minimal change is warranted.***

**22.5 Parameters for VHT MCSs**

The rate-dependent parameters for 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz are given in Table 22-29 (VHT MCSs for mandatory 20 MHz, NSS = 1) through Table 22-60 (VHT MCSs for optional 160 MHz and 80+80 MHz, NSS = 8). Support for 400 ns GI is optional in all cases. Support for MCS 8 and 9 (when valid) is optional in all cases. A VHT STA shall support single spatial stream MCSs within the range MCS 0 through MCS 7 for all channel widths for which it has indicated support regardless of the Tx or Rx Highest Supported Data Rate sub-field values in the VHT Supported MCS Set field. When more than one spatial stream is supported, the Tx or Rx Highest Supported Data Rate sub-field values in the VHT Supported MCS Set field may result in a reduced MCS range (cut-off) for greater than one spatial stream. Support for 20 MHz, 40 MHz and 80 MHz with NSS = 1 is mandatory. Support for 20 MHz, 40 MHz and 80 MHz with NSS = 2 ...8 is optional. Support for 160 MHz and 80+80 MHz with NSS = 1...8 is optional.

Note – Desired support for PHY rates for communication within a BSS may be further limited by the VHT Basic/Supported MCS Subtracted Set subfield of the VHT Basic MCS Set field of the VHT Operation element for the BSS.

***Alternate Change Set 2***

9.7.<editorToAssign> Rate Selection for VHT PPDUs

When a STA transmits a VHT PPDU with a number of spatial streams (Nss) less than or equal to 4,

- if the channel bandwidth of the PPDU is equal to CBW20 or CBW40, then the STA should not use a (VHT MCS, Nss) combination if the VHT MCS is equal to 0, 1, 2 or 3 and the HT MCS with value min(VHT MCS, 7) + 8\*(Nss-1) is marked as unsupported in the Rx MCS bitmask of the HT capabilities element of the receiver STA.

- if the channel bandwidth of the PPDU is equal to CBW80, CBW160 or CBW80+80, then the STA should not use a (VHT MCS, Nss) combination if the VHT MCS is equal to 0 or 1 and both the HT MCS values min(2\*(VHT MCS), 7) + 8\*(Nss-1) and min(2\*(VHT MCS)+1, 7) + 8\*(Nss-1) are marked as unsupported in the Rx MCS bitmask of the HT capabilities element of the receiver STA.

Note: An example tabulation of this behaviour is described in Table 9.7xxxNEW-1

Table 9.7xxxNEW-1: Example tabulation of rate selection for VHT PPDUs

|  |  |  |
| --- | --- | --- |
| HT MCS(s), in the range 0 to 31, that are marked as unsupported, listed as HT MCS(s) modulo 8 | VHT MCS that is not used for CBW20 and CBW40, for the Nss identifed by the HT MCS that is marked as unsupported, | VHT MCS that is not used for CBW80, CBW160 and CBW80+80, for the Nss identifed by the HT MCSs that are marked as unsupported |
| 0 | 0 | - |
| 1 | 1 | - |
| 2 | 2 | - |
| 3 | 3 | - |
| 0 and 1 | - | 0 |
| 2 and 3 | - | 1 |