IEEE P802.11  
Wireless LANs

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| --- | --- | --- | --- | --- |
| Resolution on CID 69 | | | | |
| Date: 2016 -07 | | | | |
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|  |  |  |  |  |

Abstract

This document contains the proposed text for 11ax Draft with respect to dynamic sensitivity control (DSC) so as to satisfy CID 69

Referenced to 11mc D5

NOTE: Need to check for 11mc D6/7

**CID 166**

**Suggested changes for DSC to 802.11 Standard**

**BACKGROUND STUFF**

|  |  |  |
| --- | --- | --- |
| 25.9 | This is too general for here: "To further improve the possibilities of spatial reuse, an STA is allowed to adjust the setting of one or more following parameters, CCA ED level, 802.11 signal detect CCA or TXPWR threshold values. The constraints on selecting threshold values are TBD." Either remove or move it to 25.9.1. | Bo Sun, Younghoon, Rossi, Junichi, Liwen, Xiaofei, Jing, Jeongki, Yasu, Gwen, Geonjung, Yusuke, Yuichi, James, Laurent |

**25.9.3 Adaptive CCA and transmit power control**

When the color code based CCA rule is used, as described in Error! Reference source not found., an HE STA is allowed to adjust the OBSS\_PD threshold in conjunction with transmit power control to improve the system level performance and the utilization of the spectrum resources.

**To further improve the possibilities of spatial reuse, an STA is allowed to adjust the setting of one or more following parameters, CCA ED level, 802.11 signal detect CCA or TXPWR threshold values. The constraints on selecting threshold values are TBD.**

**Discussion**

Yes the text is vague and detailed description of the spatial reuse technique(s) need to written.

Many submission have been made on the subject of the adjustment of signal detect CCA with specific details and settings.

This technique to improve spatial reuse need not be specific for 11ax however as it can be used with 11a/g/n/ac or even 11b if so desired.

**Proposed Resolution**

Incorporate the text as per this document.

NOTE: This is the text as originally provided in 16/310

**PROPOSED EDITS TO STANDARD FOR ‘DSC’**

Notes in ‘**green**’ are not for inclusion in the edits, but are for discussion purposes.

**References are to 11mc D5**

**Add to Section 3.1**

**“dynamic sensitivity control (DSC):** A system used to control the effective thresholds for the carrier sense clear channel assessment (CS/CCA) function of a STA”

**Add to Section 3.4**

“DSC dynamic sensitivity control”

**9.4.2.27 Extended Capabilities element**

**Add to Table 9-134 Extended Capabilities field**

|  |  |  |
| --- | --- | --- |
| **Bit** | **Information** | **Notes** |
| **TBD** | **Dynamic Sensitivity Control (DSC)** | **STA sets DSC field to 1 when dot11DynamicSensitivityControlImplemented is true and sets it to 0 otherwise.**  **See 11.xx** |

**Add to 9.4.2**

**9.4.2.X DSC Parameter Set element**

The DSC Parameter Set element provides information for operation of dynamic sensitivity control that is used to control the effective thresholds for CCA.

The format of the DSC Parameter Set element is defined in Figure 9-yyy.

The Element ID and Length fields are defined in 9.4.2.1 (General).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Element ID  255 | Length | Element ID Extension | DSC Margin/  DSC Prohibited | DSC Upper  Limit |
| octets | 1 | 1 | 1 | 1 | 1 |

**Figure 9 – yyy – DSC Parameter Set element**

For an infrastructure BSS, the DSC Parameter Set element is used by a DSC AP to establish effective CCA threshold policy, to change policy when accepting new non-AP STAs, or to adapt to changing environmental or traffic loading conditions. Dynamic Sensitivity Control procedures are described in 11.xx.

The DSC Margin field is one octet in length and indicates the value of the DSC Margin, in dBs, that shall be used by DSC non-AP STAs associated to a DSC AP.

The DSC Upper Limit field is one octet in length and indicates the value of the DSC Upper Limit in dBs below 0 dBm, that shall be used by DSC non-AP STAs associated to the AP. For example, a DSC Upper Limit field value of 40 indicates a DSC Upper Limit of -40 dBm. To indicate that DSC operation is prohibited then both DSC Margin and DSC Upper Limit are set to 0.

**Add to Clause 11**

**11. xx Dynamic Sensitivity Control**

**11.xx.1 Dynamic Sensitivity Control Dependencies**

A non-DMG STA indicates its support of Dynamic Sensitivity Control (DSC) procedures by setting dot11DynamicSensitivityControlImplemented to true and setting the Dynamic Sensitivity Control bit in the Extended Capabilities field to 1.

A DSC AP with dot11DynamicSensitivityControlImplemented set to true may include the DSC Parameter element in beacons and probe responses. If a DSC AP includes non-zero values of the DSC Margin and DSC Upper Limit fields in the DSC Element, then a DSC STA that is associated to that DSC AP shall adopt those DSC values. A DSC AP indicates that DSC procedures are prohibited by setting both the DSC Margin and DSC Upper Limit fields in the DSC Parameter element to 0. In this case a non-AP STA with dot11DynamicSensitivityControlImplemented set to true shall not use DSC procedures.

If a DSC non-AP STA is associated to an AP that does not include the DSC Parameters element in its beacons, then the DSC STA may still use DSC procedures.

**11.xx.2 Dynamic Sensitivity Control procedures**

**11.xx.2.1 General**

Dynamic Sensitivity Control (DSC) procedures may be used to dynamically control the effective carrier sense/clear channel assessment (CS/CCA) mechanism threshold of a DSC STA in order to improve spatial reuse. A DSC AP may set the DSC values for DSC Margin and DSC Upper Limit in the DSC Parameters element and these values shall be used by associated DSC non-AP STAs. A DSC AP indicates that DSC procedures are prohibited by setting both the DSC Margin and DSC Upper Limit fields in the DSC Parameter element to 0. A DSC non-AP STA may use DSC procedures unless the AP to which it is associated has set both the DSC Margin and DSC Upper Limit fields to 0 in the DSC Parameters element.

**11.xx.2.2 DSC Margin and DSC Upper Limit**

A DSC non-AP STA uses two values, DSC Margin, and DSC Upper Limit in order to determine the effective CS/CCA mechanism threshold that the DSC non-AP STA uses. These values are according to dot11DSCMargin and dot11DSCUpperLimit, respectively. In an infrastructure network, a DSC AP may advertise the values for DSC Margin and DSC Upper Limit in the DSC Parameter Set element as defined in 9.4.2.X. In this case, an associated DSC non-AP STA shall set its values of dot11DSCMargin and dot11DSCUpperLimit equal to the respective advertised values in the DSC Parameter element. When operating in a 20 MHz channel in the 2.4 GHz band designated for ISM operation, the value for DSC Margin shall be not less than 20 dB and the value for DSC Upper Limit shall be not more than -38 dBm. Note that this sets the maximum effective CCA threshold to -58 dBm.

NOTE: This is to satisfy **ETSI EN 300 328**

DSC Non-AP STAs that are associated to an AP that is not advertising the DSC Parameter Set element shall set a value for dot11DSCMargin of not less than 20 dB and a value for dot11DSCUpperLimit of not more than -38 dBm when operating in a 20 MHz channel in the 2.4 GHz band designated for ISM operation, and not more than -30 dBm if operating in a 20 MHz channel in the 5 GHz band.

Recommended procedures for determining these values are given in Annex (TBD).

**11.xx.2.3. DSC Procedure for a non-AP STA**

If using DSC procedures the non-AP STA sets dot11DynamicSensitivityControlImplemented to true and also sets the Dynamic Sensitivity Control field in the Extended Capabilities element to 1. In an infrastructure network, a DSC non-AP STA monitors the beacons transmitted by the AP to which it is associated and measures the received signal strength of the beacons. The received signal strength of beacon frames may be time averaged over recent history by a vendor-specific smoothing function. The value of dot11DSCMargin is then subtracted from the time averaged received signal strength of the beacons to provide an interim effective CS/CCA threshold value. If the received signal strength of the beacons is greater than dot11DSCUpperLimit, then the recorded received signal strength of the beacons value is set to the dot11DSCUpperLimit value. For example, assume that dot11DSCMargin is 20 dB and dot11DSCUpperLimit is -40 dBm, if the actual received signal strength of the beacons is -30 dBm, this value is greater than dot11DSCUpperLimit and hence the value of -40 dBm is used and the effective CS/CCA threshold is set at -60 dBm. Conversely, if the actual received signal strength of the beacons is -50 dBm, which is lower than the dot11DSCUpperLimit, the CS/CCA threshold or receive sensitivity is set to -70 dBm.

The effective CS/CCA threshold based upon the time averaged received signal strength of the beacons, dot11DSCMargin and dot11DSCUpperLimit is valid for any 20 MHz channel. The effective CS/CCA threshold is increased by 3 dB for 40 MHz channels, 6 dB for 80 MHz channels and 9 dB for 160 MHz channels.

**11.xx.2.4. DSC Procedure for an AP**

An AP may transmit the DSC Parameter element in beacons and probe responses in order to set values for DSC Margin and DSC Upper Limit for any associated DSC non-AP STA. If the DSC Parameter element is present in its beacons then the AP is termed a DSP AP and shall set the Dynamic Sensitivity Control field in the Extended Capabilities element to 1 and set dot11DynamicSensitivityControlImplemented to true.

A DSP AP may set both the DSC Margin and DSC Upper Limit fields to 0 in its DSC Parameter element in order to prohibit any DSC non-AP STA that is associated to it from using DSC procedures.

A DSP AP may set an effective CS/CCA threshold for itself so as to be compatible with the DSC Margin and DSC Upper Limit values advertised in its DSC Parameter element. Recommended procedures for DSC AP settings of DSC Margin, DSC Upper Limit and CCA threshold values are given in Annex (TBD).

**15. DSSS PHY specification for the 2.4 GHz band designated for ISM**

**Applications (1 and 2Mbps)**

**Note: I am disinclined to add DSC to this section. The intention of DSC is to improve efficiency and channel re-use by effectively creating ‘cells’. The use of the higher data rates is therefore encouraged. Idea would be that the STA does not fall back to these low data rates if DSC is in use.**

**16. High Rate direct sequence spread spectrum (HR/DSSS) PHY**

**Specification (5.5 and 11Mbps)**

**Note: I am disinclined to add DSC to this section.**

**17. Orthogonal frequency division multiplexing (OFDM) PHY specification (11a)**

**17.3.10.6 CCA requirements**

The PHY shall indicate a medium busy condition by issuing a PHY-CCA.indication primitive when the carrier sense/clear channel assessment (CS/CCA) mechanism detects a channel busy condition.

For the operating classes requiring CCA-Energy Detect (CCA-ED), the PHY shall also indicate a medium busy condition when CCA-ED detects a channel busy condition.

If dot 11DynamicSensitivityControlImplemented is false, the start of a valid OFDM transmission at a receive level greater than or equal to the minimum modulation and coding rate sensitivity (–82 dBm for 20 MHz channel spacing, –85 dBm for 10 MHz channel spacing, and –88 dBm for 5 MHz channel spacing) shall cause CS/CCA to detect a channel busy condition with a probability > 90% within 4 µs for 20 MHz channel spacing, 8 µs for 10 MHz channel spacing, and 16 µs for 5 MHz channel spacing.

NOTE 1—CS/CCA detect time is based on finding the short sequences in the preamble, so when *TSYM* doubles, so does CS/CCA detect time.

Additionally, the CS/CCA mechanism shall detect a medium busy condition within 4 s of any signal with a received energy that is 20 dB above the minimum modulation and coding rate sensitivity (minimum modulation and coding rate sensitivity + 20 dB resulting in –62 dBm for 20 MHz channel spacing, –65 dBm for 10 MHz channel spacing, and –68 dBm for 5 MHz channel spacing).

If dot 11DynamicSensitivityControlImplemented is true, the start of a valid OFDM transmission at a receive level equal to or greater than the effective CS/CCA threshold is derived following the procedures given in clause 11.xx shall cause CS/CCA to detect a channel busy condition with a probability > 90% within 4 µs for 20 MHz channel spacing, 8 µs for 10 MHz channel spacing, and 16 µs for 5 MHz channel spacing.

For improved spectrum sharing, CCA-ED is required in some bands. The behavior class indicating CCA-ED is given in Table D-2 (Behavior limits). The operating classes requiring the corresponding CCA-ED behavior class are given in E.1 (Country information and operating classes). The PHY of a STA that is operating within an operating class that requires CCA-ED shall operate with CCA-ED.

CCA-ED shall detect a channel busy condition when the received signal strength exceeds the CCA-ED threshold as given by dot11OFDMEDThreshold. The CCA-ED thresholds for the operating classes requiring CCA-ED are subject to the criteria in D.2.5 (CCA-ED threshold).

**18. Extended Rate PHY (ERP) specification (11g)**

**18.4.6 CCA performance**

The CCA shall indicate true if there is no CCA “medium busy” indication. The CCA parameters are subject to the following criteria:

1. If dot 11DynamicSensitivityControlImplemented is false, when the start of a valid ERP-OFDM signal or valid ERP-DSSS/CCK sync symbols at a receive level greater than or equal to –82 dBm at the receiver antenna connector are present at the start of the PHY slot, the receiver’s CCA indicator shall report the channel busy with probability CCA\_Detect\_Probabilty within a aCCATime. CCA\_Detect\_Probabilty is the probability that the CCA does respond correctly to a valid signal and shall be at least 99% for the long slot time and at least 90% for the short slot time. The values for the other parameters are found in Table 18-6 (ERP characteristics). Note that the CCA Detect Probability and the power level are performance requirements.
2. In the event that a correct PHY header is received, the ERP shall hold the CCA signal inactive (channel busy) for the full duration, as indicated by the PHY LENGTH field. Should a loss of CS occur in the middle of reception, the CCA shall indicate a busy medium for the intended duration of the transmitted PPDU.
3. CCA shall report a busy medium upon detection of any energy above –62 dBm or if dot 11DynamicSensitivityControlImplemented is true, the greater of either -62 dBm or the CS/CCA threshold as derived following the procedures given in clause 11.xx
4. If dot 11DynamicSensitivityControlImplemented is true, when a valid signal with a signal power equal to or greater than the effective CS/CCA threshold as derived following the procedures given in clause 10.xx is present at the receiver antenna connector, the receiver’s CCA indicator shall report the channel busy with probability CCA\_Detect\_Probabilty within a aCCATime.

**19. High Throughput (HT) PHY specification**

**19.3.19.5.3 CCA sensitivity in 20 MHz**

If dot 11DynamicSensitivityControlImplemented is false for an HT STA with the operating channel width equal to 20 MHz, the start of a valid 20 MHz HT signal at a receive level greater than or equal to the minimum modulation and coding rate sensitivity of –82 dBm shall cause the PHY to set PHY-CCA.indication(BUSY) with a probability > 90% within 4 s. The receiver shall indicate a channel busy condition for any signal 20 dB or more above the minimum modulation and coding rate sensitivity (–82 + 20 = –62 dBm) in the 20 MHz channel.

If dot 11DynamicSensitivityControlImplemented is true, for an HT STA with the operating channel width equal to 20 MHz, the start of a valid 20 MHz HT signal at a receive level equal to or greater than the CS/CCA threshold as derived following the procedures given in clause 11.xx shall cause the PHY to set PHY-CCA.indication(BUSY) with a probability > 90% within 4 us

If dot 11DynamicSensitivityControlImplemented is false an HT STA that does not support the reception of HT-GF format PPDUs shall indicate a channel busy condition (PHY-CCA.indication(BUSY)) for any valid HT-GF signal in the 20 MHz channel at a receive level greater than or equal to –72 dBm.

If dot 11DynamicSensitivityControlImplemented is true an HT STA that does not support the reception of HT-GF format PPDUs shall indicate a channel busy condition (PHY-CCA.indication(BUSY)) for any valid HT-GF signal in the 20 MHz channel at a receive level greater than or equal to the CS/CCA threshold as derived following the procedures given in clause 11.xx.

**19.3.20.5.4 CCA sensitivity in 40 MHz**

This subclause describes the CCA sensitivity requirements for an HT STA with the operating channel width equal to 40 MHz.

The receiver of a 20/40 MHz STA with the operating channel width equal to 40 MHz shall provide CCA on both the primary and secondary channels.

If dot 11DynamicSensitivityControlImplemented is false when the secondary channel is idle, the start of a valid 20 MHz HT signal in the primary channel at a receive level greater than or equal to the minimum modulation and coding rate sensitivity of –82 dBm shall cause the PHY to generate a PHY-CCA.indication(BUSY, {primary}) primitive with a probability > 90% within 4 µs. The start of a valid 40 MHz HT signal that occupies both the primary and secondary channels at a receive level greater than or equal to the minimum modulation and coding rate sensitivity of –79 dBm shall cause the PHY to generate a PHY-CCA.indication(BUSY, {primary, secondary}) primitive for both the primary and secondary channels with a probability per channel > 90% within 4 µs.

If dot 11DynamicSensitivityControlImplemented is true, when the secondary channel is idle, the start of a valid 20 MHz HT signal in the primary channel at a receive level equal to or greater than the CS/CCA threshold as derived following the procedures given in clause 11.xx shall cause the PHY to generate a PHY-CCA.indication(BUSY, {primary}) primitive with a probability > 90% within 4 µs.

If dot 11DynamicSensitivityControlImplemented is false an HT STA that does not support the reception of HT-GF format PPDUs shall indicate a {primary} channel busy condition (PHY-CCA.indication(BUSY, {primary}) primitive) for any valid HT-GF signal in the primary channel at a receive level greater than or equal to –72 dBm when the secondary channel is idle. An HT STA that does not support the reception of HT-GF format PPDUs shall indicate a {primary, secondary} channel busy condition (PHY-CCA.indication(BUSY, {primary, secondary}) primitive) for any valid 40 MHz HT-GF signal in both the primary and secondary channels at a receive level greater than or equal to –69 dBm.

If dot 11DynamicSensitivityControlImplemented is true an HT STA that does not support the reception of HT-GF format PPDUs shall indicate a {primary} channel busy condition (PHY-CCA.indication(BUSY, {primary}) primitive) for any valid HT-GF signal in the primary channel at a receive level equal to or greater than the CS/CCA threshold as derived following the procedures given in clause 11.xx when the secondary channel is idle. An HT STA that does not support the reception of HT-GF format PPDUs shall indicate a {primary, secondary} channel busy condition (PHY-CCA.indication(BUSY, {primary, secondary}) primitive) for any valid 40 MHz HT-GF signal in both the primary and secondary channels at a receive level equal to or greater than the CS/CCA threshold as derived following the procedures given in clause 11.xx

If dot 11DynamicSensitivityControlImplemented is false the receiver shall indicate a {primary} channel busy condition for any signal at or above –62 dBm in the 20 MHz primary channel. This level is 20 dB above the minimum modulation and coding rate sensitivity for a 20 MHz PPDU. When the primary channel is idle, the receiver indicate a {secondary} channel busy condition for any signal at or above –62 dBm in the 20 MHz secondary channel. The receiver shall indicate a {primary, secondary} channel busy condition for any signal present in both the primary and secondary channels that is at or above –62 dBm in the primary channel and at or above –62 dBm in the secondary channel.

If dot 11DynamicSensitivityControlImplemented is true the receiver shall indicate a {primary} channel busy condition for any signal in the 20 MHz primary channel at or above the greater of either –62 dBm or the CS/CCA threshold as derived following the procedures given in clause 11.xx. When the primary channel is idle, the receiver indicate a {secondary} channel busy condition for any signal in the 20 MHz secondary channel at or above the greater of either –62 dBm or the CS/CCA threshold as derived following the procedures given in clause 11.xx. The receiver shall indicate a {primary, secondary} channel busy condition for any signal present in both the primary and secondary channels that is at or above the greater of either –62 dBm or the CS/CCA threshold as derived following the procedures given in clause 11.xx in the primary channel and at or above the greater of either –62 dBm or the CS/CCA threshold as derived following the procedures given in clause 11.xx in the secondary channel.

**21.3.18.5.3 CCA sensitivity for signals occupying the primary 20 MHz channel**

The PHY shall issue a PHY-CCA.indication(BUSY, {primary}) primitive if one of the conditions listed in Table 21-27 (Conditions for CCA BUSY on the primary 20 MHz) is met in an otherwise idle 20 MHz, 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz operating channel width. With >90% probability, the PHY shall detect the start of a PPDU that occupies at least the primary 20 MHz channel under the conditions listed in Table 21-27 (Conditions for CCA BUSY on the primary 20 MHz) within a period of aCCATime (see 21.4.4 (VHT PHY)) and hold the CCA signal busy (PHY-CCA.indication(BUSY, channel-list) primitive) for the duration of the PPDU.

**Table 21-27—Conditions for CCA BUSY on the primary 20 MHz**

|  |  |
| --- | --- |
| **Operating Channel Width** | **Conditions** |
| 20 MHz, 40 MHz, 80 MHz,  160 MHz, or 80+80 MHz | The start of a 20 MHz NON\_HT PPDU in the primary 20 MHz channel as defined in 17.3.10.6 (CCA requirements).  The start of an HT PPDU under the conditions defined in 19.3.19.5 (CCA sensitivity).  The start of a 20 MHz VHT PPDU in the primary 20 MHz channel at or above –82 dBm or if dot 11DynamicSensitivityControlImplemented is true at or above the CS/CCA threshold as derived following the procedures given in clause 11.xx |
| 40 MHz, 80 MHz, 160 MHz,  or 80+80 MHz | The start of a 40 MHz non-HT duplicate or VHT PPDU in the primary 40 MHz channel at or above –79 dBm or if dot 11DynamicSensitivityControlImplemented is true at or above the CS/CCA threshold as derived following the procedures given in clause 11.xx  The start of an HT PPDU under the conditions defined in 19.3.19.5 (CCA sensitivity). |
| 80 MHz, 160 MHz, or  80+80 MHz | The start of an 80 MHz non-HT duplicate or VHT PPDU in the primary 80 MHz channel at or above –76 dBm or if dot 11DynamicSensitivityControlImplemented is true at or above the CS/CCA threshold as derived following the procedures given in clause 11.xx |
| 160 MHz or 80+80 MHz | The start of a 160 MHz or 80+80 MHz non-HT duplicate or VHT PPDU at orabove –73 dBm or if dot 11DynamicSensitivityControlImplemented is true at or above the CS/CCA threshold as derived following the procedures given in clause 11.xx. |

The receiver shall issue a PHY-CCA.indication(BUSY, {primary}) primitive for any signal in the primary 20 MHz channel at or above the greater of either a threshold equal to 20 dB above the minimum modulation and coding rate sensitivity (–82 + 20 = –62 dBm, or, if dot 11DynamicSensitivityControlImplemented is true, the CS/CCA threshold as derived following the procedures given in clause 11.xx. within a period of aCCATime after the signal arrives at the receiver's antenna(s); then the receiver shall not issue a PHY-CCA.indication(BUSY,{secondary}), PHYCCA. indication(BUSY,{secondary40}), PHY-CCA.indication(BUSY,{secondary80}), or PHYCCA.indication(IDLE) primitive while the threshold continues to be exceeded.

**21.3.18.5.4 CCA sensitivity for signals not occupying the primary 20 MHz channel**

The PHY shall issue a PHY-CCA.indication(BUSY, {secondary}) primitive if the conditions for issuing PHY-CCA.indication(BUSY, {primary}) primitive are not present and one of the following conditions are present in an otherwise idle 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz operating channel width:

* Any signal within the secondary 20 MHz channel at or above the greater of either a threshold of –62 dBm or, if dot 11DynamicSensitivityControlImplemented is true, the CS/CCA threshold as derived following the procedures given in clause 11.xx within a period of aCCATime after the signal arrives at the receiver’s antenna(s); then the PHY shall not issue a PHY-CCA.indication(BUSY,{secondary40}), PHY-CCA.indication(BUSY,{secondary80}), or PHY-CCA.indication(IDLE) primitive while the threshold continues to be exceeded.
* A 20 MHz NON\_HT, HT\_MF, HT\_GF or VHT PPDU detected in the secondary 20 MHz channel at or above the greater of either –72 dBm, or, if dot 11DynamicSensitivityControlImplemented is true, the CS/CCA threshold as derived following the procedures given in clause 11.xx with >90% probability within a period aCCAMidTime (see 21.4.4 (VHT PHY)).

The PHY shall issue a PHY-CCA.indication(BUSY, {secondary40}) primitive if the conditions for issuing a PHY-CCA.indication(BUSY, {primary}) and PHY-CCA.indication(BUSY, {secondary}) primitive are not present and one of the following conditions are present in an otherwise idle 80 MHz, 160 MHz, or 80+80 MHz operating channel width:

— Any signal within the secondary 40 MHz channel at or above a threshold of the greater of either –59 dBm, or, if dot 11DynamicSensitivityControlImplemented is true, the CS/CCA threshold as derived following the procedures given in clause 11.xx within a period of aCCATime after the signal arrives at the receiver’s antenna(s); then the PHY shall not issue a PHY-CCA.indication(BUSY, {secondary80}) primitive or PHY-CCA.indication(IDLE) primitive while the threshold continues to be exceeded.

* A 40 MHz non-HT duplicate, HT\_MF, HT\_GF or VHT PPDU detected in the secondary 40 MHz channel at or above the greater of either –72 dBm, , or, if dot 11DynamicSensitivityControlImplemented is true, the CS/CCA threshold as derived following the procedures given in clause 11.xx with >90% probability within a period aCCAMidTime (see 21.4.4 (VHT PHY)).
* A 20 MHz non-HT, HT\_MF, HT\_GF or VHT PPDU detected in any 20 MHz sub-channel of the secondary 40 MHz channel at or above the greater of either –72 dBm, or, if dot 11DynamicSensitivityControlImplemented is true, the CS/CCA threshold as derived following the procedures given in clause 11.xx with >90% probability within a period aCCAMidTime.

The PHY shall issue a PHY-CCA.indication(BUSY, {secondary80}) primitive if the conditions for PHYCCA. indication(BUSY, {primary}), PHY-CCA.indication(BUSY, {secondary}), and PHYCCA.indication(BUSY, {secondary40}) primitive are not present and one of the following conditions are present in an otherwise idle 160 MHz or 80+80 MHz operating channel width:

* Any signal within the secondary 80 MHz channel at or above the greater of either –56 dBm, or, if dot 11DynamicSensitivityControlImplemented is true, the CS/CCA threshold as derived following the procedures given in clause 11.xx.
* An 80 MHz non-HT duplicate or VHT PPDU detected in the secondary 80 MHz channel at or above the greater of either –69 dBm, or, if dot 11DynamicSensitivityControlImplemented is true, the CS/CCA threshold as derived following the procedures given in clause 11.xx with >90% probability within a period aCCAMidTime (see 21.4.4 (VHT PHY)).
* A 40 MHz non-HT duplicate, HT\_MF, HT\_GF or VHT PPDU detected in any 40 MHz sub-channel of the secondary 80 MHz channel at or above the greater of either –72 dBm, or, if dot 11DynamicSensitivityControlImplemented is true, the CS/CCA threshold as derived following the procedures given in clause 11.xx with >90% probability within a period aCCAMidTime.
* A 20 MHz NON\_HT, HT\_MF, HT\_GF or VHT PPDU detected in any 20 MHz sub-channel of the secondary 80 MHz channel at or above the greater of either –72 dBm, or, if dot 11DynamicSensitivityControlImplemented is true, the CS/CCA threshold as derived following the procedures given in clause 11.xx with >90% probability within a period aCCAMidTime.

**In C.3 MIB Detail**

**ADD to “dot11StationConfig TABLE”**

Dot11StationConfigEntry : : = SEQUENCE

Dot11DynamicSensitivityControlImplemeted TruthValue

**ADD to SA Query Procedure MIBs**

dot11DynamicSensitivityControlImplemented OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This attribute, when true, indicates that the STA implementation is capable

of supporting Dynamic Sensitivity Control."

DEFVAL { false }

::= { dot11StationConfigEntry TBA }

dot11DSCMargin OBJECT-TYPE

SYNTAX Unsigned32 (1..100)

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"This attribute indicates the value, in dBs, of the DSC Margin that a DSC STA adds to the received signal strength of Beacon frames received on the channel. The received signal strength of Beacon frames may be time averaged over recent history by a vendor-specific smoothing function.”

DEFVAL { 20 }

::= { dot11StationConfigEntry TBA }

dot11DSCUpperLimitLimit OBJECT-TYPE

SYNTAX Unsigned32 (1.. 100)

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"This attribute indicates the value, in dBs below 0dBm, of the DSC Upper Limit for a DSC STA. For example, a value of 40 indicates a DSC Upper Limit of -40dBm.”

DEFVAL { 40 }

::= { dot11StationConfigEntry TBA }

**ADD NEW ANNEX**

**ANNEX TBA**

(informative)

**Dynamic Sensitivity Control (DSC)**

**TBA.1 Introduction**

When dot11DynamicReceiveSensitivityImplemented is true, the STA is a DSC STA. A DSC STA sets the DSC Supported bit to 1 in the Extended Capabilities field.

Dynamic Sensitivity Control (DSC) procedures may be used to control the effective carrier sense/clear channel assessment (CS/CCA) mechanism threshold or the receive sensitivity of a DSC STA in order to improve the efficiency of an infrastructure network. A DSC non-AP STA may use DSC procedures unless the DSC Margin and DSC Upper Limit fields in the DSC Parameter set element are both set to 0 by the AP to which the non-AP DSC STA is associated, in which case the STA sets dot11DynamicReceiveSensitivityImplemented to false.

**TBA.2 DSC Operation for non-AP DSC STA**

**TBA.2.1. Basic Operation**

There are two settings used in DSC: DSC Upper Limit and DSC Margin. In general the non-AP DSC STA measures the average signal strength of the received beacon and then subtracts the DSC Margin to arrive at the effective value for the CCA threshold. For example, if the averaged signal strength of the beacon is -45 dBm and the DSC Margin is set to 20 dB, the effective CCA threshold is set to -45 -20 = -65 dBm. If the STA is very close to its AP, say a few feet, then the received beacon signal strength could be relatively high and the effective CCA threshold would be set to a level representing a limited range with the result that other stations in the same network could be ‘hidden’ and the network efficiency would suffer. The DSC Upper Limit sets the maximum value for the received signal strength of the beacon and this effectively sets the minimum CCA threshold at a value given by DSC Upper Limit minus DSC Margin. For example, if the DSC Upper Limit is -30 dBm and the DSC Margin is 20 dB, then the minimum value for the CCA threshold is -50 dBm. Hence, by setting the DSC Upper Limit and DSC Margin it is possible to set an effective network coverage area such that all stations in the network will contend.

If the AP to which the STA is associated is transmitting the DSC Parameter element, the STA uses the values for Upper Limit and Margin that are included in the DSC Parameter element. In the case that the AP is not a DSC STA or does not transmit a DSC Parameter element, then the DSC STA may set values for the DSC Upper Limit and DSC Margin within the limitations given in 11.xx.2.

As the beacon is transmitting in a 20 MHz channel, the effective CCA threshold calculated using the DSC Margin and DSC Upper Limit is also valid for a 20 MHz channel. The effective CCA threshold would be 3 dB, 6 dB and 9 dB higher for channel bandwidths of 40 MHz, 80, MHz and 160 MHz respectively.

**TBA.2.1 Determining Beacon Signal Strength value**

It is recommended that the received signal strength of the beacon frames be averaged over time. The received signal strength may be calculated using a variety of averaging methods but a recommended method is to use a moving average so that the average signal strength value is more influenced by the latest reading than previous ones. It is further suggested that the time to update the average received signal strength value is in the order of one second so as to account for sudden variations due to obstructions or movement.

It is relatively common to miss a certain number of Beacons especially if the STA is in Power Save mode where the STA may deliberately sleep through a number of beacons. The averaging and the update time for determining the received signal strength value may need to be adjusted to account for this.

**TBA.2.1 DSC operational algorithm**

A sample DSC operational algorithm is shown in Figure TBA – 1. In this example the following parameter settings might be used:

* BeaconCountLimit: the limit of consecutive missed beacons. When exceeded the averaged signal strength of the beacon, AverageRSSI, is decremented by a value of RSSI\_Decrement. An example default value is.
* UpdatePeriod: the period over which the received beacon signals are averaged. An example default value is 1 second.
* RSSI\_Decrement: the value, in dBs, that the existing averaged beacon signal strength, Average RSSI, is decreased by if the BeaconCountLimit is reached. An example default value is 6 dB.
* Min\_RX\_Sensitivity: the minimum value for receiver sensitivity threshold, set to a value that corresponds to RX sensitivity for the STA if it was not using DSC. An example default value may be -92 dBm



**Figure TBA – 1 – Sample DSC Operational Algorithm**

**TBA.3 DSC Operation for DSC AP**

A DSC AP may transmit the DSC Parameter element in beacons and probe responses in order to set the values for DSC Margin and DSC Upper Limit in all associated DSC STA within the limitations given in 11.xx.2.2. A variety of methods could be used for the AP to determine these values, either by pre-setting them based upon the location and environment of the network, or by a learning process. For example, if the AP is located in an apartment or house then with advanced knowledge of the dimensions or ranges required, suitable values for DSC Upper Limit and DSC Margin could be derived and used. Similarly, in the cases of an enterprise or managed network, the values for the DSC Margin and DSC Upper Limit may be determined so as to set a desired network coverage area. Alternatively an AP could discover the channel, overlapping situation and signal conditions by monitoring beacons and traffic from its own and overlapping networks. Based upon this monitoring, the AP could then determine the DSC Upper Limit and DSC Margin values that would suit the environment and afford an improvement in network efficiency.

The AP may set a CCA Threshold for itself that is compatible with its network and the values for DSC Upper Limit and DSC Margin that it has set. In most practical situations an effective CCA threshold setting that is equal to the DSC Upper Limit minus the DSC Margin is suggested. An alternative is to set the effective CCA threshold to be 10 dB less than the expected or actual received signal strength from a non-AP STA that is located at the edge of the network.