IEEE P802.11  
Wireless LANs

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| CCA Proposal  DSC Description | | | | |
| Date: 2014 -03 | | | | |
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|  |  |  |  |  |

Abstract

This document contains proposed changes to satisfy CID 2413

**CID 166**

**Suggested changes for DSC to 802.11 Standard**

**BACKGROUND STUFF**

**CID 2413**

**Comment**

We know where -82dBm comes from (min sensitivity). Is it OK to assume the 'common' -72dBm was chosen simply on 10dB above this level (i.e. about 50% of the range - not really as on practice -92dBm is minimum sensitivity)? Similarly the common -62dBm as 20dB above minimum (i.e. about 25% of the extreme range)? Is there any regulatory basis for this or, most likely, is it based on letting a Wi-Fi STA at the furthest range get in? This is based upon maximum range concerns not so much a 'managed' range/cell. There is a real case to consider allowing higher CCA such that the overall traffic can be increased as explained in presentation 13/1012

**Proposal**

Change CCA levels from mandatory. Consider allowing new CCA text which could be proposed by commenter. This also applies to Clauses 19.4.5 and 20.3.20.5.2

**BACKGROUND**

Consider that a STA would receive packets at a signal level which is, say, 25dB higher than signals from elsewhere on the same channel. In this case there is no reason why both transmissions cannot take place as the SNR is fine. CCA is likely to prevent this, more so if the preamble is seen (CCA = -82dm or -62dBm).

Only in the case of outdoor, “go-as-far-as-you-can”, is the high value of CCA required, and this, I surmise, is the original intention of CCA, but now with OBSS and desire for higher density coverage it is highly desirable to make CCA fit the case. This proposal does exactly that.

DSC is described in some detail in 13/1290r1. 13/1487r2 describes the use of DSC in the dense apartment scenario. 14/xxxxr0 describes DSC and legacy and shows that DSC does not adversely affect legacy.

In every dense environment DSC improves the area throughput. DSC is also fine in general. If DSC is not specified or defined then proprietary implementations will occur, better to describe how to use it and make it part of the standard.

**Summary of existing CCA specs:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Clause** | **Description** | **Min RX** | **CCA -CS** | **CCA-ED** |
| 16 | DSSS  1, 2Mbps  16.4.6.3 | -80dBm  @ 2Mbps) | One of following:  (1 – above ED)  2 – any DSSS  3 – DSSS above ED | -80dBm >100mW  -76dBm >50<100mW  -73dm <50mW |
| 17 | CCK  5.5, 11Mbps  17.3.8.2 | -76dBm  @ 11Mbps | One of following:  (1 – above ED)  4 – any HR (with timer)  5 – HR above ED | -76dBm >100mW  -73dBm >50<100mW  -70dm <50mW |
| 18 | 11a OFDM  18.3.10.6 | -82dBm 20MHz  -85dBm 10MHz  -88dBm 5MHz | -82dBm 20MHz  -85dBm 10MHz  -88dBm 5MHz | Mandatory  -62dBm 20MHz  -65dBm 10MHz  -68dBm 5MHz |
| 19 | 11g ERP  19.4.6 | -82dBm 20MHz  -85dBm 10MHz  -88dBm 5MHz | Valid signal  -76dBm | No Spec |
| 20 | 11n  20.3.20.5.2 | -82dBm 20MHz  -79dBm 40MHz | HT signal  -82dBm 20MHz  -79dBm 40MHz | -62dBm 20MHz  -59dBm 40MHz  If not support HT-GF  -72dBm for HT-GF (20MHz)  -69dBm for HT-GF (40MHz) |
| 22 | 11ah |  | Primary Channel  -82dBm 20MHz  -79dBm 40MHz  -76dBm 80MHz  -73dBm 160MHz | Secondary channel  Any signal -62dBm 20MHz  -59dBm 40MHz  -72dBm 20 or 40MHz |
|  |  |  |  |  |

**ETSI EN 300 328** “…Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques…”;

4.3.2.5.2

5) The energy detection threshold for the CCA shall be proportional to the transmit power of the transmitter: for a 20 dBm e.i.r.p. transmitter the CCA threshold level (TL) shall be equal or lower than -70 dBm/MHz at the input to the receiver (assuming a 0 dBi receive antenna). For power levels below 20 dBm e.i.r.p. the CCA threshold level may be relaxed to TL = -70 dBm/MHz + 20 - Pout e.i.r.p. (Pout in dBm).

*For 20MHz -70 dBm/MHz = -57dBm*

*Note: Occupied BW is 16MHz, = -58dBm*

**In 11a CCA Clause**

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 sets). The operating classes requiring the corresponding CCA-ED behavior class are given in **E.1 (Country information and operating classes).** A STA that is operating within an operating class that requires CCA-ED shall operate with CCA-ED. Unless required by regulation, the CCA-ED shall not be required for license-exempt operation

NOTE 2—The requirement to hold the CCA signal busy condition for any signal 20 dB above the minimum modulation and coding rate **sensitivity (–62 dBm for 20 MHz channel spacing, –65 dBm for 10 MHz channel spacing, and –68 dBm for 5 MHz channel spacing) is a mandatory energy detect requirement on all Clause 18** (Orthogonal frequency division multiplexing (OFDM) PHY specification) receivers. Support for CCA-ED is an additional requirement that relates specifically to the sensitivities described in D.2.5 (CCA-ED threshold).

**Table D-2—Behavior limits sets**

|  |  |  |
| --- | --- | --- |
| **Encoding** | **Behavior limits set** | **Description** |
| 15 | CCA-EDBehaviorb | CCA shall also detect a medium busy condition when CCAEnergyDetect detects a channel busy condition |

bProcedures that may be used to improve sharing spectrum in addition to explicit regulatory requirements.

In E 1 ONLY 3GHZ CHANNELS REQUIRE CCA-ED.

**D.2.5 CCA-ED threshold**

**Was**

For OFDM PHY operation with CCA-ED, the thresholds shall be less than or equal to –72 dBm for 20 MHz channel widths, –75 dBm for 10 MHz channel widths, and –78 dBm for 5 MHz channel widths (minimum sensitivity for BPSK, R=1/2 + 10 dB in Table 18-14 (Receiver performance requirements)).

**Changed in 11ac to**

CCA-ED thresholds for operation in specific bands are given in E.2 Band-specific operating requirements

where they differ from the values in PHY clauses. CCA-ED thresholds for operation in license-exempt

bands are stated in PHY clauses.

AND

Original paragraph now moved to **E.2.2 3650–3700 MHz in the United States. GOOD**

**SUMMARY DISCUSSION POINTS**

1. We know where -82dBm comes from (min sensitivity). Is it OK to assume the ‘common’ -72dBm was chosen simply on 10dB above this level (i.e. about 50% of the range – not really as on practice -92dBm is minimum sensitivity)? Similarly the common -62dBm as 20dB above minimum (i.e. about 25% of the extreme range)? Is there any regulatory basis for this or, most likely, is it based on letting a Wi-Fi STA at the furthest range get in? This is based upon maximum range concerns not so much a ‘managed’ range/cell.
2. ETSI defines a Energy threshold at 2.4GHz of -57dBm (maybe -58dBm). Question is if this also applies to a CS(real signal) threshold or just non-802.11 devices? Or probably does it assume that the CS CCA will always be less as per the 802.11 spec. If CS CCA were allowed to be greater than this level, is it in non-compliance? This would depend on how it is tested.
3. In Clause 18 (OFDM) there is a -62dBm “mandatory” CCA “for any signal”. Why is this mandatory especially when there is CCA-ED defined as -72dBm (albeit for 3GHz). So why is it especially called out as “mandatory”? It is defined with a “shall” so why the note?

**POINT: CCA levels are mandatory, DSC does relax this. Rationale is that the reasons why CCA is fixed is now outdated as long range at any price is now not a prime concern, throughput is a prime concern.**

**---------------------------------------------------------------------------------------------------------------------**

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

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

**Add to Section 3.2**

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

**Add to Section 3.3**

“DSC dynamic sensitivity control”

**In 8.4.2.26 Extended Capabilities element**

**Add to Table 8-104 – Capabilities field**

|  |  |  |
| --- | --- | --- |
| **Bit** | **Information** | **Notes** |
| TBA | DSC Supported | The DSC Support subfield indicates support for DSC as defined in 10.xx. When dot11DynamicSensitivityControlImplemented is true, this field is set to 1 to indicate support for DSC. The field is set to 0 otherwise to indicate that DSC is not supported |
| TBA | DSC Prohibited | The DSC Prohibited subfield indicates whether the use of DSC is prohibited. The field is set to 1 to indicate that DSC is prohibited and to 0 to indicate that DSC is allowed. |

**Add to 8.4.2**

**8.4.2.X DSC Parameter Set element**

The DSC Parameter Set element provides information needed by STAs for operation of dynamic sensitivity control that is used to control the thresholds for CCA. The format of the DSC Parameter Set element is defined in Figure 8-yyy.

The Element ID and Length fields are defined in 8.4.2.1 (General).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Element ID | Length | DSC Margin | DSC Upper  Limit |
| octets | 1 | 1 | 1 | 1 |

**Figure 8 – yyy – DSC Parameter Set element**

For an infrastructure BSS, the DSC Parameter Set element is used by the AP to establish CCA threshold policy (by maintaining or changing default MIB attribute values), to change policy when accepting new STAs, or to adapt to environmental or traffic loading conditions. Dynamic Sensitivity Control procedures are described in 10.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 STAs associated to the AP.

The DSC Upper Limit field is one octet in length and indicates the value of the DSC Upper Limit in dBs below 0dBm, that shall be used by DSC STAs associated to the AP. For example, a DSC Upper Limit field value of 40 indicates a DSC Upper Limit of -40dBm.

NOTE: I would have used “signed” for the DSC Upper Limit but I could not find one existing example in the dot11’s so I made it ‘unsigned’.

**Add to Clause 10**

**10. xx Dynamic Sensitivity Control**

**10.xx.1 Dynamic Sensitivity Control Dependency**

When dot11DynamicReceiveSensitivityImplemented is true, the STA is a DSC STA. A DSC STA shall advertise that it is a DSC STA by setting the DSC Supported bit to a 1 in its Extended Capabilities field.

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

**10.xx.2.1 General**

Dynamic Sensitivity Control (DSC) procedures may be used to control the carrier sense/clear channel assessment (CS/CCA) mechanism threshold of a DSC STA in order to improve the efficiency of an infrastructure or independent network. A DSC non-AP STA may use DSC procedures unless the DSC Prohibited subfield is set in the Extended Capabilities field sent by the AP to which the non-AP DSC STA is associated, in which case the STA must set dot11DynamicReceiveSensitivityImplemented to false.

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

A DSC STA uses two values, DSC Margin, and DSC Upper Limit in order to determine the carrier sense/clear channel assessment (CS/CCA) mechanism threshold that the DSC STA should use. The values are according to dot11DSCMargin and dot11DSCUpperLimit, respectively. In an infrastructure network, the AP may advertise the values for DSC Margin and DSC Upper Limit in the DSC Parameter Set element as defined in 8.4.2.X. In this case, an associated DSC STA shall set its internal values of dot11DSCMargin and dot11DSCUpperLimit to be equal to the advertised values in the DSC Parameter element. When operating in the 2.4GHz band designated for ISM operation, the value for DSC Margin shall be not less than 20dB and the value for DSC Upper Limit shall be not more than -38dBm. Note that this sets the maximum CCA threshold to -58dBm.

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

DSC 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 20dB and a value for dot11DSCUpperLimit of not more than -38dBm when operating in the 2.4GHz band designated for ISM operation, and -30dBm if not operating in this 2.4GHz band.

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

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

In an infrastructure network, a 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 received signal strength of the beacons to provide an interim CS/CCA threshold value. If the received signal strength of the beacons is greater than dot11DSCUpperLimit, then the received signal strength of the beacons value is set to the dot11DSCUpperLimit value. For example assume that dot11DSCMargin is 20dB and dot11DSCUpperLimit is -40dBm. If the received signal strength of the beacons is -30dBm, this value is greater than dot11DSCUpperLimit and hence the value of -40dBm is used and the CS/CCA threshold is set at -60dBm. Conversely, if the received signal strength of the beacons is -50dBm, which is lower than the dot11DSCUpperLimit, in this case the CS/CCA threshold is set to -70dBm.

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

An AP for which dot11DynamicReceiveSensitivityImplemented is true may set the DSC Prohibited subfield to 1 in its Extended Capabilities field in order to prohibit any DSC STA that is associated to it from using DCS procedures.

An AP for which dot11DynamicReceiveSensitivityImplemented is true 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 STA.

The CS/CCA threshold for a DSC AP should be set so as to be compatible with the DSC Margin and DSC Upper Limit values advertised in its DSC Parameter element. If the DSC AP is not advertising values for DSC Margin and DSC Upper Limit then it should set its own CS/CCA threshold to meet desired wireless and traffic conditions. Recommended procedures for DSC AP settings of DSC Margin, DSC Upper Limit and CCA threshold values are given in Annex (TBD).

**16. 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.**

**16.4.6.5 CCA**

The DSSS PHY shall provide the capability to perform CCA according to at least one of the following three methods:

— *CCA Mode 1:* Energy above threshold. CCA shall report a busy medium upon detection of any energy above the ED threshold.

— *CCA Mode 2:* CS only. CCA shall report a busy medium only upon detection of a DSSS signal. This signal may be above or below the ED threshold.

— *CCA Mode 3:* CS with energy above threshold. CCA shall report a busy medium upon detection of a DSSS signal with energy above the ED threshold.

A busy channel shall be indicated by a PHY-CCA.indication(BUSY) primitive.

A clear channel shall be indicated by a PHY-CCA.indication(IDLE) primitive.

The dot11CCAModeSupported shall indicate the appropriate operation modes. The PHY shall be configured through dot11CurrentCCAMode.

The CCA shall be true if there is no energy detect or CS. The CCA parameters are subject to the following criteria:

a) The ED threshold shall be ≤–80 dBm for TX power > 100 mW, –76 dBm for 50 mW < TX power ≤100 mW, and –70 dBm for TX power ≤50 mW.

b) With a valid signal (according to the CCA mode of operation) present at the receiver antenna within 5 μs of the start of a MAC slot boundary, the CCA indicator shall report channel busy before the end of the slot time. This implies that the CCA signal is available as an exposed test point. Refer to Figure 9-14 (DCF timing relationships) (in 9.3.7 (DCF timing relations)) for a definition of slot time boundary.

c) In the event that a correct PHY header is received, the DSSS PHY 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 packet.

This is just a mistake in 2.0 nothing to do with DSC

Conformance to DSSS PHY CCA shall be demonstrated by applying a DSSS-compliant signal, above the appropriate ED threshold (item a), so that all conditions described in item b and item c are demonstrated.

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

**Specification (5.5 and 11Mbps)**

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

**17.3.8.5 CCA**

The high rate PHY shall provide the capability to perform CCA according to at least one of the following three methods:

— CCA Mode 1: Energy above threshold. CCA shall report a busy medium upon detecting any energy above the ED threshold.

— CCA Mode 4: CS with timer. CCA shall start a timer whose duration is 3.65 ms and report a busy medium only upon the detection of a high rate PHY signal. CCA shall report an IDLE medium after the timer expires and no high rate PHY signal is detected. The 3.65 ms timeout is the duration

of the longest possible 5.5 Mb/s PSDU.

— CCA Mode 5: A combination of CS and energy above threshold. CCA shall report busy at least while a high rate PPDU with energy above the ED threshold is being received at the antenna. A busy channel shall be indicated by PHY-CCA.indication(BUSY) primitive. A clear channel shall be indicated by PHY-CCA.indication(IDLE) primitive.

dot11CCAModeSupported shall indicate the appropriate operation modes. The PHY shall be configured through dot11CurrentCCAMode.

The CCA shall indicate true if there is no energy detect or CS. The CCA parameters are subject to the following criteria:

a) If a valid high rate signal is detected during its preamble within the CCA window, the ED threshold shall be less than or equal to –76 dBm for TX power > 100 mW; –73 dBm for 50 mW < TX power ≤100 mW; and –70 dBm for TX power ≤50 mW.

b) With a valid signal (according to the CCA mode of operation) present at the receiver antenna within 5 s of the start of a MAC slot boundary, the CCA indicator shall report channel busy before the end of the slot time. This implies that the CCA signal is available as an exposed test point. Refer to Figure 9-14 (DCF timing relationships) (in 9.3.7 (DCF timing relations)) for a slot time boundary definition.

c) In the event that a correct PHY header is received, the high rate PHY 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. Upon reception of a correct PHY header, the timer of CCA Mode 2 shall be overridden by this requirement. Conformance to the high rate PHY CCA shall be demonstrated by applying an equivalent High-Rate-compliant signal above the appropriate ED threshold (item a) so that all conditions described in item b and item c are demonstrated.

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

**18.3.10.6 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 equal to or greater than 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 s for 20 MHz channel spacing, 8 s for 10 MHz channel spacing, and 16 s for 5 MHz channel spacing. 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 (–62 dBm for 20 MHz channel spacing, –65 dBm for 10 MHz channel spacing, and –68 dBm for 5 MHz channel spacing).

**Note: Why is this Energy CCA for “CS/CCA”, should it be ‘any signal’? How ‘mandatory is this? Can DSC set a level above this? Propose to override this for DSC.**

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.

If dot 11DynamicSensitivityControlImplemented is true, the start of a valid OFDM transmission at a receive level equal to or greater than the CS/CCA threshold is derived following the procedures given in clause 10.xx shall cause CS/CCA to detect a channel busy condition with a probability > 90% within 4 s for 20 MHz channel spacing, 8 s for 10 MHz channel spacing, and 16 s 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 sets). The operating classes requiring the corresponding CCA-ED behavior class are given in E.1 (Country information and operating classes). A STA that is operating within an operating class that requires CCA-ED shall operate with CCA-ED. Unless required by regulation, the CCA-ED shall not be required for license-exempt operation.

CCA-ED, if required, shall indicate 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).

NOTE 2— If dot 11DynamicSensitivityControlImplemented is false the requirement to hold the CCA signal busy condition for any signal 20 dB above the minimum modulation and coding rate sensitivity (–62 dBm for 20 MHz channel spacing, –65 dBm for 10 MHz channel spacing, and –68 dBm for 5 MHz channel spacing) is a mandatory energy detect requirement on all Clause 18 (Orthogonal frequency division multiplexing (OFDM) PHY specification) receivers. Support for CCA-ED is an additional requirement that relates specifically to the sensitivities described in D.2.5 (CCA-ED threshold).

**NOTE: SO FOR CCA-ED WE HAVE -72dBm (3GHZ Band only) WHEREAS HERE IN THE NOTE WE HAVE -62dBm. HOW CAN CCA-ED BE AN ‘’ADDITIONAL REQUIREMENT”? WHERE DID THIS -62dBm COME FROM? WHY is this note required. Propose to DELETE the Note, it says nothing more than what is already in the text.**

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

**19.4.6 CCA performance**

The CCA shall indicate true if there is no CCA “medium busy” indication. The CCA parameters are subject

to the following criteria:

a) If dot 11DynamicSensitivityControlImplemented is false, when a valid signal with a signal power of –76 dBm or greater at the receiver antenna connector is 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. If dot 11DynamicSensitivityControlImplemented is true, when a valid signal with a signal power equal to or greater than the 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.

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 19-6 (ERP characteristics). Note that the CCA Detect Probability and the power level are performance requirements

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

**20.3.20.5.3 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 equal to or greater than 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.

“ANY SIGNAL” would mean energy or Wi-Fi signals. Is this a regulatory requirement or can we change it? In 2.4GHz band we do have the -58dBm ETSI requirement so in the DSC section we have specified that for the 2.4GHz band.

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 10.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 equal to or greater than –72 dBm.

Not sure where -72dB comes from except 10dB above the minimum.

HOW DOES IT KNOW IT IS GF? IS THIS SAME AS ENERGY DETECT OR CAN WE ASSUME IT DOES RECOGNIZE AN OFDM FORMAT AND HENCE IS A SPECIAL CS CASE? CAN THIS BE OVERWRITTEN BY DSC, I HAVE ASSUMED SO.

**20.3.20.5.4 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 equal to or greater than the minimum modulation and coding rate sensitivity of –82 dBm shall cause the PHY to set PHY-CCA.indication(BUSY, {primary}) with a probability > 90% within 4 s. If dot11DynamicSensitivityControlImplemented is true, 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 10.xx shall cause the PHY to set PHY-CCA.indication(BUSY, {primary}) with a probability > 90% within 4 us.

If dot 11DynamicSensitivityControlImplemented is false , the start of a valid 40 MHz HT signal that occupies both the primary and secondary channels at a receive level equal to or greater than the minimum modulation and coding rate sensitivity of –79 dBm shall cause the PHY to set PHY-CCA.indication(BUSY, {primary, secondary}) for both the primary and secondary channels with a probability per channel > 90% within 4 s. If dot 11DynamicSensitivityControlImplemented is true, the start of a valid 40 MHz HT signal that occupies 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 10.xx shall cause the PHY to set PHY-CCA.indication(BUSY, {primary, secondary}) for both the primary and secondary channels with a probability per channel > 90% within 4 s.

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})) for any valid HT-GF signal in the primary channel at a receive level equal to or greater than –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})) for any valid 40 MHz HT-GF signal in both the primary and secondary channels at a receive level equal to or greater than –69 dBm.

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.

**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 }

WHERE ELSE DO THESE HAVE TO APPEAR?

**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 carrier sense/clear channel assessment (CS/CCA) mechanism threshold of a DSC STA in order to improve the efficiency of an infrastructure or independent network. A DSC non-AP STA may use DSC procedures unless the DSC Prohibited subfield is set in the Extended Capabilities field transmitted by the AP to which the non-AP DSC STA is associated, in which case the STA must set dot11DynamicReceiveSensitivityImplemented to false.

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

**TBA.2.1. Basic Operation**

There are two basic settings used in DSC: the ‘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 value for the CCA threshold. For example, if the average signal strength of the beacon is -45dBm and the DSC Margin is set to 20dB, the CCA threshold is set to -45 -20 = -65dBm. This particular CCA, in a typical indoor environment would represent a distance in the order of 70 feet for signals from other stations that would be received at or above the CCA threshold. If the STA is very close to its AP, however, say a few feet, and then the received beacon signal strength could be very high, say -15dBm. In this case the CCA threshold would be set to -35dB, which represents a much more limited range of only about 20 feet 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 -30dBm and the DSC Margin is 20dB, then the minimum value for the CCA threshold is -50dBm, a range of about 40 feet. Hence, by setting the DSC Upper Limit and DSC Margin it is possible to set an effective network coverage area where all stations would 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 10.xx.2.

**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 will 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.3 DSC Operation for AP DSC STA**

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 10.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 a CCA threshold setting that is equal to the DSC Upper Limit minus the DSC Margin is suggested.