IEEE P802.11
Wireless LANs

Proposal for 5850-5925 MHz unlicensed devices

Date: 2013-08-28

Author(s):

Name	Affiliation	Address	Phone	email
Peter Ecclesine	Cisco Systems	170 W. Tasman Dr., MS SJ-14-4, San Jose, CA 95134-1706	+1-408-527-0815	pecclesi@cisco.com

Abstract

Proposed requirements for 5850-5925 MHz unlicensed devices to coexist with DSRC devices in United States under FCC docket 13-49.

No change to ITS/DSRC rules or devices is proposed.

Discussions:

The 802.11p Clear Channel Assessment thresholds are given in 802.11-2012 18.3.10.6:

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 indicate busy 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. If the preamble portion was missed, the receiver shall hold the CCA signal busy 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).

NOTE—The requirement to hold the CCA signal busy for any signal 20dB 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 receivers.

The 802.11ac Clear Channel Assessment thresholds are given in P802.11ac Draft 6.0 22.3.19.5.3:

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 22-27 (Conditions for CCA BUSY on the primary 20 MHz) within a period of aCCATime (see 22.4.4 (PHY characteristics)) and hold the CCA signal busy (PHY_CCA.indicate(BUSY, channel-list)) for the duration of the PPDU.

The receiver shall issue a PHY-CCA.indication(BUSY, {primary}) for any signal that exceeds a threshold equal to 20 dB above the minimum modulation and coding rate sensitivity (–82 + 20 = –62 dBm) in the primary 20 MHz channel 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}), PHY-CCA.indication(BUSY,{secondary40}), PHY-CCA.indication(BUSY,{secondary80}) or PHY-CCA.indication(IDLE) while the threshold continues to be exceeded.

FCC 90.377 and 95.1511 give the DSRC channel assignments:

Channel number	Frequency range (MHz)	Channel use
170	5850-5855	Reserved
172	5855-5865	Service channel[2]
174	5865-5875	Service channel[3]
176	5875-5885	Service channel
178	5885-5895	Service channel
180	5895-5905	Service channel
182	5905-5915	Service channel
184	5915-5925	Service channel[4]

2 Channel 172 is designated for public safety applications involving safety of life and property.
3 Channel Nos. 174/176 may be combined to create a twenty megahertz channel, designated Channel No. 175. Channels 180/182 may be combined to create a twenty-megahertz channel, designated Channel No. 181.
4 Channel 184 is designated for public safety applications involving safety of life and property. Only those entities meeting the requirements of § 90.373(a) are eligible to hold an authorization to operate on this channel.

Proposal

Considering that DSRC operation on any 10 MHz channel indicates the presence of licensed radios used in the 5850-5925 MHz band at that location,

- Propose for 5850-5925 MHz unlicensed devices:
- The start of a valid 10 MHz OFDM transmission at a receive level equal to or greater than the minimum modulation and coding rate sensitivity ([…, –85 dBm for 10 MHz channel spacing, ...])
- [On any 10 MHz DSRC channel]
- shall cause CS/CCA to detect a channel busy condition with a probability > 90% within
- [8 μs for 10 MHz channel spacing]
- and to report PHY-CCA.indication(BUSY, (primary)) on [5825-5925 MHz] for [10] seconds.
- The maximum transmission time for U-NII-4 devices shall be [3 milliseconds]

Concerns accompanying each square bracket term:

Commercial DSRC silicon performs better than the IEEE 802.11p specification, so 5850-5925 MHz unlicensed devices should perform as well as commercial DSRC silicon

- The start of a valid 10 MHz OFDM transmission at a receive level equal to or greater than the minimum modulation and coding rate sensitivity ([…, –85 dBm for 10 MHz channel spacing, …])

The start of a valid 10 MHz OFDM transmission takes twice as long as at 20 MHz channel spacing (18.3.3)

- detect a channel busy condition with a probability > 90% within
- [8 μs for 10 MHz channel spacing]

Either 5850-5925 MHz unlicensed devices to not affect adjacent channels or their tranmissions must consider interference into adjacent channels. One way to sidestep analysis of adjacent and alternate channels is to block transmission on every channel that could cause interference into DSRC devices

- [On any 10 MHz DSRC channel]
- and to report PHY-CCA.indication(BUSY, (primary)) on [5825-5925 MHz]

Restricting the 5850-5925 MHz unlicensed device maximum transmission time allows all other devices the possibility to transmit when an unlicensed device ceases transmission

- The maximum transmission time for 5850-5925 MHz unlicensed devices shall be [3 milliseconds]

The time to stay off a busy channel could be analysed for all possible scenarios, or a worst case estimate can be proposed

- to report PHY-CCA.indication(BUSY, (primary)) for [10] seconds.

Other politeness considerations

We will also probably need something about interframe spacing and slot times. 802.11ac uses 16 microsecond SIFS vs 32 for DSRC. 802.11ac uses 9 microsecond slot times vs 13 for DSRC. After the 3 millisecond transmission limit, we need all 11ac devices to stay off the channel until a DSRC device in backoff determines it can send. If the DSRC device uses AIFSN = 3 and CWmin = 15 (one proposal), that might be as long as 32 + (3+15)*13 = 266 microseconds.

No change to ITS/DSRC rules or devices is proposed

References:

FCC docket 13-49
Private Land Mobile FCC 90.371-383
Personal Radio FCC 95.1501-1511

IEEE Std 802.11-2012
IEEE P802.11ac Draft 6.0