IEEE 802
Local and Metropolitan Area Network Standards Committee

Paul Nikolich
Chairman, IEEE 802 LMSC
p.nikolich@ieee.org

TO: Satoshi Nagata, 3GPP TSG RAN WG1 Chair, nagatas@nttdocomo.com

CC: Dino Flore, 3GPP TSG RAN Chair, oflore@qti.qualcomm.com
Joern Krause, 3GPP TSG RAN Secretary, Joern.Krause@etsi.org
Susanna Kooistra, 3GPP Liaison Coordinator, 3GPPliaison@etsi.org
John D'Ambrosia, IEEE 802 Recording Secretary, JAmbrosia@gmail.com
Adrian Stephens, IEEE 802.11 Wireless LAN WG Chair, adrian.p.stephens@ieee.org
Steve Shellhammer, IEEE 802.19 Coexistence WG Chair, shellhammer@ieee.org
Konstantinos Karachalios, Secretary, IEEE-SA Standards Board

SUBJECT: IEEE 802 LMSC response LS on energy detection threshold in future 802.11 technologies

DATE: 14 November 2016

Dear Satoshi,

Introduction:

IEEE 802 LMSC would like to thank 3GPP TSG RAN WG1 (RAN1) for their LS (R1-166040) "Response LS to IEEE 802.11 regarding LAA", 23-27 May 2016.

In this document, IEEE 802 LMSC would like to respond to the request by 3GPP RAN that the 802.11's ED threshold from be changed from -62 dBm to -72 dBm for future versions.

> *RAN1 respectfully requests future IEEE 802.11 technologies to align the energy detection threshold used with other technologies operating in the same unlicensed band, e.g., -72 dBm.*

Interpretation of the request:

IEEE 802 LMSC assumes that the energy detection (ED) threshold referred to in RAN1's LS as "-72 dBm … chosen by 3GPP for Rel-13 LAA" is actually short-hand for the same sliding-scale energy detection threshold that RAN1 has defined for Rel. 13 LAA with the following upper and lower bounds:

- ED Threshold = -62 dBm for 20 MHz channel @ Transmit Power <= +13 dBm
- ED Threshold = -72 dBm for 20 MHz channel @ Transmit Power >= +23 dBm

IEEE 802 LMSC also assumes that the "future IEEE 802.11 technologies" referred to in the above request are limited to those future technologies that are expected to operate in the same band as LAA. Considering new PHY/MAC amendments currently under development by IEEE 802.11, it is assumed this request is currently targeted towards the High Efficiency (HE) PHY/MAC being defined by the 802.11ax Task Group, for the case of operation in 5 GHz band (but not in 2.4 GHz band).

Background to 802.11 coexistence:

All 802.11 devices operating in 5 GHz band are mandated to support both 802.11 Preamble Detect (PD) and Energy Detect (ED). PD is the primary mechanism for coexistence between 802.11 devices, and is backward compatible across all generations of 802.11 technologies operating in this band (i.e. 802.11a, 802.11n, 802.11ac and the under-development 802.11ax).

Backward compatibility with previous generations is a key requirement for 11ax as defined in the Project Authorization Request (PAR) document (IEEE 802.11-14/0165r1, Section 5.2.b):

> *"The new amendment shall enable backward compatibility and coexistence with legacy IEEE 802.11 devices operating in the same band."*

The current 802.11 specification requires devices operating in 5 GHz band to detect and defer to each other with a PD threshold of -82 dBm. It is also noted that 802.11 devices may optionally defer at even lower thresholds than are required by 802.11 specification (e.g. <-90 dBm).

The 802.11ax amendment is still in early draft and therefore may be subject to significant changes. The most recent draft at the time of writing includes a mechanism known as OBSS_PD (Draft P802.11ax D0.5, Section 25.9.2.2) whereby the PD threshold used by HE (802.11ax) STAs to defer to 802.11 OBSS (Overlapping Basic Service Set) frames may be varied as a linear function of transmit power. Nevertheless it is noted that, according to the current draft, the default PD threshold used for TxPower >= +21 dBm (or >= +25 dBm for the case of APs with 3+ spatial streams) is unchanged from previous generations at -82 dBm.

In summary, both current and future 802.11 devices in 5 GHz band will continue to rely primarily on PD for coexistence.

As far as ED is concerned, the 802.11 specification requires all devices operating in 5 GHz band to implement an ED threshold of -62 dBm. Therefore, 802.11 devices are already aligned with (IEEE 802 LMSC's interpretation of) RAN1's request at lower transmit power (<= +13 dBm).

Discussion:

802.11ax devices in the 5 GHz band are expected to operate in a wide range of use cases and deployment scenarios. In some such scenarios (e.g. where APs are densely and regularly deployed in a managed environment), 802.11ax rules may allow for gains to be achieved by raising the deferral threshold above -82 dBm when the transmit power is decreased. In other scenarios (e.g. sparse deployments where maximal coverage is important), protection of links with weaker signal strengths needs to be ensured by preserving a low deferral threshold, as described above.

Therefore, it is of primary importance that all devices operating in the 5 GHz band are able to detect each other with high sensitivity. Without the ability to detect other transmissions with high sensitivity, it is impossible to provide sufficient protection to other devices in scenarios where it is necessary to do so. Such high sensitivity detection is achieved by all existing 802.11 devices thanks to their support for PD. It is also noted that PD provides additional benefits such as the ability to prevent collisions by facilitating duration-based deferral periods.

IEEE 802 LMSC considers that PD has strong technical advantages over ED, due to its robustness to noise and ability to reliably operate at a low threshold, as well as its backward compatibility with existing 802.11 devices.

Given that it is beneficial for 802.11ax devices to continue to implement high sensitivity PD for the reasons outlined above, IEEE 802 LMSC believes it would be undesirable to additionally introduce a lower ED threshold requirement (in the case of >+13 dBm transmit power) because 802.11ax devices would be significantly disadvantaged in terms of their ability to access the channel. This disadvantage would exist relative to both deployed 802.11 devices and also LAA devices for the following reasons:

- Channel access disadvantage relative to deployed 802.11 devices: Deployed 802.11 devices implement ED at least at -62 dBm and PD at least at -82 dBm. Therefore, such a change would cause 11ax devices to obtain lower than fair channel access relative to deployed 802.11 devices, because they would continue to implement high sensitivity PD but also be required to implement a lower ED threshold than deployed 802.11 devices.
- Channel access disadvantage relative to LAA: LAA devices are currently required to implement ED at between -62 dBm and -72 dBm, but are not required to implement PD at all, and hence do not defer to 802.11 devices below their ED threshold. Therefore, such a change would cause 11ax devices to obtain lower than fair channel access relative to LAA devices because, in addition to implementing ED at the same level as LAA, they would also implement high sensitivity PD.

Summary:

IEEE 802 LMSC thanks RAN1 for its LS. IEEE 802 LMSC would like to inform RAN1 that, based on the above discussion, IEEE 802 LMSC considers there would be significant system harm in modifying the ED threshold used by 802.11ax devices in 5 GHz band when operating at higher transmit power (>+13 dBm), and therefore the ED threshold defined for HE PHY in the 11ax amendment remains the same as that of deployed generations (i.e -62 dBm).

Nonetheless, IEEE 802 believes that a continuing dialog and cooperation with RAN1 would be beneficial towards agreeing a future framework for efficient sharing of 5 GHz band. Such a framework should be flexible over a wide range of use cases and deployment scenarios, ensuring protection is provided to coexisting links, while also facilitating spectrally efficient use of the band.

Actions:

To 3GPP RAN1:

IEEE 802 LMSC kindly requests RAN1 to consider the following:

- Indicating its interest in a continued dialog towards a future framework for efficient sharing of the 5 GHz band as described above
- Explicitly defining support for PD-based channel access in a future release of LAA specification.
  - IEEE 802 notes that support for both preamble detection and preamble transmission (e.g. using CTS-to-Self frames) by LAA devices, together with an alignment of the PD and ED thresholds used by LAA devices with those of 802.11 technologies, would be mutually beneficial for coexistence between deployed 802.11, 802.11ax and LAA devices. This approach would form the basis for the most efficient and fair spectrum sharing between IEEE 802 and 3GPP technologies.

Date of Next IEEE 802 LMSC and 802.11 WG Meetings:

January 15-20	Grand Hyatt Buckhead, Atlanta, GA, USA	161	Interim
March 12-17	Hyatt Regency, Vancouver, BC, Canada	162	Plenary
May 7-12	Daejeon Convention Center, Daejeon, Korea (TBC)	163	Interim

Sincerely,

Paul Nikolich
IEEE 802 LMSC Chair