IEEE P802.11
Wireless LANs

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| Liaison response to 3GPP R2-163148 |
| Date: 2016-04-29 |
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Abstract

This document is a response to the liaison from 3GPP RAN R2-163148.

Revision 0: initial version

Revision 1: editorial modifications

Revision 2: changes during TGay review.

Revision 3: adding reference 3

The 3rd Generation Partnership Project (3GPP) has submitted a letter to the IEEE 802.11 Working Group (WG). The letter is documented in IEEE 802.11-16/0548r0.

# Summary of the letter from 3GPP

**1. Overall Description:**

3GPP TSG-RAN WG2 (RAN2) would like to thank IEEE 802.11 for its LS on LWA and LWIP.

RAN2 would like to inform IEEE 802.11 that it has started working on a new WI for enhanced LTE-WLAN Aggregation (eLWA) in Release 14 (see attached WI description in RP-160600), which builds on the LTE-WLAN Aggregation (LWA) feature developed in Release 13. One of the objectives of the eLWA WI is to consider potential enhancements in 3GPP specifications to support new 60 GHz band and channels.

In the past, 3GPP has relied on IEEE specifications for performance requirements related to WLAN radio measurements. RAN2 would also like to know if IEEE has defined or plans to define radio measurements and corresponding measurement requirements in the 60 GHz frequency band for 802.11ad and 802.11ay. Further, RAN2 would like to know if different measurement metrics are used in the 60 GHz band in comparison with lower frequency bands (< 6GHz).

**2. Actions:**

**To IEEE 802.11 WG group:**

**ACTION:** RAN2 respectfully asks IEEE 802.11 WG to:

- provide information on radio measurements and measurement requirements in the 60 GHz frequency band, and whether these are already defined or planned to be defined.

- provide information on whether different measurement metrics are used in the 60 GHz band in comparison with lower frequency bands (< 6GHz).

# Summary of this reply letter

IEEE 802.11 Working Group developed this reply letter for approval by the IEEE 802.11 Working Group.

To: 3GPP TSG-RAN WG2 c/o pavan.nuggehalli@mediatek.com

CC: Wi-Fi Alliance, RAN2, RAN3, RAN4

Subject: Response to LS on enhanced LTE-WLAN Aggregation (eLWA)

Date: 2016-05-20

Dear Pavan,

IEEE 802.11 would like to thank 3GPP TSG-RAN Working Group (WG) 2 for informing us about the start of their activity on eLWA. IEEE 802.11 welcomes and supports the inclusion of the 802.11-defined 60 GHz air interface as part of 3GPP’s integration of WLAN technologies into the 3GPP architecture.

IEEE Standards Association Standards Board (IEEE-SASB) ratified the first IEEE 802.11 standard (IEEE 802.11ad) for operation in the unlicensed 60 GHz band in December 2012. In March 2015, the IEEE-SASB approved the project authorization request (PAR) that created the new 802.11ay project, which is chartered with defining extensions to 802.11ad capable of supporting a maximum throughput of at least 20 gigabits per second (measured at the MAC data service access point), while maintaining or improving the power efficiency per station. For your reference, the 802.11ay PAR can be found at [1].

### Information on whether different measurement metrics are used in the 60 GHz band in comparison with lower frequency bands (< 6GHz).

### Because of the directional nature of 60GHz transmissions, 802.11ad has defined specific measurements:

* Directional channel quality (9.4.2.21.16 in [2])
* Directional measurements ((9.4.2.21.17 in [2]))
* Directional statistics.(9.4.2.21.18 in [2])

### These directional metrics are defined as additional measurements and are not replacing the existing measurements/metrics that are applicable across all bands.

### Information on radio measurements and measurement requirements in the 60 GHz frequency band

The IEEE 802.11ad standard amendment has been defined under the common IEEE 802 architecture, and therefore measurements that apply to 802.11 operations in 2.4/5 GHz also apply to 60 GHz. This is true for link quality measurements like RSSI and channel load that are already used by LWA. This is also true for the Estimated Throughput metric that has been recommended by IEEE 802.11 in previous liaisons to 3GPP [3].

There are, however, unique characteristics of operation at 60 GHz given the physics of radio propagation in this frequency range. We describe these characteristics in the annex below.

As a result of these unique characteristics, link quality measurements such as RSSI and RCPI, as well as channel load, depend on the antenna pattern used both at the transmitter and at the receiver when performing the measurement. Hence, it is important for eLWA to consider that there are two possible types of measurements, namely, measurements performed with a directional antenna pattern (for instance after beamforming training) and measurements performed with a quasi-omni antenna pattern (for instance, before beamforming training). Measurements with a directional antenna pattern are likely to be much closer to the conditions that will be experienced during data transmission, which is not the case with measurements performed with a quasi-omni antenna pattern given the lack of antenna gain of the latter.

For example, if 3GPP wants to use RSSI measurements in the case of pre-association neighbour WLAN measurements, 3GPP might consider various approaches, including requiring a STA to report RSSI measurements after BF training, or before BF training, possibly including an estimated gain (provided by the 802.11 STA) that can be expected after beamforming training to better reflect the link quality of the data plane.

* With regards to accuracy, all RSSI measurements respect the accuracy defined by the IEEE 802.11 specification. But, as described above, measurements performed with a directional antenna pattern will better reflect the link quality during actual data communication.
* With regards to maximum delay to perform measurements, measurements for neighbour WLAN performed with a directional antenna pattern might take slightly longer time (in the order of a few milliseconds) if BF training is performed before doing the measurement.
* The power consumption for such measurements after BF training will also be higher.

Note that if 3GPP chooses to rely on measurements after BF training, 802.11 can provide MCS (modulation and coding scheme) estimates, with the same delay and consumed power. This MCS provides an indication of an achievable PHY rate.

As for future measurements, at this point, 802.11ay is open to identifying new measurements as needed.

Sincerely,

Adrian Stephens
IEEE 802.11 Working Group Chair

**References:**

1. <https://mentor.ieee.org/802.11/dcn/14/11-14-1151-08-ng60-ng60-proposed-par.docx>
2. IEEE P802.11-REVmcTM/D5.3, April 2016
3. <https://mentor.ieee.org/802.11/dcn/14/11-14-0936-03-000m-liaison-response-followup-to-3gpp-tsg-ran-wg2.docx>

**Annex:**

**Unique characteristics at 60GHz**

Transmissions at 60 GHz are primarily directional given the small wavelength (around 5 mm), and so the 802.11ad standard air interface operating in this band has been optimized to support directional communications. Omni directional transmissions as can be achieved in lower frequency bands like 2.4/5 GHz cannot be practically realized in 60 GHz. Transmissions and receptions using an quasi-omni-directional antenna pattern are possible, but they are much less efficient given the lack of antenna gain. As such, the air interface incorporates mechanisms for directional operation such as beamforming training, which allows devices to communicate with higher antenna gain and, as a consequence, much higher data rates. Specifically:

* Beacon frames are transmitted with a robust control mode over one or more sectors to provide the desired coverage. A station (STA) usually receives Beacon frames using a quasi-omni antennas.
* Following beacon reception, the STA and the AP can then perform beamforming (BF) training to attain a directional link for communication. Beamforming can be performed pre-association or post-association. Data transmissions are then performed using the BF link.