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| Proposal for a workshop between IEEE 802.11 WG and 3GPP related to the co-existence of 802.11ax and NR-U in the 6 GHz unlicenced spectrum |
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Abstract

The successfull deployment of NR-U and 802.11 technologies in the sub-7 GHz unlicensed spectrum relies on an efficient and fair access to the spectrum. 802.11 technologies are treated as incumbent in the 5 GHz band by standard bodies (i.e. 3GPP) and regulatory entities (i.e. ETSI BRAN), ensuring a ‘fair coexistence’ between 802.11 and newly developed (LTE-LAA) or future technologies (NR-U). However, the 6 GHz band is often considered as a greenfield band, where according to this understanding, 802.11ax should expect no “incumbency” based protection. This document gives an overview of recent proposals for channel access mechanisms in the new 3GPP Study Item (SI) for 5G New Radio in Unlicensed Bands (5G NR-U) and highlights the need for a close collaboration between the 3GPP and the IEEE 802.11 to agree on a fair and efficient access on the the 6 GHz spectrum. The conduct of a joined workshop is proposed with a tentative agenda and schedule provided below.

# Background

3GPP RAN plenary approved a new SI for operation of the 5G NR in the unlicensed band in September 2017. The study has officially started in the following RAN1 meeting in November 2017. The objectives of the SI are to study NR-based operation in unlicensed spectrum (RAN1, RAN2, RAN4) including:

* Physical channels inheriting the choices of duplex mode, waveform, carrier bandwidth, subcarrier spacing, frame structure, and physical layer design made as part of the NR study and avoiding unnecessary divergence with decisions made in the NR WI
	+ Consider unlicensed bands both below and above 6GHz, up to 52.6GHz
	+ Consider unlicensed bands above 52.6GHz to the extent that waveform design principles remain unchanged with respect to below 52.6GHz bands
	+ Consider similar forward compatibility principles made in the NR WI
* Initial access, channel access. Scheduling/HARQ, and mobility including connected/inactive/idle mode operation and radio-link monitoring/failure
* Coexistence methods within NR-based and between NR-based operation in unlicensed and LTE-based LAA and with other incumbent RATs in accordance with regulatory requirements in e.g., 5GHz, 37GHz, 60GHz bands
	+ Coexistence methods already defined for 5GHz band in LTE-based LAA context should be assumed as the baseline for 5GHz operation. Enhancements in 5GHz over these methods should not be precluded. NR-based operation in unlicensed spectrum should not impact deployed Wi-Fi services (data, video and voice services) more than an additional Wi-Fi network on the same carrier

As can be seen, both 5 GHz and 6 GHz are frequency bands of interest. These frequency bands are initial focus of the SI. The deployment scenarios of NR-U include license assisted access (LAA) with the licensed anchor carrier in LTE or in 5G NR in addition to stand-alone (SA) unlicensed operation. 5G NR-U can be considered as a natural evolution of LTE LAA technology. It is the intention of the 3GPP to leverage the learnings from the LTE LAA specification for the development of the NR-U technology. It is also possible to enhance the channel access of NR-U compared to LTE LAA and improve its coexistence behaviour by taking advantage of the flexilibity in the new NR frame structure and adopting enhanced carrier sensing (CS) mechanisms such as preamble detection (PD) based access. On the other hand, there are currently proposals in NR-U SI which are known to cause detrimental impact on Wi-Fi.

During the specification of LTE LAA, a few companies including CableLabs have participated in 3GPP meetings to minimize the impact of LTE LAA on WiFi and to ensure a good coexistence behaviour. The development of the ETSI BRAN Harmonized Standard (HS) and the fact that 802.11ac was already deployed in the 5 GHz band were instrumental for this effort. As of today, there is no regulation in 6 GHz yet in any region defining the channel access rules for this band, while both 3GPP and IEEE consider the 6 GHz band as a potentially unlicensed band. From the perspective of the majority of 3GPP companies, the coexistence criteria may not be considered for the channel access design to operate on this band since it is a greenfield band. If IEEE does not engage with 3GPP to indicate the intention to extend 802.11ax into the 6 GHz band, then the 3GPP may assume no incumbent technology and it will be very difficult to include clauses related to coexistence with 802.11ax.

In the following section, we look at possible scenarios for the channel access in the 6 GHz band only from the perspective of CS. Note that the channel access behaviour is a function of different mechanisms impacting coexistence. However, we focus on the CS on this document for its importance on the coexistence.

# Carrier Sensing in NR-U Design

The 3GPP will strive to reuse channel access design defined in the LTE LAA in the new NR-U SI as much as possible especially for the 5 GHz band. One of the enhancements considered for the NR-U is to implement PD based CS instead of energy detection (ED) based CS. The PD based CS will improve sensitivity level of the NR-U nodes and allow better detection of the blind nodes. Preamble can also carry useful information to improve efficiency of the network to enable mechanisms similar to RTS/CTS transmission or spatial reuse operation. The following scenarios can be considered for the new channel access design:

* + **PD based CS with universal preamble design:** The new design that includes portions that can be detected by WiFi devices in addition to NR-U specific control information. The new preamble design in NR-U could be designed to be detected by WiFi devices. This can enable lower sensing thresholds between NR-U and WiFi and reduce collisions between these technologies.
	+ **PD based CS with NR-U only preamble:** The new preamble design includes only NR-U specific information that cannot be detected by WiFi. This will lower sensing threshold between NR-U nodes while keeping ED based detection against WiFi nodes. In this case, it can be argued that NR-U does not have to back-off to WiFi nodes up to -62 dBm since it is using PD based detection.
	+ **ED based detection:** No changes from LTE LAA CS design, i.e. the NR-U nodes back off to all nodes at -72 dBm.

CS method for the LBT design is a fundamental element of coexistence. There is a possibility that the new method can degrade the coexistence behaviour with WiFi. Therefore, it is very important that 3GPP takes 802.11ax into consideration while designing the channel access mechanisms including the CS method for the 6 GHz band. This highlights the need for a close collaboration between the 3GPP and the IEEE 802.11 to agree on a fair and efficient access on the 6 GHz spectrum. The conduct of a joined workshop is proposed in the following with a tentative agenda and schedule.

# Workshop Objectives

The objectives of the workshop are as follows:

* To raise the awareness of both the 3GPP and the IEEE 802.11 that the 6 GHz band is not a greenfield reserved for a certain technology.
* To define the coexistence methodology to be used for the 6 GHz band by the 3GPP and the IEEE.
* To evaluate the possible impacts of no action.
* To review coexistence mechanism proposals for the 6 GHz band.
* To agree on a fast communication channel between the 3GPP and the IEEE 802.11.

# Possible Date/Location

The timeline for 3GPP RAN plenary and IEEE 802.11 sessions are provided below. The workshop could be either collocated with the 3GPP RAN session or the IEEE 802.11 session. Alternatively, a dedicated worshop could be conducted outside these dates with a location and date yet to be defined. Although it is not shown on the diagram below, it would be beneficial to avoid meeting dates of 3GPP RAN1 work group (WG) since delegates from the RAN1 WG would be interested to attend the proposed workshop. Since there is a 3GPP RAN1 meeting overlapping with IEEE 802.11 meeting in Novermber, 2018. IEEE 802.11 meetings in January, 2019 or in March, 2019 are potentially suitable dates.



# Conclusion

We propose that IEEE organizes a joint workshop with 3GPP to discuss the implications of the new design choices for NR-U channel access in the 6 GHz band to ensure an efficient and fair access to the spectrum with 802.11 technologies.