**3GPP TSG RAN WG1 #108-e R1-220XXXX**

**e-Meeting, February 21st – March 3rd, 2022**

**Agenda item:** 7.2.2

**Source:** Moderator (Samsung)

**Title:** Summary for [108-e-R16-NR-U-01] Email discussion/approval on possible LS response to R1-2200860

**Document for:** Discussion and Decision

# Introduction

This document is a summary for email discussion “[108-e-R16-NR-U-01] Email discussion/approval on possible LS response to R1-2200860 (LS on NR-U channel information and procedures), until February 25 – Hongbo (Samsung)”.

The background of the RAN3 LS R3-216042 (R1-2200860) described in the LS is as follow: “In the context of SON optimization for NR-U, RAN3 has agreed to support NR-U in Mobility Load Balancing and identified that it is beneficial to exchange load metrics on a per cell and per NR-U channel granularity between base stations. In order to define the load metrics in network interfaces and keep in line with the concept in RAN1 and RAN2, RAN3 would like to ask the following questions to RAN1 and RAN2.”

RAN2 provided the reply LS in R2-2201959 (R1-2200891).

# Round 1: Alignment of Companies’ View on the Answers

The working group is encouraged to provide the first round feedback to align the answers from RAN1 perspective before **UTC 16:59, Feb 23**.

## Discussion on answer to Q1

**Q1 from RAN3: How should an NR-U channel be represented?**

**A possible description identified by RAN3 for the NR-U channel representation is as following. In this representation an NR-U channel can be recognized via its centre frequency and bandwidth.**

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| **NR-U Channel List** |  | **0..1** |  |
| **>NR-U Channel Item** |  | ***1..<maxnoofNR-UChannels>*** |  |
| **>>Channel ID** | **M** |  | **INTEGER (1.. *maxnoofNR-UChannels*, …)** |
| **>>NR ARFCN** | **M** |  | **INTEGER (0.. maxNRARFCN)** |
| **>>Bandwidth** | **M** |  | **ENUMERATED (10Mhz, 20Mhz. …)** |

**RAN3 would like to check with RAN1 and RAN2 if the above information is enough to identify a NR-U channel or if more details are needed.**

The following are answers provided by contributions submitted to Agenda 5:

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| **Company** | **Proposed answer** |
| [[R1-2201057](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201057.zip), vivo] | From RAN1 perspective, according to TS 37.213 Section 4.0, NR-U channel refers to a carrier or a part of a carrier consisting of a contiguous set of resource blocks (RBs) on which a channel access procedure is performed in shared spectrum. |
| [[R1-2201742](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201742.zip), Ericsson][[R1-2201743](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201742.zip), Ericsson] | The frequency location of a channel in a band defined for operation with shared spectrum channel access (aka unlicensed operation) is determined by the ARFCN of the carrier and the carrier bandwidth. In RAN2 specifications, "Channel ID," does not exist. In Rel-16 for FR1, the carrier bandwidths 20, 40, 60, and 80 MHz are supported in Bands n46 and n96, which are divided into 1, 2, 3, and 4 sets of contiguous RBs, respectively, each referred to an "RB set" that spans approximately 20 MHz. RAN1 has specified in 37.213 that a "channel" corresponds to a carrier or part of a carrier consisting of a set of contiguous RBs over which a channel access procedure is performed. Hence, from a RAN1 perspective an RB set corresponds to a "channel," and an index is associated with each RB set value a value in the range 0 .. 3. |
| [R1-2201972, Samsung] | RAN1 understands that an NR-U channel is specified in RAN2 specifications, and confirms the answer from RAN2 that at least 'NR ARFCN' and 'Bandwidth' are defined, and 'Channel ID' does not exist in RAN2 specifications. |
| [R1-2202332, LG Electronics] | From RAN1 perspective, providing ‘NR ARFCN’ as a centre frequency along with ‘Bandwidth’ is sufficient to represent the NR-U channel. |
| [R1-2202452, Huawei, HiSilicon] | ARFCN-valueNR corresponding to 10/20MHz channel rasters defined in Table 5.4.2.3-2 and Table 5.4.2.3-2 in TS38.101-1 can be used if the load metric is measured on the channel on which channel access procedures are performed. |
| Moderator | Based on the proposed answers, here is a summary of the understanding of “NR-U channel”* In RAN2 specification, ‘NR ARFCN’ indicating the center frequency and ‘Bandwidth’ indicating the channel bandwidth are sufficient to define a NR-U channel, and “Channel ID” does not exist in current specification.
* In RAN1 specification TS 37.213, “NR-U channel” refers to a carrier or a part of a carrier consisting of a contiguous set of resource blocks (RBs) on which a channel access procedure is performed in shared spectrum.
* RAN1 further specified “RB set”, and from a RAN1 perspective an RB set corresponds to a "channel," and an index is associated with each RB set value.
* The selection of ‘NR ARFCN’ indicating the center frequency for NR-U channels is specified in Table 5.4.2.3-2 and Table 5.4.2.3-3 in TS38.101-1.
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Based on the above contributions, a draft response for Q1 is provided for further comments:

### Proposed answer to Q1 (A1-v0):

* It is RAN1 understanding that RAN2 specification has specified ‘NR ARFCN’ to indicate the center frequency and ‘Bandwidth’ to indicate the channel bandwidth of a NR-U channel, and ‘Channel ID’ does not exist in current specification.
* It is RAN1 understanding that RAN4 specification has specified the allowed values of ‘NR ARFCN’ for the corresponding “Bandwidth” of NR-U channels (e.g. Table 5.4.2.3-2 and Table 5.4.2.3-3 in TS 38.101-1 for Band n46 and n96, respectively).
* From RAN1 perspective, it is specified in TS 37.213 (Section 4.0) that a NR-U “channel” refers to a carrier or a part of a carrier consisting of a contiguous set of resource blocks (RBs) on which a channel access procedure is performed in shared spectrum. RAN1 has also specified “RB-set” in TS 38.214 (Section 7), wherein an RB set corresponds to a NR-U “channel”, and the NR-U “channel” is associated with the index of the corresponding RB set.

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## Discussion on answer to Q2

**Q2 from RAN3: According to current specifications, is an NG-RAN node supposed to sense the NR-U channel even when no data needs to be transmitted or is channel sensing performed only when the NG-RAN node needs to exchange traffic over the NR-U channel?**

The following are answers provided by contributions submitted to Agenda 5:

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| **Company** | **Proposed answer** |
| [[R1-2201057](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201057.zip), vivo] | According to TS 37.213 Section 4.1, the NG-RAN node may apply LBT in order to perform transmissions. It is not specified in 3GPP specifications whether the NG-RAN node can sense the NR-U channel even when no data are available for transmission. |
| [[R1-2201742](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201742.zip), Ericsson][[R1-2201743](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201742.zip), Ericsson] | The channel access procedures specified in TS 37.213 may be performed when there is a need to access an NR-U channel for packet transmissions over the NR-U channel. In other words, before performing a packet transmission on an NR-U channel, access to the NR-U channel should be obtained by successfully completing the corresponding channel access procedures that are specified in TS 37.213. However, a node (NG-RAN or UE) is neither required to continuously sense an NR-U channel even no data is available for transmission, nor is a node (NG-RAN or UE) required to perform the actual packet transmission even after the corresponding channel access procedures are successfully completed. |
| [R1-2201972, Samsung] | According to TS 37.213, it is only specified that when traffic is available over the channel(s), the NG-RAN node shall perform channel access procedure for accessing the channel(s) on which the transmission(s) are performed. It implies the NG-RAN node may perform channel access procedure for accessing the channel(s) when no traffic is available over the channel(s).  |
| [R1-2202332, LG Electronics] | According to TS 37.213, performing channel sensing is always required when the NG-RAN node needs to exchange traffic over the NR-U channel. As in RAN2’s answer, it is not specified in 3GPP specifications whether the NG-RAN node can sense the NR-U channel even when no data are available for transmission but it is not prohibited. |
| [R1-2202452, Huawei, HiSilicon] | UE can be configured to measure RSSI and report RSSI and channel occupancy to the associated gNB on the specific 10/20MHz channel indicated by ARFCN-valueNR in rmtc-Config. |
| Moderator | Based on the proposed answers, here is a summary of the understanding of this issue:* RAN1 spec (TS 37.213) specified the RAN node performs channel access procedure for the case that data are available for transmission.
* RAN1 spec didn’t specify RAN node behavior for the case that data are not available for transmission, which means the RAN node is not required to perform channel access procedure for that case, and not prohibited from performing so as well.
* A UE can be configured to measure RSSI regardless of whether data are available for transmission.
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Based on the above contributions, a draft response for Q2 is provided for further comments (especially on the necessity and relevance of the last bullet):

### Proposed answer to Q2 (A2-v0):

* From RAN1 perspective, it is specified in TS 37.213 that a node (a gNB or a UE) shall perform the channel access procedures for accessing the channel(s) on which the transmission(s) are performed (as described in Section 4.1 for DL or Section 4.2 for UL, respectively).
* RAN1 specification doesn’t specify whether a node (a gNB or a UE) needs to perform the channel access procedures when no date needs to exchange traffic over the channel(s), which implies the node (the gNB or the UE) is not required to and not prohibited to perform the channel access procedures for such case.
* A UE can be configured to measure RSSI and report RSSI and channel occupancy to the associated gNB on the channel indicated by *ARFCN-valueNR* in *rmtc-Config*.

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## Discussion on answer to Q3

**Q3 from RAN3: How is the ED threshold configured in RAN node?**

The following are answers provided by contributions submitted to Agenda 5:

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| **Company** | **Proposed answer** |
| [[R1-2201057](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201057.zip), vivo] | The ED threshold in RAN node is determined according to TS 37.213 Section 4.1.5 where it is a function of maximum RAN node output power, NRU channel bandwidth and etc. |
| [[R1-2201742](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201742.zip), Ericsson][[R1-2201743](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201742.zip), Ericsson] | The determination of the ED threshold for NG-RAN nodes to perform DL transmissions for n46 and n96 NR-U channels is specified in Clause 4.1.5 of TS 37.213 where the ED threshold is associated with a set of contiguous RBs of the “channel” that an NG-RAN node intends to perform sensing as described in the answer to Q1. It is important to note that there are few conditions as described in Clause 4.1.5 of TS 37.213 that determine how the ED threshold for a node is obtained. The ED threshold by itself is not specified to be “exchanged” between RAN-nodes as RAN3 expressed in the question. Whether the contributing parameters in determining the corresponding ED threshold are exchanged between RAN nodes is not within the RAN1 expertise. |
| [R1-2201972, Samsung] | According to TS 37.213, * a gNB shall set the ED threshold to be less than or equal to the maximum ED threshold, wherein the maximum ED threshold is computed as in Section 4.1.5 of TS 37.213.
* a UE shall set the ED threshold to be less than or equal to the maximum ED threshold, wherein the maximum ED threshold is configured by higher layer parameter maxEnergyDetectionThreshold-r16, if provided, or determined by a default maximum ED threshold computed as in Section 4.2.3.1 of TS 37.213 with an offset configured by higher layer parameter energyDetectionThresholdOffset-r16, if provided.
 |
| [R1-2202332, LG Electronics] | RAN1 confirm the answer from RAN2. |
| [R1-2202452, Huawei, HiSilicon] | The EDT used by gNB is defined in section 4.1.5 of TS37.213. gNB determines its ED threshold based on the channel bandwidth on which LBT is performed (10MHz or 20MHz) and maximum output power on the channel. The ED threshold used by UE is defined in section 4.2.3 of TS37.213. UE can determine the ED threshold either by default formula given in 4.2.3.1 of TS37.213 (similar as those of gNB) or according to gNB’s configuration by higher layer signalling of *ChannelAccessConfig* in *ServingCellConfig.* |
| Moderator | Based on the proposed answers, here is a summary of the views:* gNB’s ED threshold is specified in Section 4.1.5 of TS 37.213
* UE’s default ED threshold is specified in Section 4.2.3.1 of TS 37.213, and can be further adjusted by an offset provided by higher layer, or the UE’s ED threshold is directly provided by a higher layer parameter.
* The term “configured” in the question is confusing in term of gNB’s ED threshold.
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Based on the above contributions, a draft response for Q3 is provided for further comments:

### Proposed answer to Q3 (A3-v0):

* According to TS 37.213,
	+ a gNB shall set the ED threshold to be less than or equal to the maximum ED threshold, wherein the maximum ED threshold is computed based on the maximum output power on the channel, channel bandwidth, and etc., as in Section 4.1.5 of TS 37.213.
	+ a UE shall set the ED threshold to be less than or equal to the maximum ED threshold, wherein the maximum ED threshold is configured by the higher layer parameter *maxEnergyDetectionThreshold-r16*, if provided, or determined as a default maximum ED threshold computed based on the maximum output power on the channel, channel bandwidth, and etc., as in Section 4.2.3.1 of TS 37.213, with a potential offset configured by the higher layer parameter *energyDetectionThresholdOffset-r16*, if provided.
* It is RAN1 understanding that the wording “configured” in Q3 may not be applicable in term of the gNB’s ED threshold according to RAN1 specification, and whether and how the contributing parameters in computing the ED threshold are “configured” between gNBs is not within the RAN1 expertise.

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## Discussion on answer to Q4

**Q4 from RAN3: What is the ED threshold granularity (per channel, per cell, per UE…)?**

The following are answers provided by contributions submitted to Agenda 5:

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| **Company** | **Proposed answer** |
| [[R1-2201057](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201057.zip), vivo] | Since the ED threshold is calculated as a function of NRU channel bandwidth, ED threshold granularity is per channel. |
| [[R1-2201742](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201742.zip), Ericsson][[R1-2201743](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201742.zip), Ericsson] | RAN1 suspects that perhaps the existing RRC parameters maxEnergyDetectionThreshold-r16 or energyDetectionThresholdOffset-r16 have contributed to this question. If that is the case, RAN1 would like to clarify that these parameters are configured to the UE to determine the ED threshold to perform sensing for UL transmissions and are not applicable to the ED threshold at NG-RAN to perform sensing for DL transmissions. The corresponding configurations are UE specific and configured per serving cell. How these parameters are used to determine the ED threshold at UE for sensing to perform UL transmissions is specified in Clause 4.2.3 of TS 37.213.RAN1 would like to clarify that irrespective of the node being NG-RAN or UE, the corresponding ED threshold is determined for the set of contiguous RBs of the “channel” that the node intends to perform sensing as described in the answer to Q1. |
| [R1-2201972, Samsung] | According to TS 37.213, the granularity of ED threshold for both gNB and UE is per channel, wherein the channel is defined in Section 4.0 of TS 37.213. When a UE determines the ED threshold, the higher layer parameters maxEnergyDetectionThreshold-r16 and energyDetectionThresholdOffset-r16 are provided under ServingCellConfig, which usually contains the configuration per cell. |
| [R1-2202332, LG Electronics] | RAN1 confirm the answer from RAN2. |
| [R1-2202452, Huawei, HiSilicon] | If the EDT is determined by the transmitter itself, the EDT is per channel. If the EDT of UE is configured by gNB, the granularity is per cell. |
| Moderator | Based on the proposed answers, here is a summary of the views:* The gNB and UE’s ED threshold is per channel, with channel defined in answer to Q1.
* The higher layer parameters maxEnergyDetectionThreshold-r16 are energyDetectionThresholdOffset-r16 are typically cell-specific information, although included in the UE-specific configuration ServingCellConfig
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Based on the above contributions, a draft response for Q4 is provided for further comments:

### Proposed answer to Q4 (A4-v0):

* According to the answer to Q3, the granularity of ED threshold for both gNB and UE is per channel, with the definition of channel explained in the answer to Q1.
* It is RAN1 understanding that when a UE determines the ED threshold, the higher layer parameters *maxEnergyDetectionThreshold-r16* and/or *energyDetectionThresholdOffset-r16*, if provided, are cell-specific information, and provided under the UE-specific higher layer parameter *ServingCellConfig*.

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# Round 2: Finalizing the Reply LS

The working group is encouraged to provide the second round feedback to the draft LS before **UTC 16:59, Feb 24**.

Reserved.

# Conclusion

Reserved.

# Reference

[R1-2201057](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201057.zip) Draft reply LS on NRU channel information and procedures vivo

[R1-2201742](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201742.zip) Discussion on LS from RAN3 on NR-U channel information and procedures Ericsson

[R1-2201743](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201743.zip) Draft Reply LS to RAN3 on NR-U channel information and procedures Ericsson

[R1-2201972](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201972.zip) Draft Reply LS on NR-U channel information and procedures Samsung

[R1-2202332](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2202332.zip) Discussion on RAN3 LS for NR-U channel information and procedures LG Electronics

[R1-2202452](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2202452.zip) Discussion on RAN3 questions of NR-U channel information and procedures Huawei, HiSilicon