**3GPP TSG RAN WG1 #108-e R1-2202671**

**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).

# [Closed] 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:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201057.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:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201742.zip), Ericsson]  [[R1-2201743](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201742.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. |

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.

### Proposed answer to Q1 (A1-v1):

* 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” with its center frequency identified by the ARFCN and its bandwidth of 10 or 20 MHz as defined in RAN4 specification, and the NR-U “channel” is associated with the index of the corresponding RB set.

### Proposed answer to Q1 (A1-v2):

* 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” with its center frequency identified by the ARFCN and its bandwidth of ~~10 or~~ 20 MHz as defined in RAN4 specification, and the NR-U “channel” is associated with the index of the corresponding RB set.

### Proposed answer to Q1 (A1-v3):

* It is RAN1 understanding that RAN2 specification has specified ‘NR ARFCN’ to indicate the center frequency and ‘Bandwidth’ to indicate the bandwidth of a NR-U carrier, 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 carriers (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), wherein the allowed carrier bandwidths are 10/20/40/60/80 MHz.
* 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.
* For a NR-U carrier with a bandwidth of 20/40/60/80 MHz, RAN1 has also specified the support of configuring “RB-set” within the NR-U carrier, as described in TS 38.214 (Section 7), wherein an RB set corresponds to a NR-U “channel” with a bandwidth of 20 MHz, and the NR-U “channel” is associated with the index of the corresponding RB set (e.g. a value from 0, 1, 2, 3). Whether such index is applicable for RAN3 use case is up to RAN3.
* RAN1 also wants to clarify that the answers intentionally distinguish the use of “carrier” and “channel” to void potential confusion, and the corresponding interpretation of those wording in other WG may not be the same as RAN1.

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| **Company** | **View** |
| Huawei, HiSilicon | As for the 3rd bullet, it should be further clarified that the RB-set should correspond to 10/20MHz channel identified by ARFCN for 10/20MHz channels defined for n46 and n96. |
| Intel | We are OK with the FL proposed answer and suggestion from Huawei. |
| Moderator | The answer to Q1 has been updated to v1 based on the comments above. |
| ZTE, Sanechips | we are basically find with updated proposal, but we don’t understand why the bandwidth of 10 MHz can be corresponded to the that of RB set.  Moderator’s response: You are right that 10 MHz is not applicable for RB-set. Revised to v2 to address this point. |
| Moderator | The answer to Q1 has been updated to v2 based on the comments above. |
| Ericsson | We think the proposed answer mixes up "channel" defined in RAN1 as "carrier or part of a carrier over which a channel access procedure is performed" and "carrier" which can have bandwidth 20/40/60/80 MHz. We understand that RAN4 uses the word "channel" for the latter, which admittedly creates some confusion. But since we are answering from a RAN1 perspective, it is important to be consistent.  We disagree with Huawei's update in red. ARFCN identifies the center frequency of the carrier, not the center frequency of an RB set. Please see 38.101-1 Section 5.4.2.2 which specifies which subcarrier of a carrier corresponds to the ARFCN.  Suggest the following to be consistent (at least from a RAN1 perspective): Proposed answer to Q1 (A1-v2a):  * 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~~ carrier, 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 carriers ~~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). The allowed carrier bandwidths are 10/20/40/60/80 MHz. * 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” with ~~its center frequency identified by the ARFCN an~~d its bandwidth of ~~10 or~~ 20 MHz, and frequency location within the carrier, as defined in RAN4 specification, and the NR-U “channel” is associated with the index of the corresponding RB set. with possible values 0 .. 3   Moderator’s response: It’s good to clarify carrier and channel from RAN1 perspective. Added one more bullet to clarify this point. |
| LG Electronics | We are generally fine with Ericsson’s modification to alleviate the ambiguity of the wording “channel”. However, one thing to be clarified is that RB set is not applicable to 10 MHz NR-U carrier, but that 10 MHz NR-U carrier can be NR-U “channel” from our understanding. If this is the case, we can further modify A1-v2a, as follows. Proposed answer to Q1 (A1-v2b):  * 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~~ carrier, 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 carriers ~~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). The allowed carrier bandwidths are 10/20/40/60/80 MHz. * 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” for a NR-U carrier with 20 MHz or greater than 20 MHz in TS 38.214 (Section 7), wherein an RB set corresponds to a NR-U “channel” with ~~its center frequency identified by the ARFCN an~~d its bandwidth of ~~10 or~~ 20 MHz, and frequency location within the carrier, as defined in RAN4 specification, and the NR-U “channel” is associated with the index of the corresponding RB set. with possible values 0 .. 3. |
| vivo | We agree with LGE’s version A1-v2b |
| Huawei, HiSilicon | If we change the NR-U channel to NR-U carrier, does it imply that only the “RB-set” should be NR-U channel?  Another un resolved issue is how to indicated the NR-U channel. For the 3rd bullet, are we proposing to use RB set index 0..3 for NR-U channel identification?  My original intention is trying to link the RB set to some unique index which can be used by RAN3.  Moderator’s response: I think there no intention to imply RB-set is NR-U channel, since it’s only applicable when it’s configured for 20/40/60/80 MHz. To avoid such intention, added a sentence “Whether such index is applicable for RAN3 use case is up to RAN3” at the end. |
| Ericsson2 | We agree with the update from LGE, but maybe the wording could be clarified a bit more: "… for an NR-U carrier with bandwidth 20 MHz or greater ~~than 20 MHz~~ …"  @Huawei  Regarding the question "does it imply that only the “RB-set” should be NR-U channel?"  In our view, the answer is YES (from a RAN1 perspective)  Regarding the question on how to indicate the NR-U channel, 38.214 Clause 7 defines RB set indices 0 .. 3, and these are used elsewhere in 38.214 in the context of resource allocation. Furthermore, RB set index is even used in 38.331 within PUCCH-Config to indicate in which RB set the PUCCH resources are located.  We think that RAN3 could make use of RB set indices if they want. |
| Moderator | The answer to Q1 has been updated to v3 based on the comments above. Controversial part marked in red. |
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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:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201057.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:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201742.zip), Ericsson]  [[R1-2201743](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201742.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. |

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*.

### Proposed answer to Q2 (A2-v1):

* 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 perform RSSI measurement, and report RSSI and channel occupancy to the associated gNB on the channel indicated by *ARFCN-valueNR* in *rmtc-Config*. Whether the sensing in RSSI measurement is applicable for RAN3 use cases is up to RAN3.

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| **Company** | **View** |
| Huawei, HiSilicon | Fine with the answer |
| Intel | We fine with the FL proposed answer. |
| ZTE, Sanechips | We are fine with the answer from FL |
| Ericsson | We don't think the 3rd bullet should be included in the response for Q2 since it is not directly related to the question that RAN3 has asked.  We are fine with the first 2 bullets. |
| LG Electronics | We share the view with Ericsson in that the first 2 bullets are needed. |
| vivo | We are fine with the first 2 bullets. The 3rd bullet seems irrelevant to the question. |
| Huawei, HiSilicon2 | Answer to Ericsson:  The Q2 is only about sensing, which is not only restricted to LBT. Actually, RAN3 expect to know whether there is sensing mechanism which is independent of data transmission. RSSI measure is one of the candidates of “sensing”. To our understanding, the long term measurement is more suitable for network to do mobility and load balance and we could let RAN3 to make the choice. |
| Ericsson2 | @Huawei:  Okay, now I understand why you suggested to add the 3rd bullet. Perhaps the wording can be reformulated to convey that long term RSSI measurement is a form a sensing, and it is not tied to data transmission. Otherwise, the 3rd bullet seems to be out context. |
| Moderator | The answer to Q2 has been updated to v1 based on the comments above. Controversial part marked in red.  One sentence is added at the end of the 3rd bullet to try to resolve the concern. |
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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:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201057.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:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201742.zip), Ericsson]  [[R1-2201743](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201742.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. |

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.

### Proposed answer to Q3 (A3-v1):

* 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~~ up to RAN3.

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| **Company** | **View** |
| Huawei, HiSilicon | Fine with the 1st main bullet and two sub bullets under it.  For the 2nd bullet, I am not sure what it is the purpose. Are we going to request further clarification from RAN3? If not, maybe we do not need it.  Moderator’s response: The intention of that bullet comes from the comments in [[R1-2201743](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201742.zip), Ericsson], and just try to explain the gNB’s ED threshold is not “configured” (which implies the question itself is a little bit problematic). There is no intention to ask RAN1 clarification on this, and revised the wording a little to try to resolve that concern. |
| Intel | We are OK with the FL’s proposed answers. |
| Moderator | The answer to Q3 has been updated to v1 based on the comments above. |
| ZTE, Sanechips | We are fine with the updated answer from FL |
| Ericsson | We support answer to Q3. But maybe instead of "up to RAN3" the wording "not specified in RAN1" or "outside RAN1 scope" could be used instead. RAN3 can decide what to do based on RAN1's response. |
| LG Electronics | We are fine with the proposed answer. |
| vivo | We are fine with the proposed answer. |
| Huawei, HiSilicon2 | Thanks for the clarification.  I would suggest we just keep the following part for the 2nd main bullet in order not to provide irrelevant information.  “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.” |
| Moderator | The answer to Q3 has been updated to v1 based on the comments above. Controversial part marked in red.  Let’s keep the wording in v1 as is to be consistent with the wording from other answers. |
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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:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201057.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:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201742.zip), Ericsson]  [[R1-2201743](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201742.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 |

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*.

### Proposed answer to Q4 (A4-v1):

* According to the answer to Q3, the ~~granularity of~~ ED threshold for both gNB and UE is applied per channel on which a channel access procedure is performed~~, 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*.

### Proposed answer to Q4 (A4-v2):

* According to the answer to Q3, the ED threshold for both gNB and UE is applied 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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| **Company** | **View** |
| Huawei, HiSilicon | In the 1st bullet, the “granularity” is a little bit confusing. To our understanding, what RAN3 ask is how EDT is configured following the Q3. However, it is stated how the EDT is applied in the 1st bullet. Moreover, “with the definition of channel explained in the answer to Q1” is not accurate because actually two types of channel definition are provided for Q1. Based on above discussion, we suggest following modification to the first bullet.  According to the answer to Q3, ED threshold for both gNB and UE is applied per channel on which a channel access procedure is performed.  Moderator’s response: “granularity” was used because that’s the wording from RAN3’s question, but it’s ok to use the suggested wording if “granularity” is confusing from RAN1 perspective. |
| Intel | We are in general OK with the proposed answers. More information may be added for the first bullet. RAN1 also supports wide LBT over multiple channels, e.g. 40/60/80/100MHz LBT which is reflected in the formula for ED threshold determination.  Moderator’s response: A little bit confusing on the needed “more information”. If the concern is for multi-channel scenario, RAN1 already clarified ED threshold is per channel, then it should cover such scenario already. Please check whether v1 is ok, or some further polishing of the wording is needed ^^. |
| Moderator | The answer to Q4 has been updated to v1 based on the comments above. |
| ZTE, Sanechips | We are fine with the updated answer for FL |
| Ericsson | We prefer A4-v0. It seems that Huawei's concerns would be addressed by our updates to the wording of the answer to Q1 (A1-v2a). |
| LG Electronics | We are fine with the proposed answer. |
| vivo | We prefer A4-v0 |
| Huawei, HiSilicon2 | As commented in Q1, the definition of NR-U channel is still not clear to us. We hope the answer should be self contained. |
| Ericsson2 | Still prefer A4-v0. With the answers we have provided to Huawei's questions in Q1, is the definition of NR-U channel more clear now? |
| Moderator | The answer to Q4 has been updated to v2 based on the comments above. Controversial part marked in red.  Let’s keep the wording in v0 and try to clarify the definition in Q1 such that no duplicated work is needed. |
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# [Closed] Round 2: Further Tuning the Answers

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

## Discussion on answer to Q1

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

### Proposed answer to Q1 (A1-v3):

* It is RAN1 understanding that RAN2 specification has specified ‘NR ARFCN’ to indicate the center frequency and ‘Bandwidth’ to indicate the bandwidth of a NR-U carrier, 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 carriers (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), wherein the allowed carrier bandwidths are 10/20/40/60/80 MHz.
* 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.
* For a NR-U carrier with a bandwidth of 20/40/60/80 MHz, RAN1 has also specified the support of configuring “RB-set” within the NR-U carrier, as described in TS 38.214 (Section 7), wherein an RB set corresponds to a NR-U “channel” with a bandwidth of 20 MHz, and the NR-U “channel” is associated with the index of the corresponding RB set (e.g. a value from 0, 1, 2, 3). Whether such index is applicable for RAN3 use case is up to RAN3.
* RAN1 also wants to clarify that the answers intentionally distinguish the use of “carrier” and “channel” to void potential confusion, and the corresponding interpretation of those wording in other WG may not be the same as RAN1.

### Proposed answer to Q1 (A1-v4):

* It is RAN1 understanding that RAN2 specification has specified ‘NR ARFCN’ to indicate the center frequency and ‘Bandwidth’ to indicate the bandwidth of a NR-U carrier, 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 carriers (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), wherein the allowed carrier bandwidths are 10/20/40/60/80 MHz.
* 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.
* For a NR-U carrier with a bandwidth of 20/40/60/80 MHz, RAN1 has also specified the support of configuring “RB-set” within the NR-U carrier, as described in TS 38.214 (Section 7), wherein an RB set corresponds to a NR-U “channel” with a bandwidth of 20 MHz and center frequency defined in RAN4 specification TS 38.101-1, and the NR-U “channel” is associated with the index of the corresponding RB set (e.g. a value from 0, 1, 2, 3). Whether such index is applicable for RAN3 use case is up to RAN3.
* RAN1 also wants to clarify that the answers intentionally distinguish the use of “carrier” and “channel” to avoid potential confusion, and the corresponding interpretation of those wording in other WG may not be the same as RAN1.

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| **Company** | **View** |
| Ericsson | Support |
| LG Electronics | Support |
| vivo | Support. One Typo error in the final sub-bullet: void->avoid? |
| Huawei, HiSilicon | As for the 3rd bullet, the frequency location of RB set should be “roughly” aligned with the 20MHz channel defined in RAN4. So suggest add back the red text proposed by LG as following.   * For a NR-U carrier with a bandwidth of 20/40/60/80 MHz, RAN1 has also specified the support of configuring “RB-set” within the NR-U carrier, as described in TS 38.214 (Section 7), wherein an RB set corresponds to a NR-U “channel” with a bandwidth of 20 MHz and frequency location within the carrier as defined in RAN4 specification, and the NR-U “channel” is associated with the index of the corresponding RB set (e.g. a value from 0, 1, 2, 3). Whether such index is applicable for RAN3 use case is up to RAN3. |
| ZTE, Sanechips | Support the proposal with vivo’s suggestion |
| Moderator | Updated to A1-v4 based on the comments above. |

## 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?**

### Proposed answer to Q2 (A2-v1):

* 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 perform RSSI measurement, and report RSSI and channel occupancy to the associated gNB on the channel indicated by *ARFCN-valueNR* in *rmtc-Config*. Whether the sensing in RSSI measurement is applicable for RAN3 use cases is up to RAN3.

### Proposed answer to Q2 (A2-v2):

* 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 perform RSSI measurement (not tied to the data transmission), and report RSSI and channel occupancy to the associated gNB on the channel indicated by *ARFCN-valueNR* in *rmtc-Config*. Whether the sensing in RSSI measurement is applicable for RAN3 use cases is up to RAN3.

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| **Company** | **View** |
| Ericsson | Support |
| LG Electronics | Support |
| vivo | Support |
| Huawei, HiSilicon | Suggest following change in red to the 3rd bullet   * A UE can be configured to perform RSSI measurement (not tied to data transmission), and report RSSI and channel occupancy to the associated gNB on the channel indicated by *ARFCN-valueNR* in *rmtc-Config*. Whether the sensing in RSSI measurement is applicable for RAN3 use cases is up to RAN3. |
| ZTE, Sanechips | Support |
| Moderator | Updated to A1-v2 based on the comments above. |

## Discussion on answer to Q3

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

### Proposed answer to Q3 (A3-v1):

* 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 up to RAN3.

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| **Company** | **View** |
| Ericsson | Support |
| LG Electronics | Support |
| vivo | Support |
| Huawei, HiSilicon | Support |
| ZTE, Sanechips | Support |

## Discussion on answer to Q4

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

### Proposed answer to Q4 (A4-v2):

* According to the answer to Q3, the ED threshold for both gNB and UE is applied 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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| **Company** | **View** |
| Ericsson | Support |
| LG Electronics | Support |
| vivo | Support |
| Huawei, HiSilicon | Support |
| ZTE, Sanechips | Support |

# [Closed] Round 3: Finalizing the Reply LS

The working group is encouraged to provide the third round feedback to the draft reply LS before **UTC 16:59, Feb 25**. Please provide comments directly on the draft reply LS, instead of the summary document.

# Conclusion

The draft reply LS R1-2202672 is endorsed with a typo “date” fixed to “data”. The final reply LS is in R1-2202673.

# Reference

[R1-2201057](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201057.zip) Draft reply LS on NRU channel information and procedures vivo

[R1-2201742](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201742.zip) Discussion on LS from RAN3 on NR-U channel information and procedures Ericsson

[R1-2201743](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201743.zip) Draft Reply LS to RAN3 on NR-U channel information and procedures Ericsson

[R1-2201972](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201972.zip) Draft Reply LS on NR-U channel information and procedures Samsung

[R1-2202332](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2202332.zip) Discussion on RAN3 LS for NR-U channel information and procedures LG Electronics

[R1-2202452](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2202452.zip) Discussion on RAN3 questions of NR-U channel information and procedures Huawei, HiSilicon