**3GPP TSG-RAN WG1 Meeting #100bis R1-20nnnnn**

**e-Meeting, April 20th – 30th, 2020**

**Agenda Item: 7.2.2.2.2**

**Source: Moderator (Ericsson)**

**Title: Summary of [100b-e-NR-unlic-NRU-InitAccessProc-04] Email Discussion/Approval for Reply LS on NR-U PRACH Root Sequence for 2-Step RA**

**Document for: Discussion**

# Introduction

This document captures the discussion of the following email thread:

[100b-e-NR-unlic-NRU-InitAccessProc-04] Email approval of the reply LS for R1-2001237 by 4/23 - Zhipeng (Ericsson)

As stated in RAN2’s LS to RAN1 [1], a question arose in RAN2 RRC discussions of whether the newly introduced NR-U PRACH root sequences (of length 571 and 1151) are applicable to 2-step random access. As indicated in the 2-step RA parameter list R1-1913674, the parameter msgA-PRACH-RootSequenceIndex shall be applicable to 2-step if the configured, else it shall apply the value configured for 4-step RA. Since RAN2 has introduced the option of configuring a BWP with only 2-step RA, then if 2-step RA shall support the newly introduced NR-U PRACH root sequences as for the current 4-step RRC configuration, then it needs to be explicitly configurable for 2-step RA. RAN2 then ask RAN1 ask whether the new PRACH root sequences will be introduced for 2-step random access.

This email discussion addresses how to answer RAN2’s question of whether PRACH root sequences of length 571 and 1151 will be introduced for 2-step random access and the related text proposal in [2]. Section 2 is used to summarize the proposals made to date and to collect views on questions identified in the summary. The outcome of the email discussion is given in section 3.

# Summary of Identified Issues and Discussion

A table in the [Appendix](#_Appendix) lists the related contributions taken from the 2-step RACH channel structure feature lead summary [3] and the related portion of the agenda item 5 summary [4], where the proposals and rationale are also summarized. Please feel free to add your tdoc and its related proposal with its rationale in the Appendix if it is missing.

As can be seen in the Appendix, 6 companies prefer to support the new sequences for 2-step operation in NR-U, while one company prefers that the new sequences are not supported. The company arguing against support for the new sequence has the following rationale in our understanding:

* There is no need in 2-step RACH to the fulfill occupied bandwidth requirements that motivated the NR-U new sequence design
* The wideband PRACH is an optional UE feature for NR-U

Whereas those companies supporting the new sequences for 2-step in NR-U have the following primary arguments:

1. Similar to the MSGA PUSCH which supports the interlaced structure defined in NR-U, it is reasonable to support the new root sequences for the MSGA PRACH so as to satisfy the occupied bandwidth requirements
2. It was agreed to support all the preamble formats specified for NR Release-15 four-step RACH
3. It was not intended by RAN1 to restrict the use of these new NR-U new ZC sequences for NR-U 4-step RA
4. New sequence usage for 4-step in NR-U can be easily extended to 2-step in NR-U

Given that the majority of companies favor using the new PRACH sequences for 2-step RA with NR-U, we’d like to focus on the counter-arguments for support. These are addressed by questions 1 & 2. In order to save time, if RAN1 does intend to support the new PRACH for 2-step, it may also be beneficial to discuss the wording of the response to RAN2, which is covered by Q3. If there is consensus to support the new sequences for 2-step, it may be necessary to correct 38.211 to reflect this support. Therefore, Q4 considers the TP in [2] that proposes the related correction.

**Therefore, please provide responses in the tables below to the following four questions:**

**Q1: Is there a benefit in 2-step RACH to fulfill the occupied bandwidth requirements that drove the design of the new sequence lengths for PRACH?**

|  |  |
| --- | --- |
| Company | View |
| ZTE, Sanechips | We do not see any difference on the OCB requirement between Msg1 PRACH and MsgA PRACH for NR-U. So the answer is yes. |
| Apple | As the two new sequences are introducing for OCB purpose, it could limit the RO opportunity in frequency domain. Thus, this could have some restriction to network configuration. |
| Ericsson | OCB is one aspect that drove the design for the new sequence lengths for PRACH; however, a more important aspect is the additional UE Tx power that the longer sequence allows given the 10 dBm/MHz PSD constraints in some regulatory regions. We see that this benefit applies equally to 2-step and 4-step RACH. Also, similar to ZTE’s observation, interleaved PUSCH is supported for 2-step RACH, and interleaved PUSCH was designed to address the same OCB and PSD requirements that the new PRACH sequences address. |
| Samsung | Wondering the point of the question.  So if the 2step RACH does not fulfill the OCB requirement by regulation, e.g., “There is no need in 2-step RACH to the fulfill occupied bandwidth requirements that motivated the NR-U new sequence design”; Could NR-U use 2step RACH??  So it is a requirement, not a beneficial thing to have. |
| Huawei, HiSilicon | Yes. As well as OCB requirement, wideband PRACH can fully make use of the transmit power of UE considering the PSD limit. |
| CATT | The design of the new sequence lengths for PRACH in 2s RACH is satisfied with OCB &PSD requirements. This purpose is the same as that in 4-step RACH. |
| Nokia, NSB | Yes  In our understanding these new ZC sequences were designed to meet both OCB and PSD requirements for both 2-step and 4-step RACH NR-U. |
| Intel | Yes. If 2-step RACH is used for unlicensed band, new ZC sequence has benefits from OCB/PSD perspectives as we have discussed and concluded in RAN1. |
| Qualcomm | Yes |

**Q2: Presuming that wideband PRACH is an optional feature, does this preclude or excessively limit the benefit of sequence lengths 571 and 1151 PRACH for 2-step RACH in NR-U?**

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| --- | --- |
| Company | View |
| ZTE, Sanechips | No. It should be an optional feature for NR-U UEs regardless of RA type. |
| Apple | Just clarify our position, we don’t see the need to introduce the long root sequence for 2-step RACH in licensed band. If two sequences are introduced for NR-U only, we are ok with that, even the benefits is not so attritive. |
| Ericsson | No. As mentioned in Q1 there is a significant UE Tx power advantage. |
| Samsung | Wondering the assumption in the question “**wideband PRACH is an optional feature**”, does it mean some UE can only access the shared spectrum by NSA-style; thus such wideband PRACH is optional? Or even for UE accessing the shared spectrum by SA-style, meaning to do PRACH, the wideband PRACH is still optional?  If UE doesn’t support wideband PRACH, the new length’s benefit is quite limited;  On the other hand, if the wideband PRACH is needed, then the new length is needed. |
| Huawei, HiSilicon | The discussion on mandatory or optional should be in UE feature discussion together with other FG. |
| CATT | We prefer to wideband PRACH as an optional feature and needn’t extend to license band |
| Nokia, NSB | No.  As mentioned by Ericsson supporting these new ZC sequences for both 2-step and 4-step RACH NR-U may have benefits regarding PSD requirements. |
| Intel | No. |
| Qualcomm | No |

**Q3: If, taking into account Q1 and Q2 above, sequence length 571 and 1151 PRACH should be supported for 2-step RACH operation, please comment on the following proposed response to RAN2:**

* **RAN1 respectfully requests that RAN2 reflect in their specifications that the two new PRACH root sequences (of length 571 and 1151) are supported in 2-step RA.**

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| --- | --- |
| Company | View |
| ZTE, Sanechips | Support. Perhaps it is better to put ‘for NR-U’ at the end of this sentence. |
| Apple | We update the word a bit to make it clear that new sequences are applicable to NR-U only.   * **RAN1 respectfully requests that RAN2 reflect in their specifications that the two new PRACH root sequences (of length 571 and 1151) are supported in 2-step RA for NR-U.** |
| Ericsson | Agree with this response to RAN2. Regarding “for NR-U.” That is better treated in the UE capability discussions (see similar comment below). |
| Samsung | Agree with ZTE and apple, these two lengths are specifically for shared spectrum. |
| Huawei, HiSilicon | It should be clarified that wideband PRACH is only applied in NR-U for now. Whether it can be extended to licensed band should be discussed together with other NRU feature in the discussion on UE feature. |
| CATT | We prefer to the two new PRACH root sequences are only used for 2s RACH under NR-U scenario. |
| Nokia, NSB | We support the answer to RAN2 with the “**for NR-U**” wording added at the end.  BTW the ACTION from the RAN2 LS is as follows: *RAN2 respectfully ask RAN1 to consider whether the two new root sequences above are applicable to 2-step RA* ***for NR-U***.  Hence in our understanding RAN2 ask their question for NR-U only. |
| Intel | We agree with the proposal and also agree with ZTE that it is better to put “for NR-U”. |
| Qualcomm | Support |

**Q4: If, taking into account Q1 and Q2 above, sequence length 571 and 1151 PRACH should be supported for 2-step RACH operation, please comment on the TP in [2] for 38.211:**

**-------------------------------------------- Start of TP1 to Section 6.3.2.1 of TS 38.211 --------------------------------------**

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6.3.3.1 Sequence generation

The set of random-access preambles  shall be generated according to



from which the frequency-domain representation shall be generated according to



where , , , or depending on the PRACH preamble format as given by Tables 6.3.3.1-1 and 6.3.3.1-2. **For Type-1 or Type-2 random access procedure without shared spectrum channel access, or are used. For Type-1 or Type-2 random access operation with shared spectrum access, PRACH preamble formats with , , or are used.**

-----------------------------------------  **End of TP1 to Section 6.3.2.1 of TS 38.211 ---------**---------------------------------

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| --- | --- |
| Company | View |
| ZTE, Sanechips | We are not sure if the TP in RAN1 spec is necessary. |
| Ericsson | Our view is that this TP is not needed. It is fine that the spec defines all possible PRACH sequence lengths, and which one is configured/indicated depends on the deployment scenario. In the UE capability session, it is being discussed which sequence lengths are supported, and the per-band signaling can be used to address for which bands the various sequence lengths apply. |
| Samsung | TP is not needed. UE is following the gNB configuration to use which length to use. As long as the ASN.1 has made the configuration parameter clear, no TP is needed here. |
| Huawei, HiSilicon | No need to have the TP. |
| CATT | The proposed TP needn’t be captured and PRACH sequence lengths can flexibly be configured by gNB. |
| Nokia, NSB | We support a similar TP, as proposed within our R1-2002278 contribution: 6.3.3.1 Sequence generation The set of random-access preambles  shall be generated according to    from which the frequency-domain representation shall be generated according to    where:  - for operation without shared spectrum channel access,  or  depending on the PRACH preamble format as given by Tables 6.3.3.1-1 and 6.3.3.1-2.  - for operation with shared spectrum channel access, , , or depending on the PRACH preamble format as given by Tables 6.3.3.1-1 and 6.3.3.1-2.  Our reasons for supporting this TP are as follows:  1) The TP is consistent with the following RAN1 agreement, which BTW also states that L\_RA = 839 is not supported by the UE:  *In addition to the Rel-15 design for NR short PRACH (sequence length of 139), support an enhanced PRACH design* ***for NR-U*** *by adopting a single long ZC sequence of the following lengths*   * *For 15 kHz SCS L\_RA= 1151, For 30 kHz SCS L\_RA= 571* * *Introduce signalling in SIB1 to indicate to UE whether Rel-15 PRACH or enhance PRACH sequences above are used* * *Logical root indices, cyclic shifts and frequency position are determined as give in Tables in Appendix B provided in* [*R1-1911863*](file:///C:\AppData\Docs\R1-1911863.zip)   2) In our view this TP is targeting the gNB, not the UE – i.e. configured L\_RAs provided by the gNB should be in line with the above TP.  3) In our view the purpose of UE features should not be to enforce RAN1 agreements.  See also our answer to Q3. |
| Intel | We share the view with Ericsson. TP is not needed in RAN1 spec. The use of this feature can be discussed in the UE feature list discussion. |
| Qualcomm | Agree with Ericsson |

# Discussion Outcome

To be completed at the conclusion of the email discussion

# References

1. R1-2001237, “LS to RAN1 on NR-U PRACH root sequence for 2-step RA”, RAN2, RAN1 #100b-e, 3GPP TSG-RAN WG1 Meeting #100b-e, April 20-30, 2020
2. R1-2002526, “Remaining Issues and Clarification on Channel Structure for Two-Step RACH”, Qualcomm, 3GPP TSG-RAN WG1 Meeting #100b-e, April 20-30, 2020
3. R1-2001712, “FL summary on the maintenance of 2-step RACH channel structure”, ZTE, 3GPP TSG-RAN WG1 Meeting #100b-e, April 20-30, 2020
4. R1-2002736, “Outcome of RAN1#100b-e preparation phase on incoming LS”, RAN1 Chairman, 3GPP TSG-RAN WG1 Meeting #100b-e, April 20-30, 2020

# Appendix

The 2-step RACH channel structure feature lead summary [1] the related portion of the agenda item 5 summary [4] list the following tdocs. We summarize the proposals and rationale below:

Table 1: Related Contribution Summary

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| --- | --- | --- |
| **Company** | **Discussion Tdoc** | **Related Proposal and Rationale** |
| Vivo | R1-2001647 | Proposal 13: Long PRACH preamble is also supported for 2-step RACH in shared spectrum.   * Long sequence usage for 4-step in NR-U can be easily extended to 2-step in NR-U |
| ZTE, Sanechips | R1-2001710 | Proposal 1: The two new root sequences introduced in Rel-16 NR-U are applicable to 2-step RA for NR-U.   * Similar to the MSGA PUSCH which supports the interlaced structure defined in NR-U, it is reasonable to support the new root sequences for the MSGA PRACH so as to satisfy the occupied bandwidth requirements, for the 2-step RACH application for NR-U. |
| Ericsson | R1-2002369, R1-2002373 | Action to RAN2: RAN1 respectfully requests that RAN2 reflect in their specifications the two new PRACH root sequences (of length 571 and 1151) are supported in 2-step RA for operation with shared spectrum channel access.   * It is beneficial that 2-step RACH supports supports the newly defined sequence lengths 571 (for 30 kHz SCS) and 1151 (for 15 kHz SCS) * RAN1 agreed that all PRACH formats used by 4-step RACH should be supported in 2-step RACH |
| Qualcomm | R1-2002526 | Proposal 1: Correct Section 6.3.2.1 of TS 38.211 to specify the PRACH formats applicable to Type-2 random access procedure with or without shared spectrum channel access, according to the text proposal TP1   * It was agreed to support all the preamble formats specified for NR Release-15 four-step RACH, including legacy PRACH sequences of length 839 and length 139 |
| Apple | R1-2002310 | Proposal 1: Not introduce the NR-U PRACH root sequence to 2-step RACH random access.   * No need in 2-step RACH to fulfill occupied bandwidth requirements driving NR-U long sequence design * Wideband PRACH is an optional UE feature for NR-U |
| Nokia | R1-2002278 | Proposal 7: to send a reply LS to RAN2 indicating that these two new root sequences are applicable to 2-step RA for NR-U.   * It was not intended by RAN1 to restrict the use of these new NR-U long ZC sequences for NR-U 4-step RA |
|  |  |  |