**3GPP TSG RAN WG1 Meeting #100b-e                     R1-200xxxx**

**eMeeting, April 20 - 30, 2020**

**Agenda Item: 7.2.2.2.2**

**Source: Moderator (Charter Communications)**

**Title: Draft-100b-e-NR-unlic-NRU-InitAccessProc-02**

**Document for: Discussion and Decision**

# Introduction

Three email discussions have been sanctioned in RAN1#100b-e on initial access procedures for NR-U. This second discussion that aims to converge by 4/24 has the following scope:

[100b-e-NR-unlic-NRU-InitAccessProc-02] Email discussion/approval on following issues related to RA procedure by 4/24; if necessary, followed by endorsing the corresponding TPs by 4/29 – Amitav (Charter)

* MsgA PRACH-PUSCH gap for NR-U
* Remaining details of RACH occasion validation for FBE access

These issues have been selected based on the preparatory discussion summarized in [14].

# Company views

## MsgA PRACH-PUSCH gap for NR-U

Proposal 1: Apply the same PRACH-PUSCH gap defined in R16 to msgA PRACH for NR-U.

Proposal 2: Apply CP extension to PUSCH to enable no-gap msgA.

Proposal 3: Support a zero symbol gap (N = 0) between the PRACH and PUSCH parts of MsgA

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| **Company** | **Views** |
| ZTE | Among the 3 proposals, we prefer Proposal 3. We agree that symbol gap N=0 is beneficial to NRU LBT, but we think this has already been supported in 38.213, i.e. N should be 2 or 4 for licensed band, and it can be derived that N could be 0 or any other value for NRU, thus we don’t need to make any further modifications. I don’t think we should limit N=0 for NRU to decrease the configuration flexibility.As for proposal 1, it’s against the agreement made in 2-step RACH WI.Proposal 2 is an optimization issue.In 38.213:For a Type-2 random access procedure, a UE transmits a PUSCH, when applicable, after transmitting a PRACH. The UE encodes a transport block provided for the PUSCH transmission using redundancy version number 0. If *useInterlacePUSCH-Common* is not provided, the PUSCH transmission is after the PRACH transmission by at least $N$ symbols where $N=2$ for $μ=0$ or $μ=1$, $N=4$ for $μ=2$ or $μ=3$, and $μ$ is the SCS configuration for the active UL BWP. |
| Huawei, HiSilicon | We support proposal 1 that is the same gap as agreed in 2 step RACH WI. It should clarified that the agreement made in 2 step RACH WI do not imply anything for NR-U. The intention of the “Note” under the agreement is to inform NRU we should make decision by our own on unlicensed band. The specification text in 38.213 does not include any paragraph for the case where *useInterlacePUSCH-Common* is provided, so this case is currently unspecified. That’s why we are discussing now which solution to adopt.There were comprehensive technical discussions on the motivation to leave the gap between PRACH and PUSCH, such as coverage mismatch between PRACH and PUSCH, 2-step PUSCH occasions overlapping with 4-step PRACH occasions and network detection complexity, etc. These issues are still valid on unlicensed band from our perspective. Thus, we think adopting the same gap as two step RACH is reasonable. Furthermore, motivations to adopt no gap for NR-U are not convincing. We think that the licensed band design is sufficient for 2-step RACH in unlicensed band. If a UE has to perform LBT between PRACH and PUSCH of msgA then the UE will either pass LBT and still be able to transmit msgA faster than by 4-step RACH even with a 2 or 4 symbols gap, or the UE will fail LBT which probably indicates that it would be better for the UE to choose another 20 MHz channel for initial access in unlicensed band because the current 20 MHz channel is already heavily congested because the UE would have passed one LBT and failed one LBT in a short time interval. |
| vivo | Support proposal 1 |
| OPPO | We support proposal 3.  |
| Qualcomm | We support proposal 1.For proposal 2, there might be an issue consider the gap between PUSCH and PRACH for one UE maybe a PRACH transmission opportunity for another UE. Then the CP extension can cause interference to another UE’s PRACH.For proposal 3, we do understand there can be some LBT benefit. However, under the current PRACH and PUSCH configurations, only a small set of cases can actually support no gap between PRACH and PUSCH by configuration. And all the physically implementation limitations that result in enforcement of the gap in NR licensed band are still there no matter it is operating in licensed band or unlicensed band. |
| Ericsson | Support Proposal 3.We support gapless (N = 0) MsgA since the main use case for 2-step RACH is NR-U to reduce the number of LBT operations that are needed in the RACH procedure, to make for faster initial access. Having a 2-symbol gap defeats that purpose completely, since an extra LBT operation will be needed between PRACH and PUSCH.We share a similar view at ZTE, but one thing to point out is that I think ZTE is not referring to the most recent version of 38.213. |
| Samsung | Support Proposal 1. For Proposal 2, currently supported CP extension has a limitation of at most 1 OFDM symbol, and the same scheme may not fully achieve the purpose of no gap between PRACH and PUSCH. For Proposal 3, the implementation restriction from 2-step RACH on licensed band should still hold for unlicensed band, so it’s not that straightforward to conclude N can be 0 for unlicensed band.  |
| MediaTek | We support Proposal 1. As we have analyzed in our contribution (R1-2002407), with the constraint made in 2-step RACH that PRACH and PUSCH are transmitted in different slots, the number of PRACH configuration that support “no gap” in between PRACH and PUSCH is very limited. On the other hand, in order to support “no gap” MsgA transmissions, UE has to modify its implementation at additional cost compared with Rel-15. Beside the gap between msgA PRACH and msgA PUSCH, there could be a gap in the middle of msgA PUSCH when inter-slot frequency hopping is applied. See below for the detailed agreement for 2-step RACH. Therefore, we think a more generic solution and an alternative to the “no gap” solution is to allow UE to perform Cat-2 LBT for msgA PUSCH when there is a gap larger than 16usec from its preceding msgA PRACH/PUSCH. Proposal 2 from R1-2002405: In a UE-initiated channel occupancy acquired by Cat-4 LBT, the following channel access procedures are applied to a transmission related to a random access procedure when there is a gap between the transmission and its previous transmission in the channel occupancy:* If the gap is larger than 25usec, Cat-2 25us LBT is applied.
* If the gap is larger than 16usec and smaller than 25usec, Cat-2 16us LBT is applied.
* Note: If the gap is at most 16usec, no LBT is required as agreed before.

Agreements:* Support a configurable guard period between the hops, if intra-slot frequency hopping per PO for msgA is configured.
	+ Reuse the value of guard period between POs if configured; otherwise, no guard period
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| LG | We prefer Proposal 2 and Proposal 3 for U-band, in order to support continuous and complete transmission of MsgA (PRACH+PUSCH) which is the main motivation to introduce 2-step RACH in Rel-16, to be comparable with L-band.We think the gap-less MsgA transmission in U-band by those proposals 2 and 3 would provide several benefits in terms of: 1) reducing UE’s LBT procedure/overhead, 2) improving utilization efficiency of the resource reserved for MsgA PUSCH, 3) reducing fallback RAR and MsgA PUSCH retransmission, and so on.To be specific, CP extension by Proposal 2 could be applied with some condition in terms of restricting the size of configured gap allowable for the CP extension (e.g. it applies if the size is no longer than X-symbol), and/or according to whether the RO right before the gap is the only RO associated with the PO right after the gap (i.e., it applies if other ROs are not associated with the PO).In addition, even in case when N is configured to 0 with Proposal 3, CP extension by Proposal 2 could be applied to the guard period within the RO according to PRACH format. |
| Nokia, NSB | We agree with ZTE that the 2-step RACH RAN1 agreement may be felt ambiguous, but in our view it does not prevent from agreeing upon proposal 1. On the other hand, we see some benefits for proposal 2, as the use of CP extension may allow to “shorten the gap” and therefore increase the chances of LBT success – or even prevent from performing any LBT.We therefore support Proposal 1 as a baseline, with optionally and on top of it the possibility for the UE to apply CP extension, as per Proposal 2. |
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## RACH occasion validation for FBE access #1

Proposal: To accommodate DL processing time at UE, a PRACH resource is considered invalid if it overlaps with the first X symbols at the front of each FFP when FBE operation is indicated, where X could be configured or fixed in spec.

FL suggestion is to first discuss the above proposal before moving to potential TP.

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| **Company** | **Views** |
| ZTE | We don’t agree with this proposal, it’s not reasonable to define a ‘X’ to indicate the possible SSB or other DL signal position which shouldn’t be limited at the front of a FFP.  |
| vivo | Support this proposal. Defining a ‘X’ is not to indicate the possible SSB or other DL signal position. For FBE, UE needs to confirm the DL transmission before RACH transmission. However, confirm the DL transmission needs processing time. Here the first X symbols in each FFP will be the minimum processing time to confirm DL transmission, i.e. the symbols where UE has no possibility to transmit any UL transmissions. Similar with the idle time that is invalid time for both DL and UL, the first X symbols in each FFP is invalid time for UL transmissions. So it should be considered as invalid if a configured PRACH resource overlaps with this invalid time for UL transmissions. |
| OPPO | We don’t support this proposal. The ROs at the beginning of the FFP are automatically canceled, if the UE does not detect any downlink transmission, no need to specify ‘X’. If the UE detects DL transmission, it can select the upcoming RO for PRACH transmission.  |
| Qualcomm | We support the proposal. This is not about RO cancellation, which is already handled in 37.213. This is more about SSB to PRACH association, so invalid RO will not be considered. Without this, it is possible that some SSB does not have valid RO. |
| Ericsson | If a UE has not detected the beginning of an FFP due to processing time, how could it transmit PRACH anyway? Aren’t the potential PRACH occasions during this processing time period automatically unusable by the UE? Doesn’t seem necessary to specify. |
| Samsung | This proposal logically makes sense to us. More discussion should be performed on how to determine the value of X, and whether it’s related to a UE capability. With such agreement, it is more natural to adopt the TP for FBE, otherwise, it is still preliminary to adopt the TP as it is.  |
| LG | Seems to be unnecessary with same reasons as other companies. |
| Nokia, NSB | We do not support this proposal, in our view DL transmission detection is enough. |
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## RACH occasion validation for FBE access #2

Update TS 38.213 for RACH occasion validation in FBE mode when UE is not provided tdd-UL-DL-ConfigurationCommon, and for Type-2 RA procedure.

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| **Company** | **Views** |
| ZTE | Support. We suggest to adopt the TP7 in [3]. |
| Huawei, HiSilicon | Support. The text proposal are in TP#2 in [1]. |
| vivo | Support. |
| OPPO | The question is confusing, at least we see two different TPs in this table TP7 in [3] and TP#2 in [1], which one shall we refer to? |
| Qualcomm | Support |
| Ericsson | Support. We have a TP in Section 2.3 of [7]. |
| Samsung | Support the TP7 in [3].  |
| MediaTek | Support. Either TP7 in [3] or the TP in Section 2.3 of [7] is fine.  |
| LG | Seems to be supportive. |
| Nokia, NSB | We support. |
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**Proposal**: A PRACH resource in the channel occupancy of a Fixed Frame Period is valid only if a UE detects any DL transmission in the serving cell before the PRACH resource in the same FFP.

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| **Company** | **Views** |
| ZTE  | Support.  |
| Huawei, HiSilicon | Support. The text proposal are in TP#2 in [1] |
| vivo | Fine with it as a clarification. |
| OPPO | This was the RAN1 agreement to our understanding |
| Qualcomm | In 37.213, section 4.3, we already have the language that UL transmission is conditioned on the DL detection in the same FFP. Do we still need this? If this is introduced as a clarification, the word “valid” in the proposal might cause some confusion, as validation is used for SSB to PRACH association which is a long term process not depending on the LBT outcome of a particular FFP. |
| Ericsson | Clarification not needed.Agree with Qualcomm; the word “valid” is problematic as SSB-to-PRACH mapping is semi-statically configured. There should be no dynamic invalidation which could lead to gNB-UE misalignment.Moreover, it this proposal is already captured in Section 4.3 of 37.213. A channel occupancy acquired by the gNB is defined as the FFP, and after the UE detects that the gNB has acquired the channel occupancy the UE can transmit within the same FFP. |
| Samsung | Not needed. Currently only gNB initialized COT is supported in TS 37.213. If no DL transmission is detected at the beginning of the FFP, the UE will cancel all the UL transmissions including PRACH. We may not need a clarification in particular for PRACH in TS 38.213, since the general principle is already clear from TS 37.213.  |
| MediaTek | I am a bit confused. I thought we would be discussing #3.1 in the FL summary R1-2001701. *#3.1: To accommodate DL processing time at UE, a PRACH resource is considered invalid if it overlaps with the first X symbols at the front of each FFP when FBE operation is indicated, where X could be configured or fixed in spec. [R1-2001653]* Issue #3.1 is more about ROs are semi-statically invalidated to accommodate the UE processing time in between DL detection and PRACH transmission. However, the current proposal is different from #3.1. If the validation of ROs are based on the detection of DL transmissions per COT basis in a dynamic sense, then we do not agree with this proposal. The mapping between *valid* (valid in a semi-static sense) ROs and SSBs is determined once UE reads PRACH configuration from SIB1. It should not be changed dynamically based on the detection or not in each COT. And if the proposal has nothing to do the *validation* of ROs (in a semi-static sense), then did not we already agree that any UL transmission including PRACH would be conditioned on the detection of DL transmission? Why do we need this proposal and corresponding TP?In summary, for this proposal, we share a similar view with QC, Ericsson, and Samsung that this proposal is not needed.  |
| LG | Seems to be unnecessary with same reasons as other companies. |
| Nokia, NSB | We support the requirement to have PRACH transmission allowed only if DL transmission has been detected in the FFP. On the other hand, from other Companies’ feedback it seems that such requirement is already captured within TS 37.213.No strong opinion then, could be still useful as a clarification. |
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# References

1. R1-2001535 Maintainance on the initial access procedures Huawei, HiSilicon
2. R1-2001653 Remaining issues on initial access procedure for NR-U vivo
3. R1-2001706 Remaining issues on the initial access procedure for NR-U ZTE, Sanechips
4. R1-2001760 Discussion on the remaining issues of enhancements to initial access procedure OPPO
5. R1-2001936 Remaining issues of initial access and mobility for NR-U LG Electronics
6. R1-2001988 Enhancements to initial access and mobility for NR-unlicensed Intel Corporation
7. R1-2002032 Enhancements to initial access procedures Ericsson
8. R1-2002118 Initial access procedures for NR-U Samsung
9. R1-2002248 Remaining issues on initial access procedure for NR-U ETRI
10. R1-2002263 Remaining issues on initial access procedure Spreadtrum Communications
11. R1-2002278 On Enhancements to Initial Access Procedures for NR-U Nokia, Nokia Shanghai Bell
12. R1-2002407 Remaining issues on initial access procedure for NR-U operation MediaTek Inc.
13. R1-2002531 TP for Initial access and mobility procedures for NR-U Qualcomm Incorporated
14. R1-2001701 FL summary 72222 NRU Charter Communications