**3GPP TSG RAN WG1 #100bis-e R1-20xxxxx**

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

**Agenda item:** 7.2.11

**Source:** Moderator (NTT DOCOMO, INC.)

**Title:** Summary on email discussion [100b-e-NR-UEFeatures-Remaining] NR\_2step\_RACH

**Document for:** Discussion and Decision

1. Introduction

This contribution summarizes the following email discussion in AI 7.2.11 regarding Rel-16 NR UE features.

[100b-e-NR-UEFeatures-Remaining] Email discussion/approval of remaining issues (especially the one identified as low priority items in FL’s summaries) starting no earlier than 4/30 till next meeting – Hiroki (DCM)/Ralf (ATT)

Companies are encouraged to check further updates for UE features list based on R1-2003073 shown below and provide feedback if any. Please note that the target of this email discussion is to reflect agreeable updates rather than solving any controversial discussion point. If there is any controversial discussion point, it should be discussed in the next RAN1 meeting.

1. NR\_2step\_RACH

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 9. NR\_2step\_RACH | 9-1 | Basic channel structure and procedure of 2-step RACH | 1. RACH type selection for CBRA according to SSB-based RSRP threshold 2. msgA PRACH resource configuration including separately configured ROs not applicable to 4-step RO configuration and fully or partially shared ROs but different preamble sequences partitioning with 4-step RO preamble sequences configuration 3. msgA PUSCH resource (DMRS included) and waveform determination for 2-step CBRA    1. Supporting up to two msgA PUSCH configurations in an UL BWP    2. Supporting a separate or common transform precoder configuration for 2-step CBRA, when 2-step CBRA and 4-step CBRA co-exist    3. [Supporting intra-slot frequency hopping for msgA PUSCH transmission when NR Rel-15 waveform is used] 4. Validation of MsgA PRACH and PUSCH 5. Mapping between preamble of MsgA PRACH and PUSCH occasion with DMRS resource of MsgA PUSCH 6. msgB monitoring and decoding for 2-step CBRA    1. (for UE in any RRC state) monitoring msgB PDCCH with CRC masked by msgB-RNTI in Type-1 CSS set, and decoding multi-cast msgB PDSCH carrying SuccessRAR, FallbackRAR and BI    2. (for RRC connected UE only) monitoring msgB PDCCH with CRC masked by C-RNTI in USS set, and decoding the unicast PDSCH carrying absolute TA MAC CE 7. PUCCH transmission for HARQ-ACK feedback to a msgB 8. Power control for msgA PRACH, msgA PUSCH and PUCCH carrying HARQ-ACK feedback to msgB |  | Yes | N/A | UE cannot initiate a 2-step RACH process, and thus would not be expected understand the 2-step RACH configurations | per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 9. NR\_2step\_RACH | [9-3] | [Parallel MsgA and SRS/PUCCH/PUSCH transmissions across CCs in inter-band CA] | [Parallel MsgA and SRS./PUCCH/PUSCH transmissions across CCs in inter-band CA with msgA in PCell/PScell] | 9-1  TBD | Yes | N/A | UE cannot transmit an MsgA and other UL transmissions in parallel across CCs in inter-band CA | Per BC | N/A | N/A | N/A |  | Optional with capability signalling |
| 9. NR\_2step\_RACH | [9-4] | [MsgA operation in a band combination including SUL] | [MsgA operations in a band combination including SUL] | 9-1, 6-16 TBD | Yes | N/A | UE does not support msgA operations in a band combination including SUL | Per BC | N/A | N/A | N/A |  | Optional with capability signalling |
| 9. NR\_2step\_RACH | [9-5] | [intra-slot msgA PUSCH FH with non-zero GP] | [intra-slot msgA PUSCH FH with non-zero GP] | TBD | Yes | N/A |  | [Per band] | N/A | N/A | N/A |  | Optional with capability signalling |
| 9. NR\_2step\_RACH | [9-6] | [up to X of msgBs per slot/within the msgB window] | [up to X of msgBs per slot/within the msgB window] | TBD | Yes | N/A |  | [Per band] | N/A | N/A | N/A |  | Optional with capability signalling |

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| Company | Comment |
| Nokia | * 9-3: Do not introduce the FG. The FG does not make sense for initial access, as for such case the UE could simply rely on 4-step RACH. The gNB would anyway not know the capability during initial access. As optional FG, the potential use cases are much more limited, as gNB may potentially utilize the information of the capability in case of UE in RRC connected mode only. * 9-4: Do not introduce the FG. Reasoning is essentially the same as for 9-3.   We would like to observe that during the online discussions there was a clear trend on not introducing the above FGs, and we hope that it would be a non-controversial decision that we could take in this email discussion.   * 9-5: Frequency hopping is supported by default, guard period between MsgA PUSCH occasions are supported by default. Thereby, having the guard period between frequency hops should also be supported by default. If this is not acceptable, it would be preferable to drop the feature completely and clean up the specifications (would be relatively simple to remove – and the technical solution in RAN1 to provide the gap combined with SLIV indication has not been implemented yet). * 9-6: Do not introduce the FG. When monitoring for the MsgB, the UE will simply monitor configured search spaces for DCI. Also, for initial access the gNB would not know this feature and would hence not be able to act accordingly. And for connected mode, it would not make much sense to have limitations compared to initial access. It should be noted that there are no UE features for restrictions on monitoring for Msg2 for 4-step RACH. |
| CATT | For 9-1, there are 8 components with sub bullets for the basic feature group 9-1. There is a risk that some items in the specs can’t be included and will be interpreted as not required for the feature. 4s RACH in R15 can’t use this approach. We would like to suggest more simplified and clear description of FG 9-1 as follows.   1. RACH type selection for CBRA according to SSB-based RSRP threshold 2. msgA resource configuration and waveform determination for 2-step CBRA 3. Validation of MsgA PRACH and PUSCH 4. Mapping between preamble of MsgA PRACH and PUSCH occasion with DMRS resource of MsgA PUSCH 5. msgB monitoring and decoding for 2-step CBRA 6. PUCCH transmission for HARQ-ACK feedback to a msgB   Power control for msgA PRACH, msgA PUSCH and PUCCH carrying HARQ-ACK feedback to msgB.  Especially regarding 6.b (for RRC connected UE only) monitoring msgB PDCCH with CRC masked by C-RNTI in USS set, and decoding the unicast PDSCH carrying absolute TA MAC CE  Based on RAN1 agreement,  Agreements:  UEs in CONNECTED state use UE specific search space, or common search space to receive the PDCCH associated with MsgA response and with CRC scrambled by the C-RNTI.  Based on above agreement, USS and CSS can be used for msgB PDCCH with CRC masked by C-RNTI.  Regarding FG 9-3, we prefer to keep FG 9-3as single FG because for 4step RACH, there is already 4-26 FG (Parallel PRACH and SRS/PUCCH/PUSCH transmissions across CCs in inter-band CA) is similar with FG9-3 description. Regarding the difference between R16 FG 9-3 and R15 FG 4-26, there are at least two different points as follows:  1. MSGA PUSCH transmission and SRS/PUCCH/PUSCH can't be transmitted in parallel for inter band CA if FG9-3 can't be supported.  2. MSGA PUSCH transmission with TA equal to zero is different with R15 PUSCH transmission.  3. MSGA PUSCH transmission with frequency hopping is different with R15 behavior  Regarding FG 9-4, we prefer to keep FG9-4 as single FG because FG 6-16 already addressed SUL for 4- step RACH. The difference point between FG9-4 and FG 6-16 is that MSGA PUSCH with TA equal to zero can be transmitted. In addition, UL coverage can be enhanced for MSGA in SUL. So we propose to keep FG 9-3 as single FG. |
| Huawei, HiSi | **FG 9-1**:   * Component 3c should be hopping without GP configured, per the potential separate FG 9-5; * Component 4 & 5 is not needed as not associated with any RRC configurations, which is preferable to be avoided per RAN2 LS guidance on UE features; * It is not clear to us how these current components can be fit into one FG with an yes for input of ‘Need for the gNB to know if the feature is supported’, since clearly most of the components do not need to let gNB know as it is initial access. Therefore, it might need to separate the components for RRC connected UEs as other FGs with such need, while the remaining components as basic FG do not require known by gNB.   **FG 9-3/4**: Ok to not introduce either.  **FG 9-5**: We’d like to check other UE vendors view. From previous discussion we observe comments from network vendors of not introducing this, which is understood.  **FG 9-6**: Wait for RAN2 feedback on FG 9-6 (RAN1 has sent LS for this aspect), or decide from RAN1 perspective assuming msgB could have comparable payload size as msg4 so a limit is needed, then left for RAN2 for final decision. |
| Samsung | FG 9-1:   1. RACH type selection for CBRA according to SSB-based RSRP threshold 2. msgA PRACH resource configuration including fully or partially shared ROs but different preamble sequences partitioning with 4-step RO preamble sequences configuration 🡪separately configured ROs are the same as 4step RACH in rel-15, no need mention. 3. msgA PUSCH resource (DMRS included) and waveform determination for 2-step CBRA    1. Supporting up to two msgA PUSCH configurations in an UL BWP 4. 🡪 From applying transform precoder point of view, this is same as rel-15 for PUSCH, even it is both 2step and 4step RACH configured, UE will conduct only one of the RACH at one time. So this is not needed.🡪this is mandatary feature for rel-15; Validation of MsgA PRACH and PUSCH 5. Mapping between preamble of MsgA PRACH and PUSCH occasion with DMRS resource of MsgA PUSCH 6. msgB monitoring and decoding for 2-step CBRA    1. (for UE in any RRC state) monitoring msgB PDCCH with CRC masked by msgB-RNTI in Type-1 CSS set, and decoding multi-cast msgB PDSCH carrying SuccessRAR, FallbackRAR and BI    2. (for RRC connected UE only) monitoring msgB PDCCH with CRC masked by C-RNTI in USS set, and decoding the unicast PDSCH carrying absolute TA MAC CE 7. PUCCH transmission for HARQ-ACK feedback to a msgB 8. Power control for msgA PRACH, msgA PUSCH and PUCCH carrying HARQ-ACK feedback to msgB   FG 9-3: No support.  As we commented before, the msgA PRACH is same as rel-15 PRACH, msgA PUSCH is same as rel-15 PUSCH (with the TA=0) which can be considered as PUSCHs in different CC belong to different TAG; and we did not agree the Consequence if the feature is not supported by the UE is “UE cannot transmit an MsgA and other UL transmissions in parallel across CCs in inter-band CA”, on the contray, UE can do this without needing listing such feature group;  FG 9-4: no strong view.  But if a UE support 9-1 and also 6-16, naturally should support msgA operation in SUL;  FG 9-5: ok to have;  In response to Nokia’s comments, intra-slot hopping and guardperiod after PO are supported, but doesn’t mean guard between hops are supported. Since UE only need to pick one PO to transmit, so the impact of the guard after the PO and the impact of the guard in-middle of a PO are different;  FG 9-6: Ok with HW’s suggestion. |
| Ericsson | FG 9-1:  It is not clear to us why 9-1 should be so detailed. At this stage, we seem to have identified the potential additional rows, so we know what the potential optional behavior can look like, and the remaining behavior is ‘basic’ 2-step RACH. Also, the behavior should be clear according to the specifications for when the UE is configured for 2-step RACH.  We would like to understand what would be done if we do have such a detailed description. Is the intention to write these more detailed descriptions into 38.306 or 38.331? What will e.g. RAN2 do with such a detailed definition, presuming that the needed RRC parameters are already defined?  Moreover, while we are open to considering more detailed descriptions if they can be justified, we support Alt-2 discussed at the beginning of the meeting:  Alt 2 simplified basic feature group:   1. MsgA PRACH and PUSCH transmission 2. MsgB monitoring, reception, and feedback 3. Power control for MsgA PRACH, MsgA PUSCH, and PUCCH for HARQ-ACK feedback to a MsgB   FG 9-3: OK to have.  FG 9-4: There are specific parameters for two step with SUL, and so we prefer to keep this FG.  FG 9-5: Unless there is some significant difficulty in UE implementation, support of frequency hopping with the guard period is preferable, since the more UEs that have the capability, the more system capacity benefit there will be. Therefore, our first preference is to not define this feature group. Regardless of whether an FG for frequency hopping with the guard period is defined, intra-slot frequency hopping without guard period should not be a UE capability.  FG 9-6: Not yet clear to us why the new FG would be needed, but OK to discuss further in next meeting. |