**3GPP TSG RAN WG1 #100bis-e R1-2002861**

e-Meeting, April 20th – 30th, 2020

Source: NTT DOCOMO, INC.

Title: Summary on Email discussion [100b-e-NR-UEFeatures-2Step-02]

Agenda Item: 7.2.11.1

**Document for:** **Discussion and Decision**

# **Introduction**

This contribution summarizes the following email discussion in AI 7.2.11.1 regarding UE features for 2 step RACH.

[100b-e-NR-UEFeatures-2Step-02] Email discussion/approval on Basic channel structure and procedure for two step RACH (dates TBD) – (DCM, Hiroki)

* Down select following alternatives, and discuss whether/how to change the description of components.
  + Alt 1: detailed feature group
  + Alt 2: simplified basic feature group

In the email discussion [100b-e-NR-UEFeatures-2Step-01], following agreements were made.

**Agreement:**

* FG9-1 is kept as a single FG for basic support of Rel-16 2 step RACH.
  + Components and capability signaling impacts are discussed in [100b-e-NR-UEFeatures-2Step-02]

# **9-1: Basic channel structure and procedure of 2-step RACH**

In [1], FG9-1 is captured as below.

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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 | 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   FFS: if any of the components need to be more specific, i.e. the following components in Alt. 1 can be further discussed.  [Alt 1 detailed feature group]:   1. [RACH type selection based on a SSB-based RSRP threshold] 2. [Separately configured ROs not applicable to 4-step RO configuration] 3. [Same ROs but different preamble sequences partitioning with 4-step RO preamble sequences configuration] 4. [Maximum two MsgA PUSCH configurations in an UL BWP from UE perspective] 5. [Validation of MsgA PRACH and PUSCH] 6. [Mapping between preamble of MsgA PRACH and PUSCH occasion with DMRS resource of MsgA PUSCH] 7. [MsgA PUSCH transmission including scrambling, DMRS sequences and ports, RV, etc] 8. [MsgA open loop power control] 9. [Monitoring of MsgB with PDCCH addressed to msgB-RNTI or C-RNTI, and receiving MsgB including SuccessRAR, fallbackRAR, and backoff indication] 10. [Support PUCCH transmission for HARQ-ACK feedback to a MsgB] 11. [MsgA PRACH configuration and preamble formats] 12. [PUCCH power control for HARQ-ACK feedback to a MsgB] 13. [Minimum TX gap between PRACH and PUSCH (for both TDD and FDD, FR1 and FR2, single CC and intra-band CA) as specified in Rel-15] 14. [Minimum TX gap between last DL SSB reception symbol and PRACH (TDD. FR1 and FR2, single CC and intra-band CA) as specified in Rel-15] 15. [MsgA PRACH and PUSCH transmissions in different PRACH and PUSCH slots] 16. [Minimum TX gap between the last symbol of MsgB PDSCH and the first symbol of PUCCH carrying HARQ-ACK to MsgB PDSCH] 17. [2-step RACH operation in RRC\_IDLE/INACTIVE/CONNECTED state] 18. [Intra-slot frequency hopping for MsgA PUSCH] |  | 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 |  |  | Optional with capability signalling |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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| Company | Comment |
| CATT | We suggest using more clear and simplified description on Alt 2 of the basic feature group 9-1 as below TP.  1) MSGA PRACH and PUSCH configuration and transmission  2) MSGB reception and HARQ-ACK feedback  3) Power control for MsgA PRACH, MSGA PUSCH, PUCCH for HARQ-ACK feedback to a MsgB |
| Intel | We prefer Alt. 2, i.e., simplified description of basic feature group, with the modification as follows:   1. MsgA PRACH and PUSCH configuration and transmission 2. MsgB monitoring, reception, and HARQ-ACK feedback 3. Power control for MsgA PRACH, MsgA PUSCH, and PUCCH for HARQ-ACK feedback to a MsgB |
| ZTE | We slightly prefer Alt.2. As long as the basic functionality of 2-step RACH are captured, it seems to be unnecessary to describe all the details as we will not have individual capability signaling for the components.  We are also fine with the change made by CATT and Intel. |
| Huawei, HiSi | As explained in our contribution and previous input, we prefer a simplified version with some clarifications.   1. MsgA PRACH configuration including separately configured ROs not applicable to 4-step RO configuration and fully shared ROs but different preamble sequences partitioning with 4-step RO preamble sequences configuration    1. [partially shared ROs case to be separate or not] 2. Support of maximum two msgA PUSCH configurations in an UL BWP including msgA PUSCH DMRS scrambling configuration    1. [PUSCH intra-slot frequency hopping is limited to no guard period] 3. Monitoring of MsgB with PDCCH addressed to msgB-RNTI or C-RNTI, and receiving MsgB including SuccessRAR or fallbackRAR    1. [Up to X of total MsgBs per slot per CC] 4. Power control for MsgA PRACH, MsgA PUSCH, and PUCCH for HARQ-ACK feedback to a MsgB |
| Apple | We prefer Alt1. The simplified Alt.2 is too general which can’t provide the help for implementation. At the same time, we agree some of the components in Alt1 can be removed or merged with others, such as component 7, 13, 14, 15, 18 can remove. Two new components can be included in 9-1.   * + - 1. MsgA PUSCH configuration, including transform precoder, MsgA PUSCH resource, MsgA DMSRS configuration       2. DCI format with CRC scrambled by msgB-RNTI |
| Qualcomm | We think the following components should be included in FG 9-1, to avoid ambiguity/confusion in the implementation of 2-step RACH:   1. RACH type selection for CBRA according to SSB-based RSRP threshold   [Note: RAN2 has agreed that RACH type selection is NOT up to UE implementation. Therefore, network needs to configure the threshold for RACH type selection if both 4-step and 2-step RACH are supported in the same cell.]   1. msgA PRACH resource and format determination for 2-step CBRA    1. Supporting ROs and PRACH formats separately configured for 2-step CBRA    2. Supporting ROs and PRACH formats shared with 4-step CBRA, and separately configured preamble sequences on shared RO 2. 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 3. Validation of msgA PRACH and PUSCH occasions for 2-step CBRA in TDD 4. Calculating the mapping ratio between valid PRACH resources and valid PUSCH resources (DMRS included) for 2-step CBRA 5. 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 6. Power control for msgA PRACH, msgA PUSCH and PUCCH carrying HARQ-ACK feedback to msgB |
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Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

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| [2] | ZTE, Sanechips | ***Proposal 1:***   * ***A basic feature group for 2-step RACH is defined***   + ***The basic feature group includes multiple components corresponding to the essential functions to support the 2-step RACH feature.***   + ***A high-level description of the components in the basic feature group is preferred, i.e. Alt.2 is adopted. For the details the UE follows the configurations and procedures in the specification.***   + ***1 capability bit signalling is used to indicate the supportive of the basic feature group.*** |
| [3] | Intel Corporation | **Proposal 1**   * *It is slightly preferable to consider a simplified description of basic feature group 9-1 for 2-step RACH.* * *The following needs to be modified*   + *1) MsgA PRACH and PUSCH configuration and transmission*   **Proposal 2**   * *If the simplified description of basic feature group is not agreeable, consider* ***Table 1*** *as starting point for discussion of feature groups for 2-step RACH.*   Table 1. Basic UE feature groups for 2-step RACH   |  |  |  | | --- | --- | --- | | **Index** | **Feature group** | **Components** | | 9-1a | MsgA PRACH and PUSCH configuration and transmission for 2-step RACH | 1. RACH type selection based on a SSB-based RSRP threshold 2. Separately configured ROs ~~not applicable to~~ from 4-step RO configuration 3. ~~Same~~ Shared ROs ~~but~~ with different preamble sequences partitioning with 4-step RO ~~preamble sequences~~ configuration 4. Maximum two MsgA PUSCH configurations in an UL BWP from UE perspective 5. Validation of MsgA PRACH and PUSCH 6. Mapping between preamble of MsgA PRACH and PUSCH occasion with DMRS resource of MsgA PUSCH 7. ~~MsgA PUSCH transmission including scrambling, DMRS sequences and ports, RV, etc~~ 8. MsgA PRACH configuration and preamble formats 9. Minimum TX gap between PRACH and PUSCH (for both TDD and FDD, FR1 and FR2, single CC and intra-band CA) as specified in Rel-15 10. Minimum TX gap between last DL SSB reception symbol and PRACH (TDD. FR1 and FR2, single CC and intra-band CA) as specified in Rel-15 11. MsgA PRACH and PUSCH transmissions in different PRACH and PUSCH slots 12. ~~2-step RACH operation in RRC\_IDLE/INACTIVE/CONNECTED state~~ 13. Intra-slot frequency hopping for MsgA PUSCH | | 9-1b | MsgB monitoring, reception and feedback for 2-step RACH | 1. Monitoring of MsgB with PDCCH addressed to MsgB-RNTI or C-RNTI, and receiving MsgB including SuccessRAR, fallbackRAR, and backoff indication 2. ~~Support~~ PUCCH transmission for HARQ-ACK feedback to a MsgB 3. Minimum TX gap between the last symbol of MsgB PDSCH and the first symbol of PUCCH carrying HARQ-ACK to MsgB PDSCH | | 9-1c | Power control for MsgA and PUCCH for HARQ-ACK feedback to a MsgB for 2-step RACH | 1. MsgA ~~open loop~~ power control 2. PUCCH power control for HARQ-ACK feedback to a MsgB | |
| [4] | CATT | **Proposal 1: We suggest using more clear description on Alt 2 of the basic feature group 9-1 as below TP.**  ----------------------------------------Start of TP for R1-2001484---------------------------------------------------  9-1 Basic channel structure and procedure of 2-step RACH， Alt2 description for components item  1) MSGA PRACH and PUSCH configuration and transmission  2) MSGB reception and HARQ-ACK feedback  3) Power control for MsgA PRACH, MSGA PUSCH, PUCCH for HARQ-ACK feedback to a MsgB  ---------------------------------------End of TP for R1-2001484------------------------------------------------------- |
| [5] | Samsung | ***Proposal 1: For FG 9-1, Alt.1 should be supported and further reduction on the list is needed.***  ***Proposal 2: Adopt the revised UE feature group in the appendix by removing item 2),7),8),12),13),14),15),16),18) in FG9-1 for 2step RACH Rel-16 and modify the 11) to be “***MsgA PRACH configuration ***”***.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 based on a SSB-based RSRP threshold] 2. [Same ROs but different preamble sequences partitioning with 4-step RO preamble sequences configuration] 3. [Maximum two MsgA PUSCH configurations in an UL BWP from UE perspective] 4. [Validation of MsgA PRACH and PUSCH] 5. [Mapping between preamble of MsgA PRACH and PUSCH occasion with DMRS resource of MsgA PUSCH] 6. [Monitoring of MsgB with PDCCH addressed to msgB-RNTI or C-RNTI, and receiving MsgB including SuccessRAR, fallbackRAR, and backoff indication] 7. [Support PUCCH transmission for HARQ-ACK feedback to a MsgB] 8. [MsgA PRACH configuration] 9. [2-step RACH operation in RRC\_IDLE/INACTIVE/CONNECTED state] |  | 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 |  |  | Optional with capability signalling | | 9-2 | Supported 2 symbols DMRS for msgA PUSCH | Supported 2 symbols DMRS for msgA PUSCH (‘len2’) | 9-1, 2-18 | Yes | N/A | If UE does not support ‘len2’, and if msgA-maxLength is configured as ‘len2’, the UE cannot use 2-step RACH resources | per UE | No | Yes |  | Shall be aligned with 2-18 | Conditionallymandatory for UE supporting both 9-1 and 2-18 | | 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 | Yes | N/A | UE cannot transmit an MsgA and other UL transmissions in parallel across CCs in inter-band CA | per band combination | N/A | N/A |  |  | Optional with capability signalling | | 9-4 | MsgA operation in a band combination including SUL | MsgA operations in a band combination including SUL | 9-1, 6-16 | Yes | N/A | UE does not support msgA operations in a band combination including SUL | per band combination | N/A | N/A |  |  | Optional with capability signalling | |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| [6] | Apple Inc. | **Proposal 1: Components of Alt 1 are adopted by FG 9-1.**  **Proposal 2: Remove the component 7, 13, 14, 15, 18, adding two new components for FG9-1 as following,**   1. **MsgA PUSCH configuration including transform precoder, MsgA PUSCH resource, MsgA DMSRS configuration** 2. **DCI format with CRC scrambled by msgB-RNTI** |
| [7] | Ericsson | [***Observation 1 Alt-1 components require further clarification, including how they differ from Rel-15 behavior.***](#_Toc37454040)  [***Proposal 1 Update two step RACH basic UE capability 9-1 to be terse and to clarify MsgB feedback as proposed in Table 1.***](#_Toc37454042)  Table 1: Proposed updates for UE features related two step RACH.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | Alt 2 simplified basic feature group:   1. MsgA PRACH and PUSCH transmission 2. MsgB monitoring, reception, and HARQ-ACK feedback 3. Power control for MsgA PRACH, MsgA PUSCH, and PUCCH for HARQ-ACK feedback to a MsgB   ~~FFS: if any of the components need to be more specific, i.e. the following components in Alt. 1 can be further discussed.~~  ~~[Alt 1 detailed feature group]:~~   1. ~~[RACH type selection based on a SSB-based RSRP threshold]~~ 2. ~~[Separately configured ROs not applicable to 4-step RO configuration]~~ 3. ~~[Same ROs but different preamble sequences partitioning with 4-step RO preamble sequences configuration]~~ 4. ~~[Maximum two MsgA PUSCH configurations in an UL BWP from UE perspective]~~ 5. ~~[Validation of MsgA PRACH and PUSCH]~~ 6. ~~[Mapping between preamble of MsgA PRACH and PUSCH occasion with DMRS resource of MsgA PUSCH]~~ 7. ~~[MsgA PUSCH transmission including scrambling, DMRS sequences and ports, RV, etc]~~ 8. ~~[MsgA open loop power control]~~ 9. ~~[Monitoring of MsgB with PDCCH addressed to msgB-RNTI or C-RNTI, and receiving MsgB including SuccessRAR, fallbackRAR, and backoff indication]~~ 10. ~~[Support PUCCH transmission for HARQ-ACK feedback to a MsgB]~~ 11. ~~[MsgA PRACH configuration and preamble formats]~~ 12. ~~[PUCCH power control for HARQ-ACK feedback to a MsgB]~~ 13. ~~[Minimum TX gap between PRACH and PUSCH (for both TDD and FDD, FR1 and FR2, single CC and intra-band CA) as specified in Rel-15]~~ 14. ~~[Minimum TX gap between last DL SSB reception symbol and PRACH (TDD. FR1 and FR2, single CC and intra-band CA) as specified in Rel-15]~~ 15. ~~[MsgA PRACH and PUSCH transmissions in different PRACH and PUSCH slots]~~ 16. ~~[Minimum TX gap between the last symbol of MsgB PDSCH and the first symbol of PUCCH carrying HARQ-ACK to MsgB PDSCH]~~ 17. ~~[2-step RACH operation in RRC\_IDLE/INACTIVE/CONNECTED state]~~ 18. ~~[Intra-slot frequency hopping for MsgA PUSCH]~~ |  | 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 |  |  | Optional with capability signalling | | 9-2 | Supported 2 symbols DMRS for msgA PUSCH | Supported 2 symbols DMRS for msgA PUSCH (‘len2’) | 9-1, 2-18 | Yes | N/A | If UE does not support ‘len2’, and if msgA-maxLength is configured as ‘len2’, the UE cannot use 2-step RACH resources | per UE | N/A | Yes |  | Shall be aligned with 2-18 | Conditionallymandatory for UE supporting both 9-1 and 2-18 | | 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 | Yes | N/A | UE cannot transmit an MsgA and other UL transmissions in parallel across CCs in inter-band CA | per band combination | N/A | N/A |  |  | Optional with capability signalling | | 9-4 | MsgA operation in a band combination including SUL | MsgA operations in a band combination including SUL | 9-1, 6-16 | Yes | N/A | UE does not support msgA operations in a band combination including SUL | per band combination | N/A | N/A |  |  | Optional with capability signalling | |
| [8] | Qualcomm Incorporated | UE feature group 9-1   * Alt 2 is not acceptable in its current form, since it is an over-simplification and leads to potential ambiguity/confusion for UE implementation. * Alt 1 requires the following changes:   + Item 11: Need to be more specific in msgA PRACH configuration and formats by capturing the following details:     - the new PRACH configuration indexes introduced in Rel-16 are used for NR licensed UE only     - UE without shared spectrum channel access supports PRACH formats with LRA=139 or 839 only     - UE with shared spectrum channel access supports PRACH formats with LRA=139, 571 or 1171 only     - the PRACH format, starting PRB and FDM pattern of msgA PRACH is configured separately on dedicated RO   + Item 12: Including implementation details for the transmission of HARQ feedback (including ACK and NACK) on PUCCH   + Item 16: changing ACK to “feedback”   + Item 18: adding the condition to support intra-slot frequency hopping   + Item 19: adding the waveform support for CP-OFDM and DFT-s-OFDM waveform   + Item 20: adding the details for the DMRS type supported in msgA PUSCH transmission   + Item 21: adding the details for msgA PUSCH numerology in FR1 (15 or 30 kHz) and FR2 (60 or 120 kHz) |
|  | Huawei, HiSi | Suggest not spend time on proposals to adopt alt 1 or alt 2, while just clarify what is needed for FG 9-1. Basically the components shall be motivated by different implementation from Rel-15 and  shall associate with RRC per RAN2 LS guidance.  We think the following can be starting point:   * + 1 capability bit signalling is used to indicate the supportive of the feature group 9-1 for CBRA, which including the following:     - * MsgA PRACH configuration including separately configured ROs not applicable to 4-step RO configuration and   Fully shared ROs but different preamble sequences partitioning with 4-step RO preamble sequences configuration  **FFS**: partially shared ROs case to be separate or not   * + - * Support of maximum two msgA PUSCH configurations in an UL BWP including msgA PUSCH DMRS scrambling configuration       * Monitoring of MsgB with PDCCH addressed to msgB-RNTI or C-RNTI, and receiving MsgB including SuccessRAR, fallbackRAR       * Support PUCCH transmission for HARQ-ACK feedback to a MsgB       * Power control for msgA, and PUCCH carrying HARQ-ACK for msgB   The following is not needed as not associated with RRC, hence network does not need to know:   * RACH type selection based on a SSB-based RSRP threshold * Validation of MsgA PRACH and PUSCH * [Mapping between preamble of MsgA PRACH and PUSCH occasion with DMRS resource of MsgA PUSCH]   The following is not needed as no difference from Rel-15   * [Minimum TX gap between last DL SSB reception symbol and PRACH (TDD. FR1 and FR2, single CC and intra-band CA) as specified in Rel-15] * [MsgA PRACH and PUSCH transmissions in different PRACH and PUSCH slots] * [Minimum TX gap between the last symbol of MsgB PDSCH and the first symbol of PUCCH carrying HARQ-ACK to MsgB PDSCH]   The following shall be separate UE capability:   * Intra-slot frequency hopping for MsgA PUSCH [when non-zero guard period is configured] |
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During the email discussion [100b-e-NR-UEFeatures-2Step-01], following inputs including preference between Alt.1 and Alt.2 were provided.

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| Company | Comment |
| Samsung | Support |
| CATT | Prefer to FG9-1 as single FG. Proposed TP is as follows:  1) MSGA PRACH and PUSCH configuration and transmission  2) MSGB reception and HARQ-ACK feedback  3) Power control for MsgA PRACH, MSGA PUSCH, PUCCH for HARQ-ACK feedback to a MsgB |
| ZTE | Support |
| Intel | We prefer 9-1 as a single FG of simplified description of FG 9-1 is agreed. The simplified FG 9-1 can be modified as follows:   1. MsgA PRACH and PUSCH configuration and transmission 2. MsgB monitoring, reception, and HARQ-ACK feedback 3. Power control for MsgA PRACH, MsgA PUSCH, and PUCCH for HARQ-ACK feedback to a MsgB   If the above is not agreeable, consider multiple sub-FGs to make it more organized. |
| Nokia, Nokia Shanghai Bell | Support |
| Qualcomm | FG 9-1 should be kept as a single FG, which includes the basic UE capabilities to support Rel-16 two-step CBRA.  SSB-based two-step CFRA, if supported, should be kept in a FG (for optional UE capability) separate from 9-1. |
| Moderator | We could observe that majority prefers FG9-1 as a single FG.  Although I originally planned whether Alt.1(detailed) or Alt.2(simplified) will be discussed in other email discussion as medium priority, it should be clarified that which feature should be a separate FG in addition to FG9-1/2/3/4 since it impacts features list structure i.e., it is high priority discussion.  Therefore, companies are encouraged to provide possible separate FG(s) such as SSB-based two-step CFRA as Qualcomm mentioned. I’m a bit confused by Intel’s proposal since proposed FG9-1 in their comment and proposed sub-FGs in their contribution seems contradicting. So further clarification will be appreciated.  Also, it is good if we can decide to go to Alt.2 for FG9-1 here. |
| Huawei, HiSi | Suggest not spend time on proposals to adopt alt 1 or alt 2, while just clarify what is needed for FG 9-1. Basically the components shall be motivated by different implementation from Rel-15 and  shall associate with RRC per RAN2 LS guidance.  We think the following can be starting point:   * + 1 capability bit signalling is used to indicate the supportive of the feature group 9-1 for CBRA, which including the following:     - * MsgA PRACH configuration including separately configured ROs not applicable to 4-step RO configuration and   Fully shared ROs but different preamble sequences partitioning with 4-step RO preamble sequences configuration  **FFS**: partially shared ROs case to be separate or not   * + - * Support of maximum two msgA PUSCH configurations in an UL BWP including msgA PUSCH DMRS scrambling configuration       * Monitoring of MsgB with PDCCH addressed to msgB-RNTI or C-RNTI, and receiving MsgB including SuccessRAR, fallbackRAR       * Support PUCCH transmission for HARQ-ACK feedback to a MsgB       * Power control for msgA, and PUCCH carrying HARQ-ACK for msgB   The following is not needed as not associated with RRC, hence network does not need to know:   * RACH type selection based on a SSB-based RSRP threshold * Validation of MsgA PRACH and PUSCH * [Mapping between preamble of MsgA PRACH and PUSCH occasion with DMRS resource of MsgA PUSCH]   The following is not needed as no difference from Rel-15   * [Minimum TX gap between last DL SSB reception symbol and PRACH (TDD. FR1 and FR2, single CC and intra-band CA) as specified in Rel-15] * [MsgA PRACH and PUSCH transmissions in different PRACH and PUSCH slots] * [Minimum TX gap between the last symbol of MsgB PDSCH and the first symbol of PUCCH carrying HARQ-ACK to MsgB PDSCH]   The following shall be separate UE capability:   * Intra-slot frequency hopping for MsgA PUSCH [when non-zero guard period is configured] |
| vivo | FG9-1 is kept as single FG. 1-bit for capability signaling for 2-step RA is enough.  We prefer simplified structure for FG 9-1, though it may not within the scope of this email thread. |
| Apple | We support FG9-1 as a single FG, and Alt 1 detailed feature group is preferred. |
| Ericsson | Support, based on the simpler alternative (Alt 2). |

# **Conclusion**

TBD

# **References**

[1] R1-2001484 RAN1 UE features list for Rel-16 NR after RAN1#100-E Moderator (AT&T, NTT DOCOMO, INC.)

[2] R1-2001714 Discussion on the UE features for two-step RACH ZTE, Sanechips

[3] R1-2002015 Discussion on UE features for two-step RACH Intel Corporation

[4] R1-2002068 Discussion of NR Rel-16 UE features for two-step RACH CATT

[5] R1-2002150 UE features for two-step RACH Samsung

[6] R1-2002349 Views on NR 2-step RACH UE feature Apple

[7] R1-2002372 UE Features for Two-Step RACH Ericsson

[8] R1-2002562 Discussion on two step RACH UE features Qualcomm Incorporated

[9] R1-2002588 Rel-16 UE features for 2-step RACH Huawei, HiSilicon

[10] R1-2002860 Summary on Email discussion [100b-e-NR-UEFeatures-2Step-01] Moderator (NTT DOCOMO, INC.)