**3GPP TSG RAN WG1 #100bis-e R1-2002453**

e-Meeting, April 20th – 30th, 2020

Source: NTT DOCOMO, INC.

Title: Summary on UE features for two-step RACH

Agenda Item: 7.2.11.1

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

# **Introduction**

This contribution summarizes the discussions and proposals in AI 7.2.11.1 regarding UE features for two-step RACH.

In R1-2001484 [1] which is the version after [100e-NR-Rel-16-UEFeatures] email discussion, there are following feature groups for two step RACH.

* 9-1 Basic channel structure and procedure of 2-step RACH
* 9-2 Supported 2 symbols DMRS for msgA PUSCH
* 9-3 PDSCH Type B mapping of length 9 and 10 OFDM symbols
* 9-4 MsgA operation in a band combination including SUL

Based on the discussions summarized in Section 2-6, following is the suggested list of issues to be discussed and priority order considering RAN2 impact especially for capability signaling design.

**FL proposal of list of issues/proposals and priority:**

**1st priority issues (such as a certain FG is necessary or not):**

* **9-1**
  + **Whether to define basic UE features as one FG, i.e., only 9-1, or as multiple FGs, e.g., 9-1a, 9-1b and 9-1c.**
* **New FG(s)**
  + **Whether or not to add following new feature groups.**
    - **60 kHz SCS for msgA PUSCH as an optional UE feature in FR1**
    - **PUSCH transmission with frequency hopping**
    - **max number msgB to be monitored/decoded per slot**

**2nd priority issues (such as components, type and xDD/FRx differentiation that have capability signaling impacts):**

* **9-1**
  + **Down select following alternatives, and whether/how to change the description of components.**
    - **Alt 1 detailed feature group**
    - **Alt 2 simplified basic feature group**
* **Confirm FG9-2, 9-3 and 9-4 with no update.**

Companies are encouraged to check above FL proposals and to provide feedback if any in below.

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | We do not think there is a need to discuss multiple basic FGs. Based on the proposal from [3], the purpose of introducing multiple basic FG is just to break down the number of detailed components in one FG, with no intention to introduce multiple capability bits for each of the basic FG. Therefore, we think one basic FG with 1-bit signalling is enough. |
| Ericsson | We also wonder why multiple basic FGs need to be discussed. The FL proposal is otherwise OK in our view. |
| CATT | We have the same view on multiple basic FGs with ZTE and Ericsson and 1 basic FG is enough. So we suggest removing multiple basic FGs related item in 1st priority issue list.  We are fine for other proposed discussion topics. |
| Samsung | For 1st priority issues, our view is that only one 9-1 is needed, and for the “new FG”, we don’t think they are worth spending too much time:   60 kHz SCS for msgA PUSCH as an optional UE feature in FR1🡪 *60khz for FR1 is anyway optional, depends on gNB configuration*;   PUSCH transmission with frequency hopping🡪 *inter/intra slot frequency hopping is anyway decided for UE features*;   Max number msgB to be monitored/decoded per slot🡪*PDCCH candidate is already UE capability in rel-15*, no need to mention here again.  So we think we should spend the limited time for 2nd priority issues, which is reducing the list. |
| Qualcomm | * We think a single basic FG should be adequate, which can be a simplified version of Alt 1 in R1-2001484. * We do not understand why “PDSCH Type B mapping of length 9 and 10 OFDM symbols” shows up in FG 9-3 of the Introduction. It is not consistent with the description for FG 9-3 in R1-2001484. * FG 9-4 was not discussed in RAN1. It could be removed and treated as a capability of general support for SUL. |
| Nokia, Nokia Shanghai Bell | We agree with the views above that there is no need to break 9-1 into multiple FGs, a single basic FG is enough. As for the FGs 9-3 and 9-4 we agree with Qualcomm. |
| vivo | We think one basic FG is enough.  As for the FGs 9-3 and 9-4 we share the same view with Qualcomm. |

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

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |
| --- | --- | --- |
| [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,**   * **MsgA PUSCH configuration including transform precoder, MsgA PUSCH resource, MsgA DMSRS configuration** * **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) |

**Based on above, following points should be discussed for FG9-1.**

* **Whether to define basic UE features as one FG, i.e., only 9-1, or as multiple FGs, e.g., 9-1a, 9-1b and 9-1c.**
* **Down select following alternatives, and whether/how to change the description of components.**
  + **Alt 1 detailed feature group**
  + **Alt 2 simplified basic feature group**

# **9-2: Supported 2 symbols DMRS for msgA PUSCH**

In [1], FG9-2 is captured with bracket as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | 9-2 | 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 |

No feedback is provided in contributions for the RAN1#100bis-e meeting.

# **9-3: PDSCH Type B mapping of length 9 and 10 OFDM symbols**

In [1], FG9-3 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | 9-3 | 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 |

No feedback is provided in contributions for the RAN1#100bis-e meeting.

# **9-4: MsgA operation in a band combination including SUL**

In [1], FG9-4 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | 9-4 | 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 |

No feedback is provided in contributions for the RAN1#100bis-e meeting.

# **New feature group proposal**

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |
| --- | --- | --- |
| [4] | CATT | **Proposal 2: we prefer to removing 9-5 item from 2-step RACH feature list** |
| [8] | Qualcomm Incorporated | UE feature group 9-5   * Adding 60 kHz SCS for msgA PUSCH as an optional UE feature in FR1 |
| [9] | Huawei, HiSilicon | * For msgA transmission: Set separate UE capability for PUSCH transmission with frequency hopping; * For msgB reception: Define max number msgB to be monitored/decoded per slot. |

**Based on above, following points should be discussed for new feature group proposal.**

* **Whether or not to add following new feature groups.**
  + **60 kHz SCS for msgA PUSCH as an optional UE feature in FR1**
  + **PUSCH transmission with frequency hopping**
  + **max number msgB to be monitored/decoded per slot**

# **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