**3GPP TSG-RAN2 Meeting 109b-e R2-2003960**

**Electronic, 20 April – 30 April 2020**

**Source: Rapporteur (ZTE)**

**Title: UP Tdoc summary for 2-step RACH**

**Agenda item:** **6.13.2**

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

# Introduction

This document is used to gather comments on tdocs related to open issues for UP as noted below:

* [Pre 109bis-e][503][2s RA] UP Open Issues (ZTE)

Scope:

* + - Identify/Summarize all remaining/identified UP issues

Intended outcome:

* + - Set of proposals to agree by email
    - CR capturing agreements from week1 and then week2

Deadline for providing comments:

* + - Companies input: April 21st (10:00 am CET)
    - Rapporteur proposals: April 22nd to be discussed in week1 discussion.
    - CR capturing agreements: April 27th

# Measurement gap

It was suggested that the UE can take into account whether there is a possible occurrence of measurement gaps at the time of the associated PUSCH occasion when determining the next available PRACH occasion ([2], [7]).

During the previous discussion, it was the understanding that once the RACH preamble is transmitted, the UE shall transmit the MSGA payload regardless of the measurement gap. This is aligned with the legacy behaviour where the UE will monitor for RAR and transmit msg3 regardless of the measurement gap. So, it seems we should be aligned with this general framework. The MAC spec currently is according to this assumption. See for instance:

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| 5.14 Handling of measurement gaps During a measurement gap, the MAC entity shall, on the Serving Cell(s) in the corresponding frequency range of the measurement gap configured by *measGapConfig* as specified in TS 38.331 [5]:  1> not perform the transmission of HARQ feedback, SR, and CSI;  1> not report SRS;  1> not transmit on UL-SCH except for Msg3 or the MSGA payload as specified in clause 5.4.2.2; |

Further, it should also be noted that the PUSCH occasion is determined by the UE after selecting the RACH occasion and determining the preamble. i.e. the PUSCH occasion is associated with the selected RACH occasion and the preamble. So, the UE can only determine the possible overlap between the measurement gap and PO after selecting the RO first and determining the preamble. So, from the modelling within MAC, it seems it is sufficient to say that the UE is allowed to take into account the measurement gaps at the time of selecting RO.

Based on the above, companies are encouraged to answer the following questions:

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| **Q 2.1: Do you agree with the general principle that once the UE transmits the PRACH preamble then it shall transmit the associated PUSCH regardless of occurrence of measurement gaps?** | | |
| **Company** | **Yes/No** | **Comment** |
| ZTE | Yes | Inline with the legacy principle our understanding is that the UE should not drop the PUSCH transmission due to measurement gap. So, any consideration about measurement gaps can be taken into account prior to the selection of the RO, but once RO is selected, the UE shall proceed with Preamble and PUSCH transmission without any further consideration on the measurement gaps (same as msg3 for 4-step RACH). |
| LG | Yes |  |
| Samsung | Yes |  |
| Nokia | Yes | We think that the measurement gap can be taken into account already by the existing text where the RO is selected. |
| CATT | Yes | Agree with ZTE. |
| Huawei | Yes |  |
| Intel | Yes |  |
| OPPO | Yes |  |
| Qualcomm | Yes | The legacy principle can be reused here. UE should consider the measurement gaps when determine the next PO. Once msgA is transmitted, the PUSCH transmission has higher priority than measurement gap. |
| Lenovo | Yes |  |
| Ericsson | Yes |  |
| SONY | Yes | Agree with ZTE |
| Fujitsu | Yes |  |
| MediaTek | Yes |  |

All companies agree to following principle:

**Proposal 1: Once the UE transmits PRACH preamble then it shall transmit the associated PUSCH regardless of the occurrence of measurement gap**

According to the legacy 4-step RACH procedure, when the UE determines the next available PRACH occasion, the UE is allowed to select a preamble which is outside the measurement gap, as quoted and highlighted below. This means that when the immediate next preamble is within the measurement gap, the UE is allowed to select another one which is outside the measurement gap. Then RAN2 is requested to discuss whether the UE is allowed to select a preamble for which the transmission of both the preamble and the PUSCH of the MSGA is not collided with the measurement gap. This means that when the immediate next PRACH of the MSGA is within the measurement gap, the UE is allowed to jump over and select another preamble to avoid the transmission collision of the “preamble + PUSCH” of the MSGA and the measurement gap. According to [2] [7], it seems that the current MAC specification only allows the UE to consider the collision between the PRACH occasion and the measurement gap, not the collision between the PRACH+PUSCH occasion and the measurement gap.

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| determine the next available PRACH occasion from the PRACH occasions, permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, corresponding to the SSB in *candidateBeamRSList* which is quasi-colocated with the selected CSI-RS as specified in TS 38.214 [7] (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to clause 8.1 of TS 38.213 [6], corresponding to the SSB which is quasi-colocated with the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the SSB which is quasi-colocated with the selected CSI-RS). |

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| **Q 2.x: Do you agree with the general principle that when the UE determines the next available preamble, the UE is allowed to select a preamble for which the transmission of MSGA including both preamble and PUSCH is not collided with the measurement gap?** | | |
| **Company** | **Yes/No** | **Comment** |
| vivo | Yes | The same principle of 4-step RACH should be reused. The benefit is to avoid the collision between the MSGA and the measurement gap. The text pointed by ZTE is how the UE should behave when the collision between the MSGA and the measurement gap occurs. Q 2.1 are not related to Q 2.x. |
| ZTE | No need to specify | Of course, it is possible in some scenarios that the UE happens to select a preamble for which the transmission of MSGA including both preamble and PUSCH is not collided with the MG. However, it is important to note that the UE is also allowed to select a preamble for which the transmission of PUSCH is collided with the MG (e.g. if the UE does not want to wait for another PRACH period). The current implementation in MAC allows enough flexibility on UE implementation to take the MG into account. We don’t think there is any need to specify further details about the UE implementation. |
| Intel | No | We think the current implementation provides sufficient flexibility for the UE |
| OPPO | No need to specify | We agree the principle that “**UE is allowed to select a preamble for which the transmission of MSGA including both preamble and PUSCH is not collided with the measurement gap**”. However, we think the current spec already allows this principle. In our understanding, the spec quoted using “may” actually means it’s UE implementation to consider MG or not. If UE does not consider MG when selecting RO of MSGA, then RO and/or associated PUSCH may be overlapped with MG, in this case, UE is still allowed to tranmit. Thus, we think the current spec is enough, and no change is needed. |
| Lenovo | No | Agree with Intel, that there is no need to further go beyond what is already currently allowed for UE implementations. |
| Ericsson | No |  |
| SONY | No | Agree with ZTE |
| Fujitsu | No | Given the UE is allowed or not allowed to consider the MG to select RO and PO, we don't think it’s necessary to announce either possible operation in spec, because we don't need to specify every implementation of UE. |
| MediaTek | No |  |

1 company (Vivo) thinks that we should specify that the UE is allowed to select a preamble for which the transmission of MSGA including both preamble and PUSCH is does not collide with measurement gap (i.e. neither the preamble nor the PUSCH overlap with MG).

Other companies point out that there is nothing to specify for this (the reason given was to allow the flexibility to the UE implementation – specifically, to not preclude the case where a UE selects MSGA such that the PUSCH overlaps with MG).

So, it can be noted that both the following scenarios are possible:

**Observation 1:**

**Both the following scenarios are possible:**

* **UE transmits MSGA where the associated PUSCH doesn’t overlap with MG**
* **UE transmits MSGA such that PUSCH overlaps with MG (i.e. in this case PUSCH has higher priority)**

**(note: no spec updates are needed for the above)**

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| **Q 2.2: Considering the answer to the above, is there any further change needed in MAC? Specifically, do you think we should explicitly say that the UE is allowed to take into account the measurement gaps at the time of the associated PUSCH occasion when determining the next available PRACH occasion?**  **Note: If your answer is yes, please clarify how to model this. i.e. how to specify this, considering that the UE knows the PO only after selecting the RO and the preamble.**  **Note 2: Companies are also welcome to comment on the current specification and whether it needs any updates to follow the agreements as noted in [2], [7]. Also clarify in the comment if you think the UE should be allowed to select another preamble when only MSGA PUSCH overlaps with MG.** | | |
| **Company** | **Yes/No** | **Comment (clarify how to model this in MAC if your answer is yes)** |
| ZTE | No | We think the current modelling is sufficient. |
| LG | No | The current MAC spec (i.e., *MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB.*)is clear enough. In addition, it is up to UE implementation to decide details on this. |
| Samsung |  | No strong view |
| vivo | Yes | According to [2] [4], the current MAC specification seems only allowing the UE to consider the collision between the PRACH occasion and the measurement gap, not the collision between the PRACH+PUSCH occasion and the measurement gap. |
| Nokia | No |  |
| CATT | No |  |
| Intel | No |  |
| OPPO | No | Current spec is fine. |
| Qualcomm | No | No need to change. |
| Lenovo | No |  |
| Ericsson | No |  |
| SONY | No |  |
| Fujitsu | No |  |
| MediaTek | No |  |

Apart from one company, all others said that there are no further changes needed in MAC.

**Proposal 2: No changes are made to the MAC spec for the issue related to the MSGA PUSCH resources overlapping with measurement gap above issue.**

# Unsupported PUSCH configuration

It was explained in [2] that certain configuration aspects of the PUSCH (e.g. DMRS configuration) may be subject to UE capability (i.e. not all UEs may support this optional capability).

Note that there can be different PUSCH configurations (e.g. associated with preamble group A and group B). So, it is possible that one or both these configurations may be such that the UE may not support it.

The question is what the UE behaviour shall be in case the PUSCH configuration cannot be supported by the UE.

The rapporteur notes that RAN1 had made a preliminary agreement in this case:

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| * Regarding the parameter msgA-maxLength   + Keep the agreement for *msgA-maxLength,* if UE does not support ‘len2’, and if *msgA-maxLength* is configured as ‘len2’, the UE cannot use 2-step RACH resources.   + Note: it is UE capability issue, no spec impact |

Based on the above, it seems RAN1 intention is that if the UE doesn’t support the PUSCH configuration, then the UE simply selects 4-step RA.

Other options are (as noted in [2]):

* PUCH configuration associated with preamble group A never uses the optional UE features (i.e. a network restriction is needed) and if preamble group B configuration is not supported the UE shall use fallback
* UE doesn’t select group B in this case (however this option is a bit unclear as the msgA payload size is in some cases determined by upper layers – e.g. NAS and/or is dependent on some other configuration parameters in SI etc).

So, in summary the options are:

* **Option 1**: If UE doesn’t support any of the associated PUSCH configurations (either for group A or group B), then the UE simply selects 4-step RACH as per RAN1 agreement
* **Option 2**: PUCH configuration associated with preamble group A never uses the optional UE features (i.e. a network restriction is needed) and if PUSCH configuration for preamble group B is not supported the UE shall use fallback (needs a network restriction and UE behaviour to be specified)
* **Option 3**: PUCH configuration associated with preamble group A never uses the optional UE features (i.e. a network restriction is needed) and if PUSCH configuration for preamble group B is not supported the UE doesn’t select group B
  + However, this option is a bit unclear as the msgA payload size is in some cases determined by upper layers – e.g. NAS (for CCCH) and/or is dependent on some other configuration parameters in SI (e.g. *useFullResumeID*) etc.

**Option 4**: No change in the preamble selection and the RACH type selection. When the PUSCH associated to the preamble selected by the UE is not supported by the UE, the PUSCH is not transmitted.

**Option 5**: The UE does not select the preamble associated to the PUSCH not supported by the UE.

The rapporteur feels that option 1 is sufficient. But, companies are encouraged to express their views on this:

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| **Q 3.0: Which option do you prefer from the above? Explain your choice in the comments** | | |  |
| **Company** | **Option** | **Comment (why)** | **Rapporteur summary** |
| ZTE | Option 1 | Seems RAN1 agreement can be adopted for this case (we can basically extend it to the scenario where multiple PUSCH configurations exist with different configuration). There is no need to optimize this further as other options seem to result in further restrictions/complexity. | Option 1:   * This impacts RACH type selection * Optional features for PUSCH can only be used on a 2-step-only BWP if the UE supports it (clarified below) |
| LG | None | Nothing to be specified.  In our understanding, PUSCH configurations on initial BWP use UE mandatory features and PUSCH configurations on non-initial BWP can use UE optional features. If a non-initial BWP uses the optional feature, but UE doesn’t support the feature, network doesn’t send 2-step RA type configuration information for the BWP to the UE. | Nothing specified but the following is assumed (but not specified):   * Network only configures optional features on BWP using dedicated signalling |
| Samsung | Option 1 |  |  |
| Vivo | Option 2 or 3 or 4 or 5 | Firstly we would like to clarify that the RAN1 agreement is only saying to “not use 2-step RACH resource” which is not supported by the UE. Then the 2-step RACH resource supported by the UE can still be selected. If companies have different understandings, we could send an LS to RAN1 for further clarification.  Option 1 may not work for the case that a BWP is only configured with 2-step RACH.  ZTE: If we go with option 1, we don’t think the network will use such configuration on a 2-step only BWP anyway (For the BWP with 2-step RACH which is used for UE in CONNECTED mode, UE capability can be taken into account). | Other options: |
| Nokia | None | Such a configuration would unlikely be given for IDLE/INACTIVE UEs of which capabilities the NW does not have, hence, it seems like more a network error. So we agree with LG understanding.  Furthermore, we think that optionality for features related to RACH are not quite useful given RACH is used by all the UEs in IDLE/INACTIVE/CONNECTED modes. | Same view as LG |
| CATT | Option 1 | Network has the flexibility of PUSCH configurations. If UE does not support the configured msgA resource it uses 4step instead.  But does this require any change to the ran2 spec? | CATT think no changes needed with option 1, but rapporteur understanding is that option 1 needs some changes (in initial RACH type selection):   * i.e. to say if UE doesn’t support the PUSCH configuration in the BWP, it selects the RA\_TYPE as 4-stepRA. |
| Huawei | Option 1/4 | It is not clear to us why the configuration in the initial BWP has to be mandatory feature in this case. In the discussion in R15, this is true because if the configuration is not supported, the UE has no fallback solution. But here, since RAN1 has specifically agreed that when 2-step RACH is configured and UE does not support a certain PUSCH configuration, the UE uses 4-step RACH.  We wonder what is the difference between Option1 and 4. What specification change does it have for Option1?  From our understanding the current spec does not need any change. If the UE want to select PUSCH and the PUSCH turns out to be invalid (specified in the RAN1 spec) the UE anyway sends the PRACH without PUSCH. | The difference between option 1 and option 4 is that option 1 will exclude 2-step RA type at the initial RA type selection itself. Option 4, will choose 2-step RA but relies on fallback. |
| Intel | Option 1 | We prefer Option 1 as it has the least impact to the 2-step RA procedure. |  |
| OPPO | Option1 | This is a configuration issue from Network side. Network should not configure the resources beyond UE mandatory features before UE capabilities are exchanged. Changes in RA type selection or preamble group selection as in Option2 to Option5 are undesirable | Prefer Option 1 (but it seems the assumption is that there are no changes to RA type selection), this may be wrong assumption ?? see above… |
| Qualcomm | None | We believe it is a rare case. It can be left to UE implementation to resolve, i.e. not transmit the PUSCH if UE has capability limitation. We don’t think the spec change is needed. | Same as LG |
| Lenovo | Option 1 |  |  |
| Ericsson | None | Agree w Nokia and LG | Same as LG |
| Sony | Option 1 |  |  |
| Fujitsu | Option 1 | Option 1 and option 2 just result in the same effect that UE applies 4step random access (fallback is 4step) instead of 2step given the UE cannot support the PUSCH configuration of group B. For simple and aligning with RAN1, we can adopt option 1. | Prefer option 1, but to rapporteur the comment is a bit unclear since Fujitsu think fallback is 4-step (this is not the case – in option 1 the initial RA type is set to 4-step). |
| MediaTek | None | Agree with Nokia and Qualcomm |  |

9/15 companies said Option 1 is preferable. One of these companies think option 4 is also okay. However, some of these companies (at least 3, may be more) seem to wrongly assume that option 1 will not require any changes (rapporteur understanding is that option 1 need changes to RA type selection – i.e. UE selects RA type as 4-step RA if it doesn’t support PUSCH configuration etc).

5 companies think that nothing needs to be specified (but this is with the following assumptions):

* Network only configures optional features for PUSCH configuration on a dedicated BWP and only for UEs that support these optional features

1 company thinks other options (such as relying on fallback etc) need to be considered

**Proposal 3: Agree one of the following:**

**Option 1: If UE doesn’t support any of the associated PUSCH configurations (either for group A or group B), then the UE selects 4-step RA Type (initial RA type selection needs to be changed accordingly in MAC).**

**Option 2: Nothing is specified (assumption being the network only uses the optional PUSCH configuration features on dedicated BWPs and only for UEs that support these features) – no change to specification needed (may need to inform RAN1 about this conclusion)**

# Issues related to MSGA preamble without associated valid PUSCH occasion

It has been noted that some PUSCH occasions may be invalid. In this case, the physical layer specs already specify that the PUSCH transmission is dropped (see section 8.1A in 38.213).

In [7], it was proposed that the MAC entity shall still generate the MAC PDU and store it in the MSGA buffer in this case. However, this is already captured as such in the MAC spec (since currently MAC is transparent to the validation rules – which are all captured in the L1 specs). So, this will need no changes and hence is not discussed (although this is implicitly acknowledged).

However, in [12], it was proposed to change this behaviour and to not generate the PDU in this case (i.e. only the PRACH preamble is indicated to lower layers for this scenario).

Further it was also proposed in [7] that the UL grant and the associated HARQ information is not provided to the HARQ entity. This will need some changes to the MAC spec, but seems this is not necessary though.

Maybe it is worth clarifying how this is modelled in the MAC spec first and to discuss if we need any further changes.

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| **Q 4.0: Do companies agree that the following modelling in MAC can be kept as it is? If the answer is no, please explain.**  *In case the associated PUSCH occasion is mapped to an invalid PO, then the physical layer will not transmit the PUSCH (i.e. no changes to MAC). Then we simply rely on fallback (i.e. this is treated same as transmission error). With this understanding no changes are needed in MAC.* | | |
| **Company** | **Yes/No** | **Comment (if No, please explain and please see the proposals in [7] and [12])** |
| ZTE | Yes | Seems relying on fallback is sufficient for this scenario. |
| LG | Yes | We prefer no changes if there is no problem even though PHY layer receives the following instructions:   1. instruct the physical layer to generate a transmission according to the stored uplink grant. 2. instruct the physical layer to transmit the MSGA using the selected PRACH occasion and the associated PUSCH resource, using the corresponding RA-RNTI, MSGB-RNTI, PREAMBLE\_INDEX, PREAMBLE\_RECEIVED\_TARGET\_POWER, preambleReceivedTargetPower, and the amount of power ramping applied to the latest MSGA preamble transmission (i.e. (PREAMBLE\_POWER\_RAMPING\_COUNTER – 1) × PREAMBLE\_POWER\_RAMPING\_STEP); |
| Samsung | No | According to MAC: "determine the UL grant and the associated HARQ information for the PUSCH resource of MSGA associated with the selected preamble and PRACH occasion according to clause 8.1A of TS 38.213 [6];"  The above text assumes that PO (valid or invalid) is always there for each preamble/PRACH occasion. This is incorrect.  Clause 8.1A of TS 38.213, first removes all invalid POs from configured POs. The valid POs are then mapped to preamble/PRACH occasions. As a result if the selected preamble and PRACH occasion does not have an associated PO, the highlighted text will not provide any UL grant.  ZTE: Thanks, may be this is something to consider indeed. However, what is important to note is that MAC has enough information to generate the MAC PDU for MSGA. We still think that this works fine, because in order to generate the MSGA MAC PDU, what is needed is the size of the TB.  And although it may (or may not) be true that the L1 doesn’t have a valid PO in this case, the UL grant can still be determined since this (i.e. the size of the UL grant) is independent of the actual occasion at which the PUSCH is transmitted. So, since the grant size can be determined regardless, the MAC PDU can be generated by MAC and we feel that the rest of the procedure can be according to fallback. We are open to any minor fixes to clarify this, but we would like to keep the current modelling of:  a) relying on fallback for this and  b) to keep the validation rules transparent to MAC. |
| Vivo |  | No strong view, but we consider that we should avoid the specification collision between PHY and MAC. |
| Nokia | Yes | The determination of PUSCH validity can be solely done by L1. From MAC point of view the associated PUSCH is there but L1 may determine the PUSCH for being not valid and drop the PUSCH transmission. |
| CATT |  | We think Samsung has a valid point. RAN1 spec is so that all invalid POs & invalid PRACH occasions will be removed from configured POs &PRACH and then mapping will be executed between valid POs and valid preamble/PRACH occasions.  We can discuss further if there is mis-alignment btw ran1/2 specs. |
| Huawei | No | To put it in a simple way, if you cannot obtain PUSCH resource for msgA then how can you delivery the HARQ information to the HARQ entity?  1> determine the UL grant and the associated HARQ information for the PUSCH resource of MSGA associated with the selected preamble and PRACH occasion according to subclause 8.1A of TS 38.213 [6];  1> deliver the UL grant and the associated HARQ information to the HARQ entity; |
| Intel |  | We slightly prefer that we update the MAC specification to conform to the L1 specification. |
| OPPO | No | Firstly, we think Samsung raised a valid point that there is mis-alignment between RAN1 and RAN2 spec. In other words, phy spec only considers the mapping between valid POs and ROs, however, MAC spec may consider the UL grant for in-valid PUSCH.  Secondly, if a preamble without a valid PRU is selected, current MAC spec will be affected from three aspects:  1. MsgA resource selection  As pointed out by Huawei and Samsung, UL grant and the associated HARQ information can not be determined without valid PRU, thus, we should fix the UE behaviours by only determining the UL grant for valid PUSCH and delivering the corresponding HARQ information to HARQ entity..  2. MsgA buffer  For the first 2-step RACH attempt, if the selected preamble is not associated with PUSCH resources, MsgA MAC PDU can not be generated since UL grant is not available, thus MsgA buffer should be empty. In addition, fallback procedure can not be performed as Msg3 need to obtain the MAC PDU to transmit from MsgA buffer.  Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, configured semi-persistently by RRC or determined to be associated with the PUSCH resource of MSGA as specified in subclause 5.1.2a  3. MsgA transmission  MAC may not instruct the PHY to transmit MsgA using the associated PUSCH resource since it is not valid.  In our submitted paper R2-2002840, we proposed not to generate the MsgA MAC PDU if the PUSCH resource is invalid for the first 2-step RACH attempt. Upon the reception of fallbackRAR, MAC entity shall multiplex and assemble the MAC PDU for Msg3 transmission and store it in Msg3 buffer. For the following MsgA re-attempting with valid PUSCH, if MsgA buffer is empty due to invalid PUSCH in last attempts, MAC PDU can be obtained from Msg3 buffer. |
| Qualcomm | No | The principle stated by rapporteur is no problem. But we are fine that some small changes or clarifications on MAC spec might be needed. Noted that any changes should NOT cause misalignment between RAN1 and RAN2 spec. |
| Lenovo | No | We also think that it would be good to update the MAC specifications in order to be aligned with RAN1 specs. |
| Ericsson | No | Propose that a preamble only can be sent [12] as above; alignment between specs is needed and are open to have a simple solution. |
| SONY | Yes | Relying on fallback is reasonable. |
| Fujitsu | Yes | We think simply rely on fallback is ok. Not clear what’s the problem with relying fallback procedure if the MsgA PUSCH is invalid. The principle of determining invalid POs is not visible to MAC now, if we would like to capture this in MAC spec it must quote corresponding PHY spec. |
| MediaTek | No | Agree that the UE can rely on fallback, but there may be some spec impact to cover the case for invalid POs. |

All companies seem to agree that we should at least use fallback for this case (i.e. at least the preamble is transmitted).

However, 8/15 companies think we need some changes in MAC as it is not clear how the UL grant can be determined in this case.

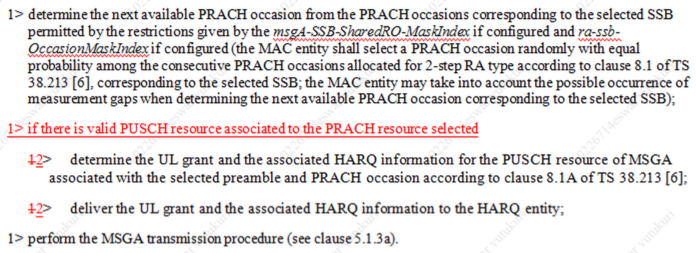
So, it is proposed to adopt fallback, but clarify the MAC spec as follows:

**Proposal 4: If there is no valid PUSCH resource associated to the PRACH resource selected:**

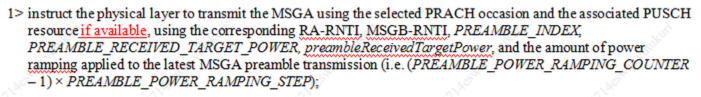
* **then MAC doesn’t determine the UL grant or the associated HARQ information**
* **MAC will only indicate the preamble resource to L1**

For information, the changes could look like below (details can be discussed in CR review phase):

Section 5.1.2a:



Section 5.1.3a



# Handling of msgA-TransMax for CFRA

In [1] and [9], it was proposed that msgA-TransMax can be configured separately for CFRA in rachConfigDedicated. It is mentioned that in case of 2 step CBRA, switching to 4-step RACH is useful to avoid unnecessary transmissions of MSGA payload, but in CFRA case, this is not needed since the payload is dedicated.

However, the rapporteur notes that this (i.e. avoiding unnecessary MSGA payload transmissions) is not the only reason for switching. According to the RAN1 LS reply in the past (R2-1912009) the switching is also motivated by performance difference in the preamble itself. So, the switching point may be determined by performance differences within the preamble itself (which is common to both CBRA and CFRA). Considering this, it is not clear if we do need to allow separate configuration for msgA-TransMax for CFRA as proposed. So, it seems this proposal is an optimisation but, companies are encouraged to comment on the proposal so that we know if there is enough support to adopt this.

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| **Q 5.0: Do companies agree that *msgA-TransMax* is configured for 2 step CFRA in *rachConfigDedicated* and that the UE is not allowed to switch to 4-step RACH if this is not configured in rachConfigDedicated as proposed in [1] (proposals 1 and 2)** | | |
| **Company** | **Yes/No** | **Comment** |
| ZTE | May be not | We don’t have a strong view on this, but we think that the existing mechanism is sufficient. |
| LG | Yes | Preamble performance of CFRA can be different from that of CBRA because ra-PrioritizationTwoStep (i.e., powerRampingStepHighPriority that is one of the influence factors) can be configured for CFRA. |
| Samsung | Yes | We have earlier agreed to have network control for switching. Since many aspects (configured RACH occasions/prach format, prioritisation parameters, preambles, etc.) of CFRA are different from CBRA, it is beneficial to have msgA-TransMax configured separately for CFRA. Network may configure same or different value compared to CBRA. |
| vivo | No | We think this is an enhancement, and the benefit is not very clear as the UE seems still have only one configuration of msgA-TransMax for both CBRA and CFRA when the CFRA is configured with a different value of msgA-TransMax, and the network by implementation can configure a longer msgA-TransMax for the RACH configuration of handover according to the current specification. If the UE has two different values of msgA-TransMax for CBRA and CFRA. The UE behaviours should be clarified when the UE switches between CBRA and CFRA. |
| Nokia |  | Indeed, this is an optimization and we think the existing solution (applying the configuration in rachConfigCommon) should suffice, however, we do not have a strong view. |
| Intel | No | We see this as an optimisation and as the rapporteur pointed out that the switching is supported because of the difference between 2-step and 4-step RA performance and the switching should be common between 2-step CFRA and CFRA. |
| OPPO | Yes | Separate configurations can be more flexible.In addition to independent value setting for CBRA and CFRA, *msgA-TransMax* can be configured only for CFRA while switching is not supported for CBRA, and vice versa. |
| Qualcomm | Yes | We support the *msgA-TransMax* can be configured with different values for 2-step CFRA in *RACH-ConfigDedicated*. |
| Lenovo | Yes/No | No strong opinion, however it appears to us rather as an optimization. |
| Ericsson | Yes |  |
| SONY | Yes | We are ok with this proposal. |
| Fujitsu | No | Agree with rapporteur that the switching is for the performance difference in preamble between 2step and 4step RA. It’s may be an optimization to consider the different performance for 2step CBRA and 2step CFRA in preamble, but we don’t think it’s critical enough to be settled in Rel-16. |
| MediaTek | No strong view | We are ok to use the value in *RACH-ConfigDedicated.* |

It seems companies are split in their views. 6/13 support it.

A number of companies said they have no strong view and a few companies also pointed out that this is an optimization.

Based on the comments, it is not entirely clear to the rapporteur how strong the views are on either side. However, this is not essential. So, we can quickly check online if there is any objection to have this. If any company objects to this, we will **not** have it.

**Proposal 5: Unless there is an objection, we agree that:**

***msgA-TransMax* is configured for 2 step CFRA in *rachConfigDedicated* and that the UE is not allowed to switch to 4-step RACH if this is not configured in *rachConfigDedicated***

# UE capability aspects

In [5] and [9] it was proposed that there is no need for a separate CFRA capability for UE. It should be noted that in Rel-15, the UE capability for CFRA is only separate for the case of CSI-RS support (i.e. we only have csi-RS-CFRA-ForHO bit). So, for SSB case, the support CFRA is mandatory. So, first it seems it is good to clarify the same understanding here also for 2-step RACH. So, companies are asked to answer this question:

|  |  |  |
| --- | --- | --- |
| **Q 6.1: Do companies agree that** **if the UE supports 2-step RA, it shall support 2-step CFRA for the SSB case (i.e. same as 4-step RACH)?** | | |
| **Company** | **Yes/No** | **Comment** |
| ZTE | Yes | We should align the capability for SSB based CFRA with Rel-15 (i.e. no separate capability is needed for this) |
| LG | Yes |  |
| Samsung | Yes |  |
| vivo | Yes |  |
| Nokia | Yes |  |
| CATT | Yes |  |
| Intel | Yes | We do not see a motivation not to support CFRA if CBRA is supported for the band |
| OPPO | Yes |  |
| Qualcomm | No | UE’s capability to support SSB-based 2-step CFRA is not aligned between 2-step RACH and 4-step RACH. This capability signalling is still under RAN1 feature list/capability discussion now and we should wait for and align with RAN1 decision. It is possible that some UEs may support 2-step RACH but not 2-step CFRA. Hence it is better to have a separate UE capability for 2-step CFRA. |
| Lenovo | Yes |  |
| Ericsson | Yes |  |
| SONY | Yes |  |
| Fujitsu | Yes |  |
| MediaTek | Yes |  |

Apart from 1 company, all others (i.e. 13/14) agree to the following:

**Proposal 6: If the UE supports 2-step RA, it shall support 2-step CFRA for the SSB case (i.e. same as 4-step RACH)**

Then the next question is how to handle the CSI-RS scenario. In 4-step RACH there is a separate capability bit for CSI-RS for handover as noted above. The question is whether such bit is needed. However, the answer to this is dependent on first support of CSI-RS in RAN1. So, for the sake of progress, the rapporteur would like to gather views on the company preference, assuming RAN1 agrees support of CSI-RS for 2-step CFRA. (of course if RAN1 doesn’t support this, then we can simply ignore this discussion at that point). So, please answer the following question (please don’t answer “wait for RAN1” ):

|  |  |  |
| --- | --- | --- |
| **Q 6.2: Assuming that RAN1 supports CSI-RS for 2-step CFRA for HO, do companies think that we need a separate capability bit for csi-RS based 2-step CFRA (e.g. csi-RS-CFRA-2-stepRA-ForHO)?** | | |
| **Company** | **Yes/No** | **Comment** |
| ZTE | May be not | We think there is no need for this, but we are open to the feedback from chipset/UE vendors on this aspect. |
| LG | Yes | We need to follow RAN1 decision. |
| Samsung |  | No strong view |
| Vivo | Maybe | This capability bit of the 4-step CFRA could be reused for the 2-step CFRA. |
| Nokia | No | We think the legacy capability should suffice for both. |
| CATT |  | Let’s wait for ran1 response. |
| Intel | No | If UE supports CSI-RS for 4-step CFRA, it can also support CSI-RS for 2-step CFRA as long as it support 2-step RA for the band. |
| OPPO | Maybe | Wait for ran1 response. If no specific features for CSI-RS based 2-step CFRA should be considered, the capability bit can be reused. |
| Qualcomm | No | The csi-RS-CFRA-ForHO can be used for 2-step CFRA (Only if RAN1 supports CSI-RS based 2-step CFRA) |
| Ericsson | No | Legacy 4-step signalling principle should be possible to reuse |
| SONY | No | We are ok with legacy Rel-15 behaviour that is capability bit of 4-step CFRA to be reused for 2-step CFRA |
| Fujitsu | No | We think there is no need for this. |
| MediaTek | Yes | There should be a separate capability for 2-step RA, but we can wait for RAN1 decision on this topic. |

We need to wait for RAN1 reply about support of CSI-RS, but in RAN2 it seems (11/13) we don’t need a separate capability for this.

**Proposal 7: If RAN1 indicates support for CSI-RS for 2-step CFRA, no need for a separate capability bit for this in 38.306 is needed from RAN2 perspective.**

# Miscellaneous topics

* In [3] it was again proposed to differentiate between CFRA and CBRA RNTI by employing an offset. But since this proposal was discussed (see R2-2001916) and apart from 1 company seems not supported by others to be pursued in Rel-16, it is again proposed not to pursue this in Rel-16 for 2-step RACH. This can be discussed first for 4-step RACH.
* In [7], it was proposed that the UL grant for msgA payload shall have higher priority when it overlaps with the configured UL grant during initial transmission. Companies are encouraged to express views on this aspect.

|  |  |  |
| --- | --- | --- |
| **Q 7.1: Do companies agree that UL grant of MSGA shall have higher priority when it overlaps with the initial transmission of the configured grant as proposed in [7]?** | | |
| **Company** | **Yes/No** | **Comment** |
| ZTE | May be yes | We are okay with this. However, there may be cases where the configured grant may be mapped to logical channel with higher priority than the logical channel triggering the RACH, in this case, further discussion may be needed in IIOT session (intra-UE prioritization) and we can align the solution with whatever is chosen for that case. |
| LG | Yes | Nothing to be specified. The current MAC spec (i.e., if the PUSCH duration of the configured uplink grant does not overlap with the PUSCH duration of an uplink grant received on the PDCCH or in a Random Access Response for this Serving Cell or with a transmission of MSGA payload)is clear enough. |
| Samsung | Yes |  |
| vivo | Yes |  |
| Nokia | Yes | The principle is OK. |
| CATT |  | As ZTE pointed out, IIOT is discussing this and let’s wait. |
| Intel | Yes | This is already the case in the current MAC spec. |
| OPPO | Yes |  |
| Qualcomm | No | It can be left to UE implementation. UE can select either to use UL grant of msgA or configured grant to transmit payload in different cases. For RRC connected UE, MsgA PUSCH is not much different from configured grant. Therefore, the same intra-UE prioritization rule for overlapping CG occasions agreed in IIOT can be applied to this case too. |
| Lenovo | Yes | Principle is fine for us. |
| Ericsson | Yes | As already specified. Special cases can be discussed in e.g. IIoT if really needed. |
| SONY | Yes |  |
| Fujitsu | Yes | It is already clear in the case without IIoT, i.e. LCH-priority is not configured, that msgA is prioritized over configured grant, so nothing needs to be clarified without IIoT. In IIoT, however, this topic is under discussion in [Offline-028][IIOT] Issue#3. We can follow the conclusion in IIoT topic for the prioritization between MsgA PUSCH and configured grant with LCH-priority configured. |
| MediaTek | Yes, but | We can align with IIoT solution (if any), but no spec change needed in 2-step RA WI point of view. |

It seems companies agree with the principle but also think there is no need to specify anything. So, no proposal is made for this for now.

* In [11], it was proposed to change the LCID to eLCID for Absolute Timing Advance Command. The rapporteur feels that this change is logical given that this MAC CE is not too frequent is of low priority. So, the proposal is to agree to this change and capture in the running rapporteur CR.

|  |  |  |
| --- | --- | --- |
| **Q 7.2: Do companies agree that the change in [11] can be agreed?** | | |
| **Company** | **Yes/No** | **Comment** |
| ZTE | Yes | We are okay with the above proposal. |
| LG | Yes |  |
| Samsung | Yes |  |
| Vivo | Yes |  |
| Nokia | No | As NW may not be able to determine the link quality during RACH procedure, we think the less overhead we need to send, the better coverage we can achieve. |
| Huawei | Yes |  |
| Intel | Yes | We are fine with this since overhead over C-RNTI PDSCH is not an issue. |
| OPPO | Yes |  |
| Qualcomm | No | We prefer to legacy LCID for Absolute Timing Advance Command MAC CE. |
| Ericsson | Yes |  |
| Fujitsu | Yes | OK with the proposal. |
| MediaTek | No | Agree with Nokia. Prefer to leave it in LCID space. |

Majority view (9/12) is to agree to this proposal. But this is not an essential change. Again, it is not clear to the rapporteur how strong the views are on either side of the argument! Hence, the proposal from the rapporteur is to check online if there is any objection to this.

**Proposal 8: Unless there is an objection, the following can be agreed:**

**Change the LCID to eLCID for the Absolute Timing Advance Command**

* In [14], it was proposed to move the initialisation of RSRP\_THRESHOLD\_RA\_TYPE\_SELECTION after the BWP operation since the threshold can be different in different BWP. This seems correct observation. So, the proposal is to agree to this change and capture in the running rapporteur CR.

|  |  |  |
| --- | --- | --- |
| **Q 7.3: Do companies agree that the change to the initialisation of RSRP\_THRESHOLD\_RA\_TYPE\_SELECTION as proposed in proposal 2 of [14] can be agreed?** | | |
| **Company** | **Yes/No** | **Comment** |
| ZTE | Yes |  |
| LG | Yes |  |
| Samsung | Yes |  |
| vivo | Yes |  |
| Nokia | Yes |  |
| Intel | Yes |  |
| OPPO | Yes |  |
| Qualcomm | Yes |  |
| Lenovo | Yes |  |
| Ericsson | Yes |  |
| Fujitsu | Yes |  |
| MediaTek | Yes |  |

All companies agree to the following

**Proposal 9: Move the initialisation of RSRP\_THRESHOLD\_RA\_TYPE\_SELECTION after the BWP operation since the threshold can be different in different BWPs**

# Feedback on running MAC CR

As can be noted, the rapporteur has captured some proposals received prior to the meeting already in the running CR [6]. So, companies are encouraged to also comment on the changes captured in this CR so that we can minimise the online discussion for these.

ZTE: We have no comments to these

|  |  |  |
| --- | --- | --- |
| Change | Comments from companies | Rapporteur summary |
| Swapping of order of succssRAR and fallbackRAR in section 5.1.4a | e.g: Company X: comment etc..  LG: We cannot understand the reason included in [6]: *NW might only be able to decode PUSCH transmission from one of the UEs* ***without knowing exactly which preamble the UE has sent.*** *The NW provides successRAR to the UE for which PUSCH is successfully decoded.* How can the NW send successRAR including Timing Advance Command even though the NW doesn’t exactly know the preamble sent by the UE?  Nokia: Response to LG. Naturally, the NW would not send successRAR in case it could not determine the timing for it. Preambles mapped to the same PUSCH occasion may lead to very similar timing even they are sent by multiple UEs (e.g., in small cell scenario), hence, NW can send a successRAR for a UE without exactly knowing whether the UE used preamble#X or preamble#Y as it could determine the UEs identity from the MsgA.  OPPO: It may not be a problem for NW to distinguish the preamble associated with the successfully decoded PUSCH transmission. PUSCH transmission is scrambled as follows defined by RAN1 and preamble index is included to assist NW to determine the corresponding preamble:  The initialization ID for msgA PUSCH scrambling is:   * cinit = RA-RNTI×216+RAPID×210+nID   nID is a cell-specific higher-layer parameter if configured; otherwise nID =NIDcell  QC: We don’t agree with the statement ‘the NW might only be able to decode PUSCH transmission from one of the UEs without knowing exactly which preamble the UE has sent.’ even for the multiple preambles to one PUSCH resource mapping case. In our understanding, The scrambling ID for PUSCH needs the value of RAPID (already specified in RAN1 spec). Network decodes the PUSCH by using different scrambling ID considering the different RAPID which UE may use. So, network should know which msgA preamble the UE has sent if PUSCH is decoded successfully. Network only needs to send successRAR but no fallbackRAR to that preamble in this case. Hence, the change is not needed.  SONY: The motivation is not clear: why re-ordering helps and how it comes that the network does not know the preamble and then decodes the PUSCH, usually the preamble is more resilient than PUSCH channel. | It seems not all companies have same understanding regarding the problem statement.  Oppo’s observation regarding the scrambling of PUSCH using the preamble index is correct. However, it should be noted that even in this case, the network may need to send both successRAR and fallbackRAR (if the network detects two preambles, but it only decoded one of the payloads). i.e. the assumption that only successRAR is sent in this case may not be correct in all scenarios.  So, may be the change is useful. But given the questions, we can discuss this further online and see if it is clear now. If there is doubt, we can postpone this.   * Keep as it is but continue discussing until 27th |
| BFR for SpCell | LG: This CR might be needed, but this should be discussed in eMIMO, not 2-step RACH.  Nokia: Response to LG. This will likely not be discussed in eMIMO and we can safely capture it in the 2-step RACH discussions – all this follows is the general decision we already made in the eMIMO for 4-step RACH, there should be no difference between the RA types when it comes to BFR.  OPPO: 2-step RACH can be applied for BFR, and it’s only for SpCell. | It seems there is some confusion. The discussion in eMIMO is about applicability of BFR MAC CE to SpCell BFR. However, the change here is different. So, I guess the change here can be kept. May be cover sheet can be clarified   * Keep the change, further comments can be collected till 27th (CR review deadline) |
| Ambiguity in PRACH prioritisation for 4-step RA | LG: OK. But, the current CR in [6] is incomplete. *scalingFactorBI*sfor BFR and HO and *powerRampingStepHighPriority* for HO should be also modified.  Samsung: Agree that HO part should also be updated.  OPPO: Agree. | * Fix the HO part for the update. |
| Addition of LBT parameters for MSGB | LG: Disagree. R bits of success RAR should be used for a futureproof common feature. We don’t want to use R bits for the L1 parameter (i.e., ChannelAccess-CPext) used only for shared spectrum. It may be possible to provide the L1 parameter in the existing fields (e.g., TPC, HARQ indicator and PUCCH indicator) like UL grant, where LBT category for msg 3 is provided, of msg2. (i.e., no MAC spec change). | There is still one R bit left. There is no design requirement to have 3 R bits in the successRAR! The other alternative would be to completely redesign the succssRAR format which would need significant changes! So, the proposal is to accept this.   * No changes to the proposed update |
| Other misc corrections | LG: Regarding the change about msgA-RSRP-ThresholdCSI-RS in Section 5.1.1, the current CR in [6] has removed text of RSRP-ThresholdCSI-RS, not msgA-RSRP-ThresholdCSI-RS. | * Fix the typo |
|  |  |  |

**Proposal 10: The running CR (updated per the above agreements) can be used as baseline for further review until 27th**

# Summary and proposals

The following proposals are made:

Observation 1: (note: no spec updates are needed for the above)

Both the following scenarios are possible:

* UE transmits MSGA where the associated PUSCH doesn’t overlap with MG
* UE transmits MSGA such that PUSCH overlaps with MG (i.e. in this case PUSCH has higher priority)

Proposal 1: Once the UE transmits PRACH preamble then it shall transmit the associated PUSCH regardless of the occurrence of measurement gap

Proposal 2: No changes are made to the MAC spec for the issue related to the MSGA PUSCH resources overlapping with measurement gap.

Proposal 3: Agree one of the following:

* + Option 1: If UE doesn’t support any of the associated PUSCH configurations (either for group A or group B), then the UE selects 4-step RA Type (initial RA type selection needs to be changed accordingly in MAC).
  + Option 2: Nothing is specified (assumption being the network only uses the optional PUSCH configuration features on dedicated BWPs and only for UEs that support these features) – no change to specification needed (may need to inform RAN1 about this conclusion)

Proposal 4: If there is no valid PUSCH resource associated to the PRACH resource selected:

* + then MAC doesn’t determine the UL grant or the associated HARQ information
  + MAC will only indicate the preamble resource to L1

Proposal 5: *msgA-TransMax* is configured for 2 step CFRA in *rachConfigDedicated* and that the UE is not allowed to switch to 4-step RACH if this is not configured in *rachConfigDedicated*

Proposal 6: If the UE supports 2-step RA, it shall support 2-step CFRA for the SSB case (i.e. same as 4-step RACH)

Proposal 7: If RAN1 indicates support for CSI-RS for 2-step CFRA, there is no need for a separate capability bit for this in 38.306 from RAN2 perspective.

Proposal 8: Change the LCID to eLCID for the Absolute Timing Advance Command

Proposal 9: Move the initialisation of RSRP\_THRESHOLD\_RA\_TYPE\_SELECTION after the BWP operation since the threshold can be different in different BWPs

Proposal 10: The current running CR (updated per the above agreements) can be used as baseline for further review until 27th

* **Swapping of order of succssRAR and fallbackRAR in section 5.1.4a:** Further comments can be provided for this issue (including the necessary clarification on the need etc) during the CR review phase
* **BFR for SpCell:** Changes can be kept, text can be reviewed further
* **Ambiguity in PRACH prioritisation for 4-step RA:** HO part to be fixed and the changes will be kept but to be reviewed further
* **Addition of LBT parameters for MSGB:** Changes can be kept and CR can be reviewed further
* **Other misc corrections:** Fix the typo in section 5.1.1 and review other changes in the next round

# References

\* Some parts of this contribution are handled in this email discussion and rest should be part of CP discussion

\* This tdoc is to be handled in CP discussion

1. R2-2002556 Issues - 2 step RA Samsung Electronics Co., Ltd
2. R2-2002585 Remaining Issues on Resource Selection in 2-setp RACH vivo
3. R2-2002668 msgB-RNTI ambiguity for CFRA and CBRA of 2-Step RACH Sony
4. R2-2002840 Remaining issues of 2-step RACH OPPO
5. R2-2002878 RAN2 related UE capability for 2-step RACH Intel Corporation
6. R2-2002965 Updates to MAC spec for 2-step RACH ZTE (CR editor), Nokia, Samsung, Vivo
7. R2-2003007 Discussion on remaining issues of 2-step RA Huawei, HiSilicon
8. R2-2003009 4-step RA type description Nokia (rapporteur), Nokia Shanghai Bell, ZTE
9. R2-2003255 Remaining issue on 2-step CFRA Qualcomm Incorporated
10. R2-2003356 Handling invalid POs for MsgA transmissions Ericsson
11. R2-2003357 Change LCID to eLCID for Absolute Timing Advance Command Ericsson
12. R2-2003362 Correction of Handling of invalid POs for MsgA transmissions Ericsson
13. R2-2003649 Correction on 2-step RACH configurations in RRC ASUSTeK
14. R2-2003666 Further clarifications on parameters for Random Access procedure LG Electronics