3GPP TSG-RAN WG2 #116-e R2-21xxxxx

Electronic meeting 1st - 12th November, 2021

Agenda Item: 8.13.2.2

Source: CATT

Title: [Post115-e][898][SON/MDT] 2-step RA related SON aspects(CATT)

Document for: Discussion and Decision

# 1 Introduction

This document captures the outcome of the following email discussion

* [POST 115e][898][SON/MDT] 2-step RA related SON aspects (CATT)

**Scope:**

 Technical discussion rather than voting yes/no on open issues in 8.13.2.2 2-step RA related SON aspects.

 How to capture all the related agreements we got so far.

 **Intended outcome**: Report

 **Deadline**: until next meeting

Please provide your comments for phase I before 9/27/2021 23:59 UTC and for phase II before 10/19/2021 23:59 UTC.

Phase I: progress on FFS

* Expected outcome: agreeable proposals

Phase II: progress on FFS of phase I and ASN.1 structure for all agreements

* Expected outcome: potential ASN.1 structure

If the convergence can be achieved in phase I, the corresponding conclusion can be captured in ASN.1 structure in phase II.

This document is organized as the following. For phase I, the discussions are in section 2, and the proposals are in section 3. For phase II, the content in section 4 and 5 are FFS, it will include the draft CR for all the agreements, and the possible ASN.1 structure depending on the progress in phase I.

# 2 Discussion

Rapporteur encourages the participating delegates to provide their contact information in this table.

|  |  |
| --- | --- |
| Company | Contact: Name (E-mail) |
| Samsung | Sb07.kim@samsung.com |
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| Huawei, HiSilicon | jun.chen@huawei.com |
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| Qualcomm | rkum@qti.qualcomm.com |
| Lenovo | Wulh5@lenovo.com |
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|  |  |
|  |  |

## 2.1 Switching information related

There are two options for switching information summarized in [1]:

|  |
| --- |
| **Proposal 2: FFS which option should be made for RACH type switch indication in the RACH report:*** **Option 1: including an explicit switch indication in the IE related to the last/first RA attempt before/after the 2-step to 4-step RA switch.**
* **Option 2: including the parameter MsgA-Transmax in each RA-InformationCommon IE.**
 |

Besides the 2 options above, one company points out that using stage-3 signaling design, i.e. to introduce a new fieldfor reporting whether the DL beam quality, associated to the used 2 step RA resource, is above or below the *msgA-RSRP-ThresholdSSB,* could implicitly indicate the switching RA attempt in [1]. Therefore rapporteur lists this method as option 3, and there are three options for indicating switching point:

* Option 1: including an explicit switch indication in the *PerRAAttemptInfo* IE related to the last/first RA attempt before/after the 2-step to 4-step RA switch;
* Option 2: including the field *msgA-Transmax* in *RA-InformationCommon* IE;
* Option 3: switching indication from 2-step RA to 4-step RA can be implicitly indicated by introducing a new field, i.e. whether the DL beam quality, associated to the used 2 step RA resource, is above or below the *msgA-RSRP-ThresholdSSB*.

Since there is no consensus on bits consumption of the above three options in offline discussion [1], rapporteur analyzes the ASN.1 structure and bits consumption of the above options in the following.

* Option 1: including an explicit switch indication in the PerRAAttemptInfo IE related to the last/first RA attempt before/after the 2-step to 4-step RA switch

The ASN.1 structure could be:

PerRAAttemptInfoList-r16 ::= SEQUENCE (SIZE (1..200)) OF PerRAAttemptInfo-r16

PerRAAttemptInfo-r16 ::= SEQUENCE {

 contentionDetected-r16 BOOLEAN OPTIONAL,

 dlRSRPAboveThreshold-r16 BOOLEAN OPTIONAL,

...,

[[

lastRAAttemptOf2sRA-r17 ENUMERATED {true} OPTIONAL

]]

}

The bits consumption:

Since the structure of “ENUMERATED {true}” will not cost bit, the consumption of option 1 is introduced by the “OPTIONAL”, it will cost 1 bit in each RA attempt to indicate whether the *lastRAAttemptOf2sRA* occurs or not. If there are N numbers of RA attempts, as many as 1\*N bits are needed for option 1, the possible maximum number of bits could be 200.

The ASN.1 structure of indication related to first RA attempt after the 2-step to 4-step RA switch is similar as the above example.

If the option 1 is applied, the legacy field *dlRSRPAboveThreshold* can be reused with small description modification for 2-step RA report.

For RA procedure initiated for beam failure recovery, only *rsrp-ThresholdSSB* associated with 4-step RA can be configured in *beamFailureRecoveryConfig*. The *msgA-RSRP-ThresholdSSB* can be only configured in *RACH-ConfigCommonTwoStepRA*. Therefore, this field description can be modified as following to cover 2-step RA and 4-step RA cases:

|  |
| --- |
| ***dlRSRPAboveThreshold***This field is used to indicate whether the DL beam (SSB) quality associated to the random access attempt was above or below the threshold *rsrp-ThresholdSSB(for 4-step random access)* in *beamFailureRecoveryConfig* in UL BWP configuration of UL BWP selected for random access procedure initiated for beam failure recovery; Otherwise, *rsrp-ThresholdSSB(for 4-step random access)* in *rach-ConfigCommon* or *msgA-RSRP-ThresholdSSB(for 2-step random access)* in *msgA-ConfigCommon* in UL BWP configuration of UL BWP selected for random access procedure. |

* Option 2: including the field *msgA-Transmax* in *RA-InformationCommon* IE

The ASN.1 structure could be:

RA-InformationCommon-r16 ::= SEQUENCE {

 absoluteFrequencyPointA-r16 ARFCN-ValueNR,

 locationAndBandwidth-r16 INTEGER (0..37949),

 subcarrierSpacing-r16 SubcarrierSpacing,

 msg1-FrequencyStart-r16 INTEGER (0..maxNrofPhysicalResourceBlocks-1) OPTIONAL,

 msg1-FrequencyStartCFRA-r16 INTEGER (0..maxNrofPhysicalResourceBlocks-1) OPTIONAL,

 msg1-SubcarrierSpacing-r16 SubcarrierSpacing OPTIONAL,

 msg1-SubcarrierSpacingCFRA-r16 SubcarrierSpacing OPTIONAL,

 msg1-FDM-r16 ENUMERATED {one, two, four, eight} OPTIONAL,

 msg1-FDMCFRA-r16 ENUMERATED {one, two, four, eight} OPTIONAL,

 perRAInfoList-r16 PerRAInfoList-r16,

...,

[[

 msgA-TransMax-r16 ENUMERATED {n1, n2, n4, n6, n8, n10, n20, n50, n100, n200} OPTIONAL

]]

}

The bits consumption:

The field is indicated per RA procedure. The structure of “ENUMERATED {n1, n2, n4, n6, n8, n10, n20, n50, n100, n200}” will cost 4 bits to indicate, and the consumption of the “OPTIONAL” is 1 bit. Therefore a mandatory size of 4+1=5 bits are needed for option 2.

If the option 2 is applied, similar as for the option1, the legacy field *dlRSRPAboveThreshold* can be reused with the small description modification for 2-step RA report.

* Option 3: switching indication from 2-step RA to 4-step RA can be implicitly indicated by introducing a new field, i.e. whether the DL beam quality, associated to the used 2 step RA resource, is above or below the msgA-RSRP-ThresholdSSB.

For option 3, there is a need to introduce a new field to indicate whether the DL beam quality, associated to the used 2 step RA resource, is above or below the *msgA-RSRP-ThresholdSSB*. Rapporteur gives the ASN.1 structure of the new field, e.g. *dlRSRPAboveThreshold2sRA*.

The ASN.1 structure could be:

PerRAAttemptInfoList-r16 ::= SEQUENCE (SIZE (1..200)) OF PerRAAttemptInfo-r16

PerRAAttemptInfo-r16 ::= SEQUENCE {

 contentionDetected-r16 BOOLEAN OPTIONAL,

 dlRSRPAboveThreshold-r16 BOOLEAN OPTIONAL,

...,

[[

dlRSRPAboveThreshold2sRA-r17 BOOLEAN OPTIONAL

]]

}

The bits consumption:

The structure of “BOOLEAN” will cost 1 bit to indicate, and the “OPTIONAL” is also 1 bit cost. A size of 1+1=2 bits for each RA attempt is needed for the option 3. If there are N numbers of RA attempts, as many as 2\*N bits are needed for option 3, the possible maximum number of bits could be 2\*200.

**Q1: Do you agree the rapporteur’s analysis on the ASN.1 structure and bits consumption of three options? If No, please give your analysis.**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Yes/No** | **comments if any** |
| **Samsung** | ~~No~~Yes | We have assumed that the analysis of bits consumption is correct.  ~~However, we are not sure if the option 2 can fully cover the original intention indicating whether to switch to 4RA.~~ ~~For instance, when UE has received no RAR corresponding to the UE’s preamble until the expiry of window, UE may perform the “Random Access Resource Selection” described in TS38.321 clause 5.1.2 and 5.1.4.~~~~In other words, UE can switch 2RA to 4RA, due to the RA resource Selection process, as well as reaching to msgA-TransMax.~~~~Thus, we don’t think that the option 2 is a valid solution.~~ |
| OPPO | Yes | Response to Samsung: when UE has not received RAR corresponding to the UE’S preamble until the expiry, according to TS 38.321, if the UE has selected the 2-step RACH type, the UE will only stick on performing the 2-step RA type Random access resource selection procedure. Details could be found in TS 38.321 as follows:[Samsung]Thank you for the clarification. We agree Oppo’s clarification. We have identified that we misled the current procedural text. Hence, we have changed our view.5.1.4a MSGB reception and contention resolution for 2-step RA type:[omit]2> if the Random Access procedure is not completed:3> if *msgA-TransMax* is applied (see clause 5.1.1a) and *PREAMBLE\_TRANSMISSION\_COUNTER* = *msgA-TransMax* + 1:4> set the *RA\_TYPE* to *4-stepRA*;4> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;4> if the Msg3 buffer is empty:5> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;4> flush HARQ buffer used for the transmission of MAC PDU in the MSGA buffer;4> discard explicitly signalled contention-free 2-step RA type Random Access Resources, if any;4> perform the Random Access Resource selection procedure as specified in clause 5.1.2.3> else:4> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;4> if the criteria (as defined in clause 5.1.2a) to select contention-free Random Access Resources is met during the backoff time:5> perform the Random Access Resource selection procedure for 2-step RA type Random Access (see clause 5.1.2a).4> else:5> perform the Random Access Resource selection procedure for 2-step RA type Random Access (see clause 5.1.2a) after the backoff time. |
| CATT | Yes |  |
| vivo | Yes |  |
| Huawei, HiSilicon | Yes |  |
| ZTE | Yes |  |
| CMCC | Yes |  |
| Ericsson | Yes  |  |
| Qualcomm | Yes |  |
| Lenovo | Yes |  |
| Intel | Yes |  |
| Sharp | Yes |  |
| Apple | Yes |  |

Rapporteur would like the companies give the most suitable option based on the above analysis.

**Q2: Which option do you prefer based on the analysis of the options?**

* Option 1: including an explicit switch indication in the PerRAAttemptInfo IE related to the last/first RA attempt before/after the 2-step to 4-step RA switch;
* Option 2: including the field *msgA-Transmax* in *RA-InformationCommon* IE;
* Option 3: switching indication from 2-step RA to 4-step RA can be implicitly indicated by introducing a new field, i.e. whether the DL beam quality, associated to the used 2 step RA resource, is above or below the *msgA-RSRP-ThresholdSSB*.

|  |  |  |
| --- | --- | --- |
| **Company**  | **Option 1/Option 2/Option 3** | **comments if any** |
| **Samsung** | ~~Option 1~~Option 2 | ~~The option 1 is a clear solution covering all cases.~~~~Alternatively, a RA type indicator can be intuitively introduced.~~ |
| OPPO | Option 2 | Option 2 is the most efficient reporting method in extreme cases (UE has tried many times of RACH attempts before succss). |
| CATT | Option 2 | If there are more than five RA attempts in one RA procedure, the option 2 can indicate the switching point with lower bits consumption. |
| vivo | Option 2 | Our original thought about Opt3 is that if a new field is necessary to be introduced (due to the signalling design), then there is no need to additionally include *msgA-Transmax*, but if majority thinks the new field (related to Opt3) is not needed, Opt2 seems to be the most efficient option. |
| Huawei, HiSilicon | Option 2 | Share similar views as CATT. |
| ZTE | Option 2 | Share similar comments as Rapporteur. In addition, another gain of option 2 is that NW can know whether absent of switching indication is due to no configuration of MsgA-Transmax or no reaching the maximum allowed number. |
| CMCC | Option 2 | Share the view with OPPO and CATT. |
| Ericsson | Option 2 (see comments) | Option-1 could be more efficient when the number of RA attempts in the RA procedure is very low (which is the most often scenario). Further, option-1 is better for future compatibiltiy if new features to switch to 4 step RA are introduced. However, from this release point of view we are okay to compromise to use option-2 and we can get back to this topic if new switching features are introduced in the future releases.  |
| Nokia, Nokia Shanghai Bell | Option 2 | Option 2 can be used to indicate that 2-step RACH switched to 4-step RACH because a maximum number of MSGA transmissions was met. However, it falls short to completely indicate reasons why 2-step RACH changed to 4-step RACH (e.g., if a fallback occurred or whether there was an LBT and PUSCH could not be transmitted). |
| Qualcomm | Option 2 |  |
| Lenovo | Option 2 | For option 1, if lastRAAttemptOf2sRA-r17 IE is absent, UE can consider it is not last one. If so, it could be more efficient. But, we can compromise to option2.  |
| Intel | Option 2 |  |
| Sharp | Option 2 | Based on the analysis for Q1, we are fine with option 2. |
| Apple | Option 2 |  |

[Summary]

Out of 14 responding companies, (14/14) companies agree to use option 2 for indicating the RA type switching point. One company think we can get back to this topic if new switching features are introduced in the future releases. However, it should be future proof, rapporteur opens to this issue when the new switching features are introduced.

It seems option 2 can be taken as majority in the table (14/14). Based on company feedback, the following is proposed based on majority:

**Proposal 1: Including the field *msgA-Transmax* in *RA-InformationCommon* IE to indicate RA type switching point in the 2-step RA report.**

## 2.2 MSGA PUSCH related information

The companies as below suggest to include the MSGA PUSCH related information in RA report to optimize MSGA PUSCH transmission, the information suggested can be divided into two aspects: one is preamble group related, the other is MSGA PUSCH resource related.

* preamble group related

 As the options summarized in [1], rapporteur lists the preamble group related information in the table below:

|  |
| --- |
| * A: the payload size transmitted in MSGA for a 2-step RACH attempt (from [2] Nokia)
* B: indication of whether the payload size is above or below the ra-MsgA-SizeGroupA threshold (Ericsson[1]) [Samsung] We has then suggested a new indicator to indicate whether MSGA PUSCH was transmitted or not during this RA attempt
* C: the group type of a preamble i.e., group type A or B (from [2] Nokia, [4] Ericsson)
* D:PUSCH group information(from [3] ZTE, [4] Ericsson)
* E: indication of pathloss above or below the pathloss threshold for groupA/B (from [4] Ericsson)
 |

For the RACH optimization in Rel-16, the RACH preamble split (among dedicated, group A, group B) aspects was included in stage 1, i.e. TR37.816. However, it was not discussed in the subsequent WI stage. Since the corresponding optimization was not introduced for 4-step RA report, rapporteur thinks we should firstly discuss the necessity to include the preamble group related information into RA report which is out of the scope of 2-step RA report optimization.

In TS 38.321, for the contention-based Random Access preamble selection of 4-step RA type and 2-step RA type, there are two kinds of condition to select the RA preambles group B, one is contention-free Random Access Resources have not been configured, another is contention-free Random Access Resources have been configured.

For the first condition, the preamble group selection is based on the threshold *ra-Msg3SizeGroupA (ra-MsgA-SizeGroupA)* and/or pathloss. For the second condition, the preamble group selection based on whether the transport block size of the MSGA payload configured in the *rach-ConfigDedicated* corresponds to the transport block size of the MSGA payload associated with Random Access Preambles group B.

Since the preamble group selection procedure is similar for 4-step RA and for 2-step RA, if there is a need to optimize the preamble group, the optimization needs to cover both 2-step RA and 4-step RA cases.

Please take above information into account when considering whether there is a need to optimize preamble group for RACH optimization. Therefore, the rapporteur suggests: RAN2 first discusses whether there is a need to optimize preamble group for RACH optimization and the corresponding conclusion is applied to both 2-step RA report and 4-step RA report.

If companies consider the preamble group optimization is necessary, the information may be needed to achieve an acceptable proposal.

**Q3: Do you agree to optimize preamble group for RACH optimization, and the corresponding conclusion is applied to 2-step RA report and 4-step RA report?**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Yes/No** | **comments if any (Reason or Benefit)** |
| Samsung | No |  |
| OPPO | No | It is more related to 4-step RACH optimization. |
| CATT | No |  |
| vivo | No |  |
| Huawei, HiSilicon | No |  |
| ZTE | Yes | Both 4step and 2step can benefit from preamble group information, especially for 2tepRA. The common benefits is that NW can based on this information to optimize the preamble division and assignment. And for 2stepRA, the preamble group information is also related to PUSCH group information which can help NW to understand which PUSCH resource has been used. Thus it is beneficial to add such information. |
| CMCC | Maybe | We also think it is beneficial for both 2-step RA and 4-step RA, and we could do the optiomization if time is allowed. |
| Ericsson | Yes | Currently the PL RSRP value is included only for2 step RA and thus, that is not available for 4 step RA. Therefore the reasoning behind preamble group selection is not visible to the network in 4 step RA procedure.Therefore, we see some benefits in harmonizing these measurements so that both 2 step RA related RA report and 4 step RA report can contain similar info which are useful in both RA procecure optimization. |
| Nokia, Nokia Shanghai Bell | Yes | In our view, optimizing preamble group can help the network optimize the groups for random access preambles parameter, as well as the used physical layer parameters for PUSCH “MSGA”. |
| Qualcomm | No |  |
| Lenovo | No |  |
| Intel | No |  |
| Sharp | Maybe | We think it is beneficial for preamble grouping, but can be considerred as low priority if the time is tight. |
| Apple | No |  |

Since the option “D” is general information and covered in Q3, rapporteur excludes this option in Q4.

**Q4: If you agree with Q3, which option(s) do you prefer?**

* A: the payload size transmitted in MSGA for a 2-step RACH attempt
* B: indication of whether the payload size is above or below the ra-MsgA-SizeGroupA threshold
* C: the group type of a preamble i.e., group type A or B
* E: indication of pathloss above or below the pathloss threshold for groupA/B

|  |  |  |
| --- | --- | --- |
| **Company**  | **A/B/C/E/others** | **Comments if any** |
| **ZTE** | C |  |
| Ericsson | A, E, C |  |
| Nokia, Nokia Shanghai Bell | A/C |  |
| CMCC | A, C |  |
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[Summary]

**For the Q3, out of 14 responding companies:**

* **(9/14) companies disagree to optimize preamble group for RACH optimization, and the corresponding conclusion is applied to 2-step RA report and 4-step RA report.**
* **(3/14) companies agree to optimize preamble group for RACH optimization, and the corresponding conclusion is applied to 2-step RA report and 4-step RA report.**
* **(2/14) company think this optimization can be considered as low priority if the time is tight.**

**For the Q4, out of 4 companies give their views:**

* **(3/4) support A (the payload size transmitted in MSGA for a 2-step RACH attempt).**
* **(4/4) support C (the group type of a preamble i.e., group type A or B).**
* **(1/4) support E (indication of pathloss above or below the pathloss threshold for groupA/B).**

Based the comments provided by companies, rapporteur gives a view summary of “Yes” and “No” as follows:

Views of Yes:

* NW can apply this information to optimize the preamble division and assignment.
* For 2 step RA, the preamble group information is related to PUSCH group information which can help NW to understand which PUSCH resource has been used.
* Both 2 step RA related RA report and 4 step RA related RA report can contain similar info which is useful in both RA procedure optimization.

Views of No:

* It is more related to 4-step RACH optimization.

The companies agreed preamble group optimization think that the preamble group information can help the network optimize the groups for random access preambles parameter, however, there are not many proponents. Thus, rapporteur suggests that the preamble group optimization can be considered in the future release based on more sufficient benefits.

Considering the clear intention provided by 12 companies and the limit time, it seems “No” can be taken as majority for the Q3 (9/12). Based on company feedback, the following is proposed based on majority:

**Proposal 2: Preamble group optimization for RACH report is not introduced in Rel-17.**

* MSGA PUSCH resource related

|  |
| --- |
| * F: the MCS index(from [3] ZTE)
* G: the number of PRB per PO of the PUSCH resource(from [3] ZTE)
* H: the combination of start symbol and length and PUSCH mapping type(from [3] ZTE)
* I: offset of lowest PUSCH occasion in frequency domain with respect to PRB 0(from [3] ZTE)
* J: the number of msgA PUSCH occasions FDMed in one time instance(from [3] ZTE)
* K:MSGA PUSCH resource information (from [4] Errcsson and [5] CMCC)
* M: whether MSGA PUSCH was transmitted or not during this RA attempt (from Samsung)
 |

For the MSGA PUSCH resource related, the rapporteur lists the detail parameters related the above information that configured in *MsgA-PUSCH-Resource*.

F: the MCS index

|  |
| --- |
| ***msgA-MCS***Indicates the MCS index for msgA PUSCH from the Table 6.1.4.1-1 for DFT-s-OFDM and Table 5.1.3.1-1 for CP-OFDM in TS 38.214. |

G: the number of PRB per PO of the PUSCH resource

|  |
| --- |
| ***nrofPRBs-PerMsgA-PO***Number of PRBs per PUSCH occasion (see TS 38.213, clause 8.1A). |

H: the combination of start symbol and length and PUSCH mapping type

|  |
| --- |
| ***msgA-PUSCH-TimeDomainAllocation***Indicates a combination of start symbol and length and PUSCH mapping type from the TDRA table (*PUSCH-TimeDomainResourceAllocationList* if provided in *PUSCH-ConfigCommon*, or else the default Table 6.1.2.1.1-2 in 38.214 is used if *pusch-TimeDomainAllocationList* is not provided in PUSCH-ConfigCommon). The parameter K2 in the table is not used for msgA PUSCH. The network configures one of *msgA-PUSCH-TimeDomainAllocation* and *startSymbolAndLengthMsgA-PO,* but not both. If the field is absent, the UE shall use the value of startSymbolAndLenghtMsgA-PO. |

I: Offset of lowest PUSCH occasion in frequency domain with respect to PRB 0

|  |
| --- |
| ***frequencyStartMsgA-PUSCH***Offset of lowest PUSCH occasion in frequency domain with respect to PRB 0 (see TS 38.213, clause 8.1A). |

J: The number of msgA PUSCH occasions FDMed in one time instance

|  |
| --- |
| ***nrofMsgA-PO-FDM***The number of msgA PUSCH occasions FDMed in one time instance (see TS 38.213, clause 8.1A). |

The detail information and configuration of the above parameters can be checked in TS 38.214 and TS 38.213.

In the previous meeting, a fallback indication is agreed to be included into 2-step RA report per RA attempt. This indication can be used for network to optimize the frequency and time domain allocation or MCS of MSGA PUSCH, e.g. if the fallback occurs frequently, the network can adjust the above mentioned parameters for MSGA PUSCH payload transmission. It is a coarse [granularity](https://fanyi.baidu.com/#en/zh/granularity) but efficient way to optimize MSGA PUSCH resource.

If a finer [granularity](https://fanyi.baidu.com/#en/zh/granularity) method is needed, as in the above table, a lot of information may be needed to optimize MSGA PUSCH resource. Please take the complexity and the signalling overhead into account when considering this finer [granularity](https://fanyi.baidu.com/#en/zh/granularity) optimization of MSGA PUSCH resource.

M: whether MSGA PUSCH was transmitted or not during this RA attempt.

In NR-U, the LBT failure may happen in the MSGA PUSCH occasion, or SSB/PRACH occasion corresponding to MSGA PUSCH occasion may be invalid. Then, MSGA PUSCH cannot be transmitted. Hence, M is helpful to identify any problem in MSGA transmission.

**Q5: Do you agree that there is a need to introduce the MSGA resource related information in 2-step RA report?**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Yes/No** | **Comments if any(Reason or benefit)** |
| Samsung | Yes | See the new description above |
| CATT | No | The fallback indication can be used for MSGA PUSCH optimization. If further optimization for MSGA PUSCH resource is required, the complexity and the signaling overhead may be largely increased but with a little gain. |
| Huawei, HiSilicon | No | The above information may be userful for network optimization, but the extra signalling overhead needs to be justified. Currently for Rel-16 RA report, there are at most 200 PerRAInfo-r16 and there are at most 200 PerRAAttemptInfo-r16, so there are different calculations if including the MSGA resource information into different levels. |
| ZTE | Yes | There could be more than one set of PUSCH configuration configured, even with fallback indication, NW cannot know which sets of PUSCH resource is the problem, and the possible problematic configuration, thus do not know how to do optimization. To improve the successful rate of PUSCH transmission is one of the important optimization for 2stepRA, thus it is necessary to include PUSCH related information in 2stepRA report.Moreover, considering PUSCH resource will need to reserve resource in advance, thus with the actual intended PO size or the difference between transmitted MsgA size and actual required size NW can optimize the configuration of PO size which also can help improve the resource efficiency. Regarding to M, we agree Samsung’s analysis, thus it is also beneficial to includes.In response to Huawei, since once the preamble group or PUSCH group is decided UE will not switch the group again and won’t rebuilt the PUSCH payload, thus besides M proposed by Samsung, the rest of PUSCH information will only need to be included once for one RA procedure. Therefore the cost is acceptable comparing to the gain. If PUSCH resource cannot be optimized properly, then the performance gain of 2stepRA will be decreased, and that’ s why we think it is important to include PUSCH related information. |
| CMCC | Yes | The PUSCH related information is quite important for network to optimize the further allocation of PUSCH resource. And we think such kind of optimization is necessary from the point view of operator.  |
| Ericsson | Yes | We agree with the motivation provided by proponents.Further, this information is not per RA attempt specific i.e., this information is at a per RA procedure level and thus the overhead is not very large.  |
| Nokia, Nokia Shanghai Bell | Yes but | Though we see the need to introduce MSGA resource related information in the 2-step RA Report we do not think it is necessary to introduce all the listed options together. We think that for example G, H, I, J, and RO index should be enough. M is useful to be logged, but in our view it should be one more indicator that indicates RACH failure and possibly change of the RACH due to an error (in this case due to LBT). M should not be categorized as MSGA PUSCH Resource Related. |
| Qualcomm | No | Agree with CATT. |
| Lenovo | No | Agree with HW and CATT |
| Intel | No | Agree with CATT |
| Sharp | No strong view | We understand the need to optimize the MsgA PUSCH configuration. Generally, it is always benefitial to provide more detailed information to the NW, The question is to what extent is it needed. Should consider the complexity, the overhead and the gain more prudently. |
| Apple | No |  |
|  |  |  |

Since the option “K” is general information and covered in Q5, rapporteur excludes this option in Q6.

**Q6: If you agree with Q5, which option(s) do you prefer?**

* F: the MCS index
* G: the number of PRB per PO of the PUSCH resource
* H: the combination of start symbol and length and PUSCH mapping type
* I: offset of lowest PUSCH occasion in frequency domain with respect to PRB 0
* J: the number of msgA PUSCH occasions FDMed in one time instance
* M: whether MSGA PUSCH was transmitted or not during this RA attempt

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| --- | --- | --- |
| **Company**  | **F/G/H/I/J/M/others** | **Comments if any** |
| Samsung | M | See the new description above |
| ZTE | ALL |  |
| CMCC | ALL |  |
| Ericsson | All |  |
| Nokia, Nokia Shanghai Bell |  | See Q5 |
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[Summary]

**For the Q5, Out of 12 responding companies:**

* **(6/12) companies disagree that there is a need to introduce the MSGA resource related information in 2-step RA report.**
* **(5/12) companies agree that there is a need to introduce the MSGA resource related information in 2-step RA report.**
* **(1/12) companies with no strong view.**

**For the Q6, Out of 5 companies agreed the optimization:**

* **(3/5) support F.**
* **(4/5) support G/H/I/J/M.**

Based the comments provided by companies, rapporteur gives a view summary of “Yes” and “No” as follows:

View of Yes:

* In NR-U, the LBT failure may happen in the MSGA PUSCH occasion, or SSB/PRACH occasion corresponding to MSGA PUSCH occasion may be invalid.
* There could be more than one set of PUSCH configuration configured, even with fallback indication, NW cannot know which set of PUSCH resource has the problem and needs to be optimized.
* With the actual intended PO size or the difference between transmitted MsgA size and actual required size, NW can optimize the configuration of PO size which is also helpful to improve the resource efficiency.
* The rest of PUSCH information will only need to be included once for one RA procedure.
* If PUSCH resource cannot be optimized properly, then the performance gain of 2stepRA will be decreased.
* Such kind of optimization is necessary from the point view of operator.

View of No:

* The fallback indication can be used for MSGA PUSCH optimization.
* If further optimization for MSGA PUSCH resource is required, the complexity and the signaling overhead may be largely increased but with a little gain.
* Currently for Rel-16 RA report, there are at most 200 PerRAInfo-r16 and there are at most 200 PerRAAttemptInfo-r16, so there are different calculations if including the MSGA resource information into different levels.

For the Q6, it seems that (4/5) supporters think **G/H/I/J/M** should be reported to help the network to optimize the MSGA PUSCH resource.

Consider the views of the proponent and the dissenter, the rapporteur suggests this issue can be taken as FFS and discussed in phase II.

It seems there is no majority view. Based on the company feedback, the following is proposed:

**Proposal 3: FFS the MSGA PUSCH resource optimization and the detail information:**

1. **the MCS index**
2. **the number of PRB per PO of the PUSCH resource**
3. **the combination of start symbol and length and PUSCH mapping type**
4. **offset of lowest PUSCH occasion in frequency domain with respect to PRB 0**
5. **the number of msgA PUSCH occasions FDMed in one time instance**
6. **whether MSGA PUSCH was transmitted or not during this RA attempt**

# 3 Phase I Conclusion

Based on the discussion, we firstly have a set of proposals for RAN2 agreements:

**Proposal 1(14/14, easy agreement and captured in phase II ASN.1 structure): Including the field *msgA-Transmax* in *RA-InformationCommon* IE to indicate RA type switching point in the 2-step RA report.**

**Proposal 2 (9/12, easy agreement): Preamble group optimization for RACH report is not introduced in Rel-17.**

**Proposal 3 (5/11, discussed in phase II): FFS the MSGA PUSCH resource optimization and the detail information:**

1. **the MCS index**
2. **the number of PRB per PO of the PUSCH resource**
3. **the combination of start symbol and length and PUSCH mapping type**
4. **offset of lowest PUSCH occasion in frequency domain with respect to PRB 0**
5. **the number of msgA PUSCH occasions FDMed in one time instance**
6. **whether MSGA PUSCH was transmitted or not during this RA attempt**

# 4 Phase II

## 4.1 MSGA PUSCH resource related

The following proposal is summarized in phase I:

**Proposal 3 (5/11, discussed in phase II): FFS the MSGA PUSCH resource optimization and the detail information:**

1. **the MCS index**
2. **the number of PRB per PO of the PUSCH resource**
3. **the combination of start symbol and length and PUSCH mapping type**
4. **offset of lowest PUSCH occasion in frequency domain with respect to PRB 0**
5. **the number of msgA PUSCH occasions FDMed in one time instance**
6. **whether MSGA PUSCH was transmitted or not during this RA attempt**

The rapporteur lists the key points for MSGA PUSCH resources optimization provided by companies in phase I, one is overhead related, and another is MSGA PUSCH configuration related.

* For the overhead related:

View of No:

* If further optimization for MSGA PUSCH resource is required, the complexity and the signaling overhead may be largely increased but with a little gain.
* Currently for Rel-16 RA report, there are at most 200 PerRAInfo-r16 and there are at most 200 PerRAAttemptInfo-r16, so there are different calculations if including the MSGA resource information into different levels.

View of Yes:

* The rest of PUSCH information will only need to be included once for one RA procedure.
* For the gain:

To improve the successful rate of PUSCH transmission is one of the important optimization for 2stepRA, thus it is necessary to include PUSCH related information in 2stepRA report.

Rapporteur gives the bits consumption of fields that are suggested to be included into 2-step RA report:

|  |  |  |
| --- | --- | --- |
| Field | Structure  | Bits consumption |
| msgA-MCS | INTEGER (0..15) | 4 bits |
| nrofPRBs-PerMsgA-PO | INTEGER (1..32) | 5 bits |
| msgA-PUSCH-TimeDomainAllocation | INTEGER (1..maxNrofUL-Allocations)maxNrofUL-Allocations INTEGER ::= 16 -- Maximum number of PUSCH time domain resource allocations. | 4 bits  |
| frequencyStartMsgA-PUSCH | INTEGER (0..maxNrofPhysicalResourceBlocks-1)maxNrofPhysicalResourceBlocks-1 INTEGER ::= 274 -- Maximum number of PRBs minus 1 | 9 bits |
| nrofMsgA-PO-FDM | ENUMERATED {one, two, four, eight} | 2 bits |
| whether MSGA PUSCH was transmitted or not during this RA attempt | Possible structure:ENUMERATED {true} | At most 200 bits |

Given the bits consumption, around 24 bits are used to report the MSGA PUSCH resource for optimization. In NR-U, for indication of whether MSGA PUSCH was transmitted or not during this RA attempt, at most 200 bits are needed. The proponent gives the gain as improving the successful rate of PUSCH transmission for 2-step random access.

* For MSGA PUSCH configuration related:

One view of No: The fallback indication can be used for MSGA PUSCH optimization.

One view of Yes: There could be more than one set of PUSCH configuration configured, even with fallback indication, NW cannot know which sets of PUSCH resource is the problem.

The MSGA PUSCH resource can be configured per BWP in system information or the dedicated signalling. If configured via system information, the MSGA PUSCH resource is configured for initial BWP of the PCell and there could be only one set of PUSCH configuration for all UEs. If configured via dedicated signalling, there could be more than one set of PUSCH configuration for different UEs.

Based on the above analysis, rapporteur would like companies give the opinion by considering the above information.

**Q1: Do you agree that there is a need to introduce the MSGA resource related information in 2-step RA report by considering the following aspects:**

**1. Signalling overhead;**

**2. Possible more than one set of MSGA PUSCH configuration?**

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| --- | --- | --- |
| **Company**  | **Yes/No** | **comments if any (Reason or Benefit)** |
| CMCC | Yes | The PUSCH related information is quite important for network to optimize the further allocation of PUSCH resource. And we think such kind of optimization is necessary from the point view of operator, especially regarding the signalling overhead is acceptable. |
| OPPO | Yes | The signaling overhead burden should be taken into account for making decision.  |
| CATT | See comments | For the scenarios with only one set of PUSCH resource configuration, the fallback indication seems enough for MSGA PUSCH resource optimization. However, it also seems reasonable to introduce the MSGA PUSCH related information in 2-step RA report in secnarios with more than one set of MSGA PUSCH configuration for indicating which set is really used. |
| ZTE | Yes | We agree with most of the analysis from Rapporteur except the following :*If configured via system information, the MSGA PUSCH resource is configured for initial BWP of the PCell and there could be only one set of PUSCH configuration for all UEs.* Even for initial BWP there could be two groups of PUSCH resource configured, where the PUSCH configuration can be different, e.g., MCS, nrofPRBs-PerMsgA-PO, and etc. Therefore only fallback indication is still insufficient. Since the PUSCH resource is only included in a per RA procedure granularity, the overhead shall be bearable. |
| Huawei, HiSilicon | Yes | We see the benefits of including the PUSCH related information in SON functionality, and the overhead seems acceptable based on more analysis provided by the email rapporteur. |
| Qualcomm | NO (we donot think PUSCH information needs to be reported by UE) | RA-report is already quite big. We donot prefer to introduce PUSCH related information in the RA-report. PUSCH related information is already known to the network. In our understanding the scope of optimization is very limited.  |
| Intel | Yes | We see some beneit to report more than one set of PUSCH  |
| Lenovo | No | RA-report aims to reduce the failure rate of RA. The successful preamble transmission is more important than PUSCH. We don’t see the necessary to optimize the PUSCH compared to the signaling overhead. |
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Considering the signalling overhead and the MSGA PUSCH configuration related information, rapporteur would like companies give your further preferable option(s) in the following.

**Q2: If you agree with Q1, which option(s) do you prefer?**

* A: the payload size transmitted in MSGA for a 2-step RACH attempt
* F: the MCS index (4 bits)
* G: the number of PRB per PO of the PUSCH resource (5 bits)
* H: the combination of start symbol and length and PUSCH mapping type (4 bits)
* I: offset of lowest PUSCH occasion in frequency domain with respect to PRB 0 (9 bits)
* J: the number of msgA PUSCH occasions FDMed in one time instance (2 bits)
* M: whether MSGA PUSCH was transmitted or not during this RA attempt (at most 200 bits)

|  |  |  |
| --- | --- | --- |
| **Company**  | **F/G/H/I/J/M** | **comments if any**  |
| CMCC | A/F/G/H/I/J | No strong view for M |
| OPPO | F/G/J/ | For option A, it may consume too many bits to represent. An alternative way could be catogrize the payload size into different classes, and therefore could reduce the overhead. In addition, we think at least I and M is not needed, which may consume too much overhead and cannot reflect either the PUSCH resource allocation situation or the UE actually transmitted msgA size. |
| ZTE | F/G/H/I/J/MA needs clarification  | A requires further clarification, whether it is the payload transmitted without padding or the actual transmitted TB size. If it is later, than it can be derived based on F,G and J, as UE always build TB based on PO size configured. Based on the intention of optimizing PUSCH configuration, more useful information shall be the payload size without padding. Also, since UE is not required to rebuilt PUSCH in current specs, it only needs to be reported per RA procedure not per RA attempt. |
| Huawei, HiSilicon | A, F, G, H, I, J | For A, the graularity may need more discussions. |
| Qualcomm | None |  |
| Samsung | At least, M | At least, it’s impossible for newtork to indenfy the information, M |
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[Summary]

**For the Q1, out of 8 responding companies:**

* **(5/8) companies propose to introduce the MSGA resource related information in 2-step RA report.**
* **(2/8) companies disagree to introduce the MSGA resource related information in 2-step RA report.**
* **(1/8) company think it seems reasonable to introduce the MSGA PUSCH related information in 2-step RA report in secnarios with more than one set of MSGA PUSCH configuration for indicating which set is really used.**

**For the Q2:**

* **(2/9) support A**
* **(4/9) support F**
* **(4/9) support G**
* **(3/9) support H**
* **(3/9) support I**
* **(4/9) support J**
* **(2/9) support M**

It seems “Yes” can be taken as majority for the Q1 (5/8) and FFS for Q2. Based on companies’ feedback, the following is proposed based on majority:

**Proposal 3a Introduce MSGA PUSCH resource related information in 2-step RA report. FFS the details within the following information:**

* the payload size transmitted in MSGA for a 2-step RACH attempt
* the MCS index
* the number of PRB per PO of the PUSCH resource
* the combination of start symbol and length and PUSCH mapping type
* offset of lowest PUSCH occasion in frequency domain with respect to PRB 0
* the number of msgA PUSCH occasions FDMed in one time instance
* whether MSGA PUSCH was transmitted or not during this RA attempt

## 4.2 Draft CR of the current agreements for 2-step RA report

The rapporteur gives a draft CR including changes related to the previous RAN2 agreements as well as the potential easy agreement(s) from phase I of this email discussion (highlighted in grey). Please give your comments in the following table or in draft CR document.

|  |  |
| --- | --- |
| **Company** | **Comments if any** |
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[Summary]

Based on feedback of companies, the following is proposed:

**Proposal 4 FFS the signalling structure and procedure description of PRACH resource information when 2-step RA and 4-step RA share the same ROs.**

# 5 Phase II Conclusion

Based on the discussion, we firstly have a set of proposals for RAN2 agreements:

**Proposal 3a Introduce MSGA PUSCH resource related information in 2-step RA report. FFS the details within the following information:**

* the payload size transmitted in MSGA for a 2-step RACH attempt
* the MCS index
* the number of PRB per PO of the PUSCH resource
* the combination of start symbol and length and PUSCH mapping type
* offset of lowest PUSCH occasion in frequency domain with respect to PRB 0
* the number of msgA PUSCH occasions FDMed in one time instance
* whether MSGA PUSCH was transmitted or not during this RA attempt

**Proposal 4 FFS the signalling structure and procedure description of PRACH resource information when 2-step RA and 4-step RA share the same ROs.**

# 6 Conclusion

**Phase I:**

**Proposal 1(14/14, easy agreement and captured in phase II ASN.1 structure): Including the field *msgA-Transmax* in *RA-InformationCommon* IE to indicate RA type switching point in the 2-step RA report.**

**Proposal 2 (9/12, easy agreement): Preamble group optimization for RACH report is not introduced in Rel-17.**

**Proposal 3 (5/11, discussed in phase II): FFS the MSGA PUSCH resource optimization and the detail information:**

1. **the MCS index**
2. **the number of PRB per PO of the PUSCH resource**
3. **the combination of start symbol and length and PUSCH mapping type**
4. **offset of lowest PUSCH occasion in frequency domain with respect to PRB 0**
5. **the number of msgA PUSCH occasions FDMed in one time instance**
6. **whether MSGA PUSCH was transmitted or not during this RA attempt**

**Phase II:**

**Proposal 3a (5/7, easy agreement) Introduce MSGA PUSCH resource related information in 2-step RA report. FFS the details within the following information:**

* the payload size transmitted in MSGA for a 2-step RACH attempt
* the MCS index
* the number of PRB per PO of the PUSCH resource
* the combination of start symbol and length and PUSCH mapping type
* offset of lowest PUSCH occasion in frequency domain with respect to PRB 0
* the number of msgA PUSCH occasions FDMed in one time instance
* whether MSGA PUSCH was transmitted or not during this RA attempt

**Proposal 4 FFS the signalling structure and procedure description of PRACH resource related information when 2-step RA and 4-step RA share the same ROs.**

# 7 References

1. R2-2108963, Report of [AT115e][821][SON/MDT] 2-Step RA related SON (OPPO)
2. R2-2107507, Remaining Issues and New Aspects in 2-step NR UE RACH Report, Nokia
3. R2-2108354, 2-step RA related enhancements, ZTE
4. R2-2108418, 2-step RA information for SON purposes, Ericsson
5. R2-2108542, SON Enhancement for 2-step RA, CMCC