3GPP TSG-RAN WG2 Meeting #109bis-e R2-2003930

Online, April 20th – 30th , 2020

**Agenda item: 7.1.10**

**Source: Qualcomm Inc (summary rapporteur)**

**Title: [AT109bis-e][415][eMTC/NB-IoT] Connection to 5GC - Open issues (Qualcomm)**

**Document for: Report**

# 1 Scope of the document

This document aims to discuss list of remaining open issues (which were not discussed from summary doc [12]) and provide summary as per below email discussion:

* [AT109bis-e][415][eMTC/NB-IoT]  Connection to 5GC - Open issues (Qualcomm)

      Scope: Remaining open issues on connection to 5GC.

      Intended outcome: Report including a list of proposals categorized as agreeable, need further discussion etc. The outcome can be provided in R2-2003930.

      Deadline: Friday, Apr. 24th 10:00 UTC

**During RAN2#109bis-e, 04-22-2020 web conf session, following agreements were made**

**Agreements**

- If RRCConnectionResume message received in response to MO-EDT includes fullConfig, the UE considers the data were successfully transmitted.

- Upon fallback to RRC connection setup procedure during RRC connection resumption when connected to 5GC, eMTC UEs use default NR-PDCP configuration for all subsequent messages via SRB1.

- In TS 36.306 a separate table is introduced for BL UEs and the existing Cat M categories are removed.

Section 2 provides summary of open issues for further discussion. This section includes topics which were discussed during RA2#109bis-e online discussion on 04-22-2020 but no consensus.

Section 3 provides summary of open issues (which are pending online discussion) based on [Pre109bis-e][NBIOT/eMTC] Summary of eMTC/NB-IoT connected to 5GC [12]. Companies may still provide any updated comments if any for this section.

Section 4 provides summary of Tdocs submitted for AI 7.1.10, which require online discussion.

# 2 open issues for further discussion

## Early UE capability retrieval enhancements for eMTC/5GC

In case of NB-IoT/EPC, upon eNB receiving Msg 3 from NB-IoT UE, eNB can retrieve UE radio capabilities from MME (by using S1-AP UE Retrieve Information and S1-AP UE Information Transfer) before sending Msg 4 to UE. S-TMSI included in Msg3 is used by eNB to unambiguously identify the MME where the UE is registered with.

In case of NB-IoT/5GC and eMTC/5GC, it should be allowed for ng-eNB to retrieve UE radio capabilities from AMF during RRC Connection Setup procedure, i.e., upon receiving RRC Connection Setup request-NB/RRC Connection Setup Request from UE and before sending RRC Connection Setup-NB/RRC Connection Setup message to UE. From SA2 perspective, it is possible for NG-RAN to retrieve UE capabilities after Msg3 reception as given below.

From TS 23.502 [13], Section 4.24.1

*1a. In the NB-IoT case, during step 1 the NG-RAN, based on configuration, may retrieve the NB-IoT UE Priority and the Expected UE Behaviour Parameters from the AMF, if not previously retrieved. Based on such parameters, the NG-RAN may apply prioritisation between requests from different UEs before triggering step 2 and throughout the RRC connection.* ***The NG-RAN may retrieve additional parameters (e.g. UE Radio Capabilities).***

**Motivation for eMTC:**

When UE is using CP C-IoT EPS/5GS optimization, data is sent in Msg5 (i.e., RRCConnectionSetupComplete message carrying NAS PDU). Therefore, correct configuration of PDSCH/PUSCH for Msg4/Msg5 is important in terms of resource efficiency, latency and hence power saving.

**Example use cases for eMTC:**

When ng-eNB receives Msg3 from UE, it would not have the information of UE’s capability to provide the correct RRC configuration in Msg4. For example, 14 dBm power class UE elevates the PRACH CE level, network needs to know UE’s capability (powerClass-14dBm-r15) in order to efficiently use the UL and DL resources.

In RAN2#101bis, it was companies’ understanding that network should be able to retrieve UE’s context after Msg3 as indicted in discussion report [14] below.

***Discussion point 4.*** *With above information, companies are invited to provide their comments on the understanding that the eNB can choose suitable downlink repetitions for MSG4 based on the determined CE level and the knowledge of UE capability. Companies are also invited to provide their comments on whether it is not needed to indicate UE lower power class in MSG3.*

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| **Company** | **Short answer****Not need/Need** | **Comments** |
| ZTE | Not need | We agree the understanding that eNB can choose suitable downlink repetitions for MSG4 based on the determined CE level and the knowledge of UE capability obtained from eNB or MME.So we think we don’t need to introduce new indication in MSG3. |
| Ericsson | No need | eNB can fetch the UE context in UP solution or use S1AP signalling in CP solution to retrieve the UE capability in case it would like to compensate repetitions for Msg4. On top of this, we do not think there is need for any additional indication.  |
| Huawei, HiSilicon | Not needed |  |
| Qualcomm | Not Needed | For most cases eNB should be able to obtain UE capability information from MME after MSG3. Only case this would not be possible when UE is registering. |
| Intel | Not needed | Since the size of Msg4 is larger than the RAR, we see benefit of knowing lower UE power class after Msg3 to save some DL resource due to repetitions for Msg4. We are fine if it can be resolved by network by retrieving the UE context earlier (i.e., after Msg3) most of the time. |
| Sierra Wireless | Not needed | MME can provide the information to the eNB. (If we ever define an option for higher power class UE to request the low power class then we might need to introduce a UE indication.) |
| LG | Not needed |  |

Early termination of PUSCH has been introduced in Rel-15 so that UE can save power by not transmitting unnecessary repetitions and network can reuse the remaining allocated PUSCH resource for other purpose. This benefit won’t be realized for Msg5 if network cannot retrieve the UE capability (i.e., ce-UL-HARQ-ACK-Feedback-r15) early and configure it (i.e., mpdcch-UL-HARQ-ACK-FeedbackConfig-r15) in Msg4. In addition, pucch-NumRepetitionCE-Msg4-Level3-r14 (e.g., new repetition numbers n64 and n128 for PUCCH) is configured as common configuration in system information for HARQ feedback of Msg4. But, network would not know UE has capability (i.e., ce-PUCCH-Enhancement-r14) to use it.

After Msg3, network may also want to know if the UE is non BL UE or Cat M2 UE, for example, to know supported maximum bandwidth and TBS size (e.g., ce-PUSCH-NB-MaxTBS-r14 and ce-PDSCH-PUSCH-MaxBandwidth-r14) specially when these UEs want to send a larger UL data using CP CIoT EPS/5GS optimization. It would be very power consuming and resource consuming to send RRC reconfiguration message after Msg4.

**Discussion Point P1: Do companies agree with the motivation for introduction of early eMTC UE capability retrieval by ng-eNB from AMF? If not, please explain details in comments section below.**

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| **Company** | **Yes or No** | **Comments** |
| QC | Yes | If this feature is not introduced in R16, it is not possible to introduce in later releases without using spare bit in Msg3. RAN2 impacts are minimum. SA2 already supported UE capability retrieval for NG-RAN and RAN3 is already working on draft CRs to align with SA2 spec.“m and n” used for truncated 5G-S-TMSI is already supported for NB-IOT CP Optimization Re-establishment and is not additional work for SA2/RAN3/CT1.In R16, NR co-existence and multiTB scheduling are introduced for both EPC and 5GC and both will have UE capabilities for DL and UL.In case of eMTC UEs, for CP Optimization, (ng)-eNB need to know these R16 capabilities after Msg 3 to determine how to configure and schedule these UEs. |
| Huawei | Yes  | We agree that it would be nice to have but is not absolutely essential. In EPC and 5GC, it is only specified for NB-IoT (the paragraph 1a in 23.502 only applies to NB-IoT). In EPC also there is no guarantee that the MME supports this in other cases. It is even likely that the MME does not support if it does not support NB-IoT. |
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Conclusion:

Yes : 3 companies (QC, Huwaei, Thales)

In below discussion, Thales agree with motivation. So counting towards this question as well.

One company indicated that if this feature is not introduced in R16, it is not possible to introduce in later releases without using spare bit in Msg3. RAN2 impacts are minimum.

Another company agree with motivation of this feature but says it is not absolutely essential.

Rapporteur thinks it is beneficial to have this feature for eMTC as well. Thus, following is proposal

**Proposal 1: RAN2 agrees to introduce enhancements for early eMTC UE capability retrieval (i.e after Msg3 reception) by ng-eNB from AMF.**

If RAN2 agrees with the motivation for introducing this enhancements then we need to discuss about potential solution.

Document [1] discussed about enhancements required to enable ng-eNB to retrieve UE radio capabilities from AMF after receiving Msg 3 from eMTC/5GC UE and proposals are given below:

* **P1.1 : For eMTC connected to 5GC, adopt 40 bit truncated 5G-S-TMSI as UE Identity in RRC Connection Request Message.**
* **P1.2 : RAN2 agrees that “m and n” values for truncated 5G-S-TMSI are provided to UEs in 5G NAS layer (same solution adopted for NB-IoT CP Optimization Re-establishment).**
* **P1.3 : Introduce an indicator in SIB1 to indicate whether eMTC UEs connected to 5GC are allowed to use truncated 5G-S-TMSI as UE identity in Msg3.**
* **P1.4 : If truncated 40 bit 5G-S-TMSI is used in Msg 3 for eMTC UE connected to 5GC, there is no need for including ng-5G-S-TMSI-Part2 in Msg 5.**
* **P1.5 : For R16 eMTC/5GC UEs, it is mandatory to support truncated 5G-S-TMSI as UE identity in Msg3 without any UE capability.**
* **P1.6 : Send LS to SA2, RAN3 and CT1 and draft available in R2-2002611**

Rapporteur wants to emphasize that if we want to introduce such functionality in future release and not in Rel-16, that would require differentiating msg3 with or without truncated 5G-S-TMSI, and that would be almost impossible given that there is only one spare bit left in msg3 for eMTC.

**Discussion Point P2: Do you agree with above proposals P1.1 to P1.6? Please provide your comments to for each proposal, if any.**

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| **Company** | **Do you agree with the proposals P1.1 to P1.6 above?** | **Comments** |
| QC | Yes | Same comments as above. |
| Huawei | P1.1..P1.5: NoP1.6: FFS | P1.1..P1.5: We do not agree with discussing in RAN2 a solution for a system wide feature, this is SA2 job.If we send a LS, we just ask SA2 about the feasibility, indicating that we have only 40 bits available for the UE identification, nothing else, same as we did for CP re-establishment.  |
| Thales | Yes | Feature should be also available for eMTC, from Rel.-16 onwards, we see this beneficial. Introduction later than Rel.-16 would require differentiating msg3 with or without truncated 5G-S-TMSI, and our understanding is that there is only one spare bit left in msg3 for eMTC.  |
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Conclusion:

Yes : 2 companies (QC, Thales)

NO: 1 company

One company thinks that this has system wide impact and need to be discussed in SA2 first. They just want to send LS to SA2 about feasibility for truncated 5G-S-TMSI inclusion in Msg3 due to limited Msg 3 size.

1. other companies agree with motivation, proposals and sending LS as well.

Since there is clear technical benefit of introducing this enhancement for eMTC. The proposed solution (i.e truncated 5G-S-TMSI) is already supported for NB-IOT CP-Optimization Re-establishment. SA2, RAN2, RAN3, CT1 have already adopted this solution for NB-IOT case. There is no significant new spec impact for other working groups. From RAN2 point, it is key to have this feature introduced in R16 time frame itself to avoid using spare bit in Msg 3. Due to limited time availability, rapporteur suggests RAN2 to agree these proposals and send LS to SA2, RAN3, CT1 requesting them to introduce this enhancements. LS can include motivation and RAN2 agreements.

Other logical question is what about eMTC/EPC. In current SA2, RAN3 specification, there is already S1-AP signalling frame work supported for NB-IOT/EPC. In same LS, we can ask them to look at introducing it for eMCT/EPC as well.

If there are any issues from other working groups, RAN2 can decide based on any reply LS received.

**Proposal 2: RAN2 agrees to send an LS to SA2, CC: RAN3, CT1 asking them to introduce enhancements for early eMTC UE capability retrieval (i.e after Msg3 reception) by (ng)-eNB from AMF/MME and LS includes motivation and RAN2 agreements.**

**Proposal 2.1 : For eMTC connected to 5GC, adopt 40 bit truncated 5G-S-TMSI as UE Identity in RRC Connection Request Message.**

**Proposal 2.2 : RAN2 agrees that “m and n” values for truncated 5G-S-TMSI are provided to UEs in 5G NAS layer (same solution adopted for NB-IoT CP Optimization Re-establishment).**

**Proposal 2.3 : Introduce an indicator in SIB1 to indicate whether eMTC UEs connected to 5GC are allowed to use truncated 5G-S-TMSI as UE identity in Msg3.**

**Proposal 2.4 : If truncated 40 bit 5G-S-TMSI is used in Msg 3 for eMTC UE connected to 5GC, there is no need for including ng-5G-S-TMSI-Part2 in Msg 5.**

**Proposal 2.5 : For R16 eMTC/5GC UEs, it is mandatory to support truncated 5G-S-TMSI as UE identity in Msg3 without any UE capability.**

## How to report AS RAI when it leads to data segmentation

In document [2], AS RAI reporting was discussed. Summary of discussion point 3 from [2] is shown below:

For discussion point 3: Do you agree that AS RAI, when triggered, should have higher priority than data? Please elaborate on why.

5 companies agree that AS RAI, when triggered, should have higher priority than data. One company did not provide any comments to this discussion point and one company did not state any preference but shared their understanding that AS RAI can have the same priority as existing DL channel quality report MAC CE. Two companies argued that AS RAI should not be provided if including AS RAI would lead to data segmentation.

Based on discussion of [3], the following was agreed.

* For EDT and PUR: When AS RAI is triggered by upper layers but cannot be sent along with the associated MAC SDU due to MAC prioritisation, AS RAI is cancelled.

 FFS non-EDT/non-PUR case

From email discussion [Post109e#47] [15], for discussion point 5, following is summary

NO : 5 companies (QC, BB, Huawei, Ericsson, ZTE)

One company says NO but they don't agree that UE should send AS RAI without data solely as "assistance info".

Yes :1 company ( LG)

FFS : 1 company (Nokia)

If inclusion of R16 AS RAI leads to data segmentation, UE will not include it for Non-EDT/Non-PUR case, R16 AS RAI is not cancelled and is allowed to be sent later. companies indicated that R14 AS RAI is applicable for 5GC as well.

**Proposal: For non-EDT/non-PUR cases, when Rel-16 AS RAI triggered by upper layers is not included in order to avoid data segmentation, the Rel-16 AS RAI is not cancelled.**

**Discussion Point P3: Do companies agree with above proposal “ For non-EDT/non-PUR cases, when Rel-16 AS RAI triggered by upper layers is not included in order to avoid data segmentation, the Rel-16 AS RAI is not cancelled”?**

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| **Company** |  **Yes or No ?** | **Comments** |
| QC |  Yes |  UE should be allowed to send R16 AS RAI in RRC\_CONNECTED state at any time if RAI conditions are met. It is upto UE implementation about triggering conditions. |
| MediaTek | Yes | UE may carry the AS RAI in the next UL data if possible. If there is no more UL grant, UE may choose to send it without any UL data.Test data shows that UE can benefit for power saving by sending AS RAI in good coverage than waiting connection to be released by eNB. UE can choose if the RAI needs to be sent alone based on knowledge of the coverage condition.Suggest leave it to UE implementation that whether and when Rel-16 AS RAI is cancelled. |
| Huawei | FFS | 1. We don’t really understand how it works. RAN2 has agreed “AS RAI, when triggered, should have higher priority than data if including AS RAI would not lead to data segmentation.”What is data segmentation? is that for one RB ? or is it that data have always priority over RAI ? What if data will be segmented regardless of AS RAI being included or not?  2. We should first answer the question whether we can send rel-16 AS RAI standalone (i.e. w/o data).  |
| Ericsson | Yes | No need to cancel the AS RAI in this case – there is a data transmission for which the AS RAI is connected to, thus interpretation and the intention of the code points should be clear.  |
| BlackBerry | Yes | We should leave it to UE implementation. If the UE finds it beneficial then it should be allowed to send the RAI in a next MAC PDU. Maybe the current phrasing is too strong, instead we could say “… is not included in order to avoid segmentation, the UE is **allowed to not cancel** the Rel-16 RAI”. |
| Turkcell | Yes | Same opinion with BlackBerry |
| Thales | Yes | Triggering for AS Rai should be left to UE implementation. |
| LG | FFS | We think two other discussions should be agreed first* whether AS RAI can be signalled alone w/o data
* whether Rel-14 AS RAI is not configured for 5GC

If the UE cannot send Rel-16 AS RAI due to data segmentation, the UE can send BSR=0 if no further UL/DL transmission is expected. If subsequent DL transmission is expected, the connection should be continued. Upon reception of DL transmission and no more transmission is expected at this point, the UE may send BSR=0.The information of Rel-16 AS RAI is different with Rel-14 AS RAI, and Rel-14 AS RAI could be a proper choice without data transmission.If Rel-14 AS RAI is not supported from Rel-16, we think* Rel-16 AS RAI is not cancelled for this case
* Rel-16 AS RAI can be signalled w/o data.
 |

Conclusion :

Yes : 6 companies

FFS : 2 companies

One company is not clear about what is data segmentation.

Rapporteur clarifies that due to limited UL grant size if a MAC PDU can not accommodate all MAC SDUs (i.e data) and AS RAI in same MAC PDU, based on priority rules UE may have to drop sending AS RAI. In some case even if all data can not be sent in same MAC PDU even without including AS RAI, UE may have to send high priority logical channel data in current grant and drop remaining data. The remaining data can be sent in subsequent UL grants. Based on UE implementation, AS RAI can be sent later.

Based on clear majority view, following is proposal

**Proposal 3: For non-EDT/non-PUR cases, when Rel-16 AS RAI triggered by upper layers is not included in order to avoid data segmentation, then the Rel-16 AS RAI is not allowed to be cancelled.**

But there is no consensus about how eMTC/NB-IoT connected to 5GC in RRC\_CONNECTED state reports AS RAI to ng-eNB. Some companies prefer to use R16 AS RAI and some companies prefer to use R14 AS RAI.

Note that reporting of R14 AS RAI means (i.e when ***rai-Activation is*** configured***)*** UE sends null BSR (i.e. zero byte BSR) and R16 AS RAI reporting is by using MAC CE used for Channel Quality reporting. Both mechanisms require MAC CE and amount of overhead is same. R14 AS RAI null BSR indicates that there is no more UL data and R16 AS RAI indicates more information by using 2 bit code-point (mandatory support for 5GC UEs).

R14 MAC functionality is given below:

*-    if rai-Activation is configured, and a buffer size of zero bytes has been triggered for the BSR, and the UE may have more data to send or receive in the near future:*

*-     cancel any pending BSR.*

Rapporteur thinks that sending R14 RAI and R16 RAI has same overhead (i.e 2 bytes MC CE overhead) and R16 RAI provide more information than R14 RAI.

**Proposal 3-1: UE in RRC\_CONNECTED can send Rel-16 RAI without any UL data.**

**Discussion Point P3-1: Do you agree on proposal 3-1?**

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| **Company** | **Yes/No** | **Comments** |
| QC | Yes |  |
| MediaTek | Yes | For the use case of pure DL data services like FOTA or some cases that the last packet is DL and UE (maybe application on UE) only can decide to release connection after that, there would be no chance for UE to send RAI with UL data. And it shouldn’t blame the network why not release the connection as soon as the service ends, because it may depend on the needs that the application to notify eNB to release the connection, which is not accountable. Since the RAI is sent by UE, so just let the UE has full capacity to suggest the right time of releasing the connection, i.e. support the condition of no UL data. R14 AS RAI (BSR=0) is not suitable for this use case. There is no condition in the specification that allows triggering a BSR=0 for RAI purpose when there is no UL grant.As for the consideration of power consumption that it might be saving power to wait for the connection to be released contrast to initiate a random access procedure proactively to release it. The test data shows that in good coverage UE can benefit from initiating random access, but in bad coverage, it can’t. Considering the major of UE should be in good coverage, and UE has the knowledge of the coverage condition, UE can choose which way is beneficial, this proposal can benefit for power saving.Even it doesn’t benefit the power consumption, it still can benefit the latency in some cases (e.g. OTDOA, it needs to release the connection to perform the measurement in idle state). In conclusion, UE needs RAI without any UL data in some cases, it can benefit for power saving for some cases, it can benefit for latency for some cases even when it’s not optimized for power saving and R14 AS RAI cannot help.  |
| Huawei | Yes | This was our understanding and this is why we agreed to have it applicable to the CP solution.Also, in the case where the data have already be transmitted and AS RAI not included to avoid segmentation but we are still waiting for a DL, how do we indicate this to the eNB? This is not possible with Rel-14 AS RAI |
|  Ericsson | Yes | OK to us after further consideration. |
| BlackBerry | Yes |  |
| Turkcell | Yes |  |
| LG | FFS | Depending on the next discussion, Rel-14 AS RAI |

Conclusion:

Yes: 6 companies (QC, MediaTek, Huawei, Ericsson, BlackBerry, Turkcell)

FFS: 1 company (LG)

Based on clear majority view,

**Proposal 3-1: UE in RRC\_CONNECTED is allowed to send Rel-16 RAI without any UL data.**

**Proposal 3-2: Rel-14 AS RAI is not configured for the UE connected to 5GC.**

**Discussion Point P3-2: Do you agree on proposal 3-2? If not, please explain benefits of R14 AS RAI for 5GC UEs**

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| **Company** | **Yes/No** | **Comments** |
| QC | Yes | R16 AS RAI and R14 AS RAI both require MAC CE. R16 AS RAI is agreed as mandatory for UE to support. R16 RAI provides more info than R14 AS RAI. We don’t see any reason to support both for 5GC UEs. |
| MediaTek | Yes  | Agree with Qualcomm |
| Huawei | Yes | 1. This is related to P3-1. If we can send Rel-16 AS RAI standalone to indicate waiting for a DL packet, we should also be able to send it to indicate no UL/DL.2. It will make the UE implementation complex if it needs to switch between both mechanisms depending on the actual ‘RAI’.  |
| Ericsson | No | First, it is not clear to us why it should be prohibited to use it just based on the core network type. This is a RAN feature and in principle CN type shouldn't matter – it seems nothing is really solved by agreeing to this proposal as the functionality would still work, even if R16 AS RAI is supported as well. There is at least one use case where R14 AS RAI would be beneficial: In case UE has triggered BSR=0 already, but also would like to indicate to (ng-)eNB there is no more data – if not possible to configure/use R14 AS RAI in this case, the MAC CE for R16 AS RAI needs to be added which in this case would be unnecessary. If R14 AS RAI follows BSR triggering rules in any case, there doesn't seem to be additional complexity on UE side for the feature.  |
| BlackBerry | Yes |  |
| LG | Yes | Agree with Huawei’s first comment. |
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Conclusion:

Yes : 5 companies

No : 1 company

One company indicated that “ There is at least one use case where R14 AS RAI would be beneficial: In case UE has triggered BSR=0 already, but also would like to indicate to (ng-)eNB there is no more data – if not possible to configure/use R14 AS RAI in this case, the MAC CE for R16 AS RAI needs to be added which in this case would be unnecessary. If R14 AS RAI follows BSR triggering rules in any case, there doesn't seem to be additional complexity on UE side for the feature.”

From above description, it is not clear what is major benefit of R14 AS RAI over R16 AS RAI ?

Having UE to maintain single R16 AS RAI is simpler than having 2 different AS RAI support for different scenarios and simplifies UE logic for implementation.

Based on clear majority view,

**Proposal 3-2: Rel-14 AS RAI is not configured for the UE connected to 5GC.**

# 3 Summary of open issues not discussed from [Pre109bis-e][NBIOT/eMTC] Summary of eMTC/NB-IoT connected to 5GC [12].

For section 3, I copied discussion and companies view from [12]. If any company wants to add additional comments, pls feel free to update your comments for this section.

## 3.1 RRC Indication to 5G NAS about AS entering into RRC\_INACTIVE vs UP 5GC CIoT Optimization

CT1 has sent a LS [4] asking for clarification on how NAS could distinguish between suspension to RRC\_INACTIVE and Suspension to RRC\_IDLE in 5GC.

The same issue was raised in [5]. From 5G NAS, perspective

* For RRC\_INACTIVE state, NAS will be in CM\_CONNECTED state
* For UP CIoT 5GC Optimization, 5G NAS will be in CM\_IDLE with suspended state

When UE AS enters into either RRC\_INACTIVE and UP CIoT 5GC Optimization, RRC has to indicate to indicate to 5G NAS about which AS optimization is used to enable 5G NAS to use appropriate 5G NAS procedures.

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| There seems to be an ambiguity associated with the suspend indication that the RRC provides to the NAS as follows:1. Section 5.3.8.7 of TS 36.331 (titled: UE actions upon entering RRC\_INACTIVE) states:

“*1> indicate the suspension of the RRC connection to upper layers;*”1. For a UE that is using user plane CIoT 5GS optimization, section 5.3.12 of TS 36.331 (titled: UE actions upon leaving RRC\_CONNECTED or RRC\_INACTIVE) states:

 “*1> if leaving RRC\_CONNECTED was triggered by suspension of the RRC:**… [SKIP] …**2> store the following information provided by E-UTRAN:**3> the resumeIdentity;**… [SKIP] …**2> indicate the suspension of the RRC connection to upper layers;*”For the UE in WB-E-UTRA that is using user plane CIoT 5GS optimization, the NAS cannot know the trigger for the suspend indication from the lower layers i.e. RRC entering RRC inactive state or a suspension of the RRC connection for user plane CIoT 5GS optimization. **ACTION:** CT1 kindly requests RAN2 to clarify how the NAS can differentiate the two triggers for a suspend indication received from the RRC described above. |

**Proposal 5-1: For eMTC connected to 5GC, when UE RRC enters into either RRC\_INACTIVE state or UP CIoT 5GC Optimization, RRC procedure has to clearly indicate about RRC state to 5G NAS to enable 5G NAS using appropriate procedure.**

**Discussion Point P4: Do you agree with above proposals P5-1?**

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| **Company** | **Yes or No** | **Comments** |
| QC | Yes | This is needed to avoid 5G NAS ambiguity of whether AS entered into RRC\_INACTIVE or UP Optimization. Depending on AS state, 5G NAS CM state would be different. |
| BB | Yes | Useful for AS/NAS synchronization. |
| Huawei | Yes | But we should avoid to impact legacy eLTE (RRC\_INACTIVE). so the default should be RRC\_INACTIVE |
| Ericsson | Agree on intention but not agree on wording | We don't think the RRC layer should indicate which RRC state is used, as that information would be specific to RRC layer only. However, the indication should contain unambiguous information to NAS layer on which type of suspension is done so that it is unambiguous whether CN considers the UE to be connected or not. We suggest to indicate in 5GC UP optimization case that it considers 5GC UP optimization, e.g. "indicate the suspension of the RRC connection for user plane CIoT 5GS optimization to upper layers" and keep the RRC\_INACTIVE indication intact.  |
| LG | Yes |  |
| ZTE | Yes | The wording can be further discussed. |

Conclusion:

Yes : 6 companies

All companies agree with intention. But wording can be discussed during CR discussion.

**Proposal 4: For eMTC connected to 5GC, when UE enters into either RRC\_INACTIVE state or UP CIoT 5GC Optimization RRC suspension, RRC has to clearly indicate whether RRC entered in RRC\_INACTIVE state or UP Optimization RRC suspension to 5G NAS.**

## 3.2 UAC check for eMTC in RRC\_CONNECTED after handover

UAC check for eMTC UEs in RRC\_CONNECTED mode was discussed at RAN2#109e and the following agreement was made:

* BL UEs or UEs in CE in RRC\_CONNECTED mode performs access barring check based on the latest UAC parameters acquired prior to entering RRC\_CONNECTED.

However, the issue of handover was not discussed. Section 5.3.16.1 requires the UE to acquire a valid version of SIB25 in the target cell. As per section 5.2.1.3, this is not feasible for eMTC UEs.

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| --- |
| 5.3.16.1 GeneralThe purpose of this procedure is to perform access barring check for an access attempt associated with a given Access Category and one or more Access Identities upon request from upper layers according to TS 24.501 [95] or the RRC layer.After a handover resulting in change of PCell in RRC\_CONNECTED the UE shall defer access barring checks until it has obtained valid UAC information (from SystemInformationBlockType25) from the target cell if the SystemInformationBlockType25 is broadcasted. |

5.2.1.3 System information validity and notification of changes

In RRC\_CONNECTED, BL UEs or UEs inCEor NB-IoT UEs are not required to acquire system information except when T311 is running, or upon handover where the UE is only required to acquire the *MasterInformationBlock* in the target PCell, or for UEs in CE to receive ETWS/CMAS information. In RRC\_IDLE, E-UTRAN may notify BL UEs or UEs inCEorNB-IoT UEs about SI update, and except for NB-IoT, ETWS and CMAS notification, EAB modification and UAC modification, using Direct Indication information, as specified in 6.6 (or 6.7.5 in NB-IoT) and TS 36.212 [22].

NOTE 2: Upon system information change essential for BL UEs, UEs in CE, or NB-IoT UEs in RRC\_CONNECTED, E-UTRAN may initiate connection release.

**Discussion Point P5: Do you agree that eMTC/5GC UEs are not required to acquire SIB25-BR of target cell after handover?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| QC | Yes |  This should be similar to handling of SIB14 in EPC case during handover and RAN/cell specific barring parameters should not be applicable if target accepts HO request. We do not expect any change to CN specific barring parameters and UE should apply the stored unified access control information, if any, in the target cell. |
| BB | Yes | We can keep the EPC principles unless a new issue is raised. |
| Huawei | Yes | We think it is different from EPC because there is no access barring check in connected mode. This can be solved by eNB implementation, e.g. release the UE is access control parameters are different in the target cell.We still need to clarify in 5.3.16.1 the behaviour for the eMTC, i.e. either carrying on with the parameters acquired before entering RRC\_CONNECTED or consider after handover that SIB25-R is not broadcast in the new cell |
| Ericsson | Yes | We think RAN2 should further discuss whether SIB25 should be acquired in one way or another for handover purposes. UAC should be supported in RRC\_CONNECTED if possible, this is a requirement in TS 22.261. After handover, UE would typically have no information of any previously configured UAC parameters in a new cell, thus there is nothing to compare against (cf. the solution of checking the latest UAC parameters in non-HO case).Exception could be made for SIB25 or information could be provided during handover if agreed be supported. Update: We agree with QC view on this issue – i.e. we could follow the legacy principles with this. |
| LG | Yes |  |
| ZTE | FFS | With current specification, the eMTC UE cannot acquire SIB25-BR of target cell after handover in RRC\_CONNECTED. We disagree with QC that UE should apply the stored unified access control information, if any, in the target cell. This may cause issues, e.g, in the case that an Access Category or Access Identity is not barred in source cell but barred in target cell. For the eNB implementation way mentioned by HW, we are also not sure whether it’s feasible or whether it may cause bad UE experience.We tend to agree with Ericsson that maybe we can further discuss whether SIB25 could be provided during handover, e.g., via handover command message? |

Conclusion:

Yes : 5 companies (QC, BB, Huawei, LG, Ericsson)

One company thinks that it is different from EPC because there is no access barring check in connected mode.

This can be solved by eNB implementation, e.g. release the UE is access control parameters are different in the target cell and clarification needed in 5.3.16.1 the behaviour for the eMTC, i.e. either carrying on with the parameters acquired before entering RRC\_CONNECTED or consider after handover that SIB25-R is not broadcast in the new cell

FFS : 1 company (ZTE)

UAC should be supported in RRC\_CONNECTED if possible, this is a requirement in TS 22.261. After handover, UE would typically have no information of any previously configured UAC parameters in a new cell, thus there is nothing to compare against (cf. the solution of checking the latest UAC parameters in non-HO case).

 One company think that exception could be made for SIB25 or information could be provided during handover if agreed be supported.

**Proposal 5: eMTC/5GC UEs are not required to acquire SIB25-BR of target cell after handover**

**Proposal 6: RAN2 to discuss whether SIB25-BR can be provided during HO signalling procedure, or whether to leave it to ng-eNB implementation**

# 4 Summary of proposals submitted for AI 7.1.10

|  |  |  |
| --- | --- | --- |
| [6] | Qualcomm, TurkCell | **Title: Idle Mode cell reselection based on CN type supported** **Observation 1: Inter CN mobility during RRC\_IDLE/RRC\_INACTIVE state increases UE battery drain and increased inter-CN signaling between EPC and 5GC.** **Observation 2: During initial CN migration, it is possible that different regions will have different CN type connectivity support.****Observation 3 : Based on device population supporting EPC only and EPC + 5GC, different bands/frequencies may be configured to support different CN types to cater to different CN type traffic.****Observation 4 : If UE upon cell re-selection camps on a cell that does not support the current CN type, then NAS is forced to select a different CN type and NAS only based solution does not solve CN type ping-pong issue.****Observation 5 : It is not possible to use existing Qoffset parameter to add additional offset value (as function of CN type supported by target cell frequency) to minimize CN type ping-pong during idle cell reselection.****Observation 6 : Prioritization of intra frequency cells of desired CN type over other cells causes UE to camp on inferior radio quality cells and causes intra frequency interference and increases unnecessary ping-ping reselections.****Proposal 1. For ranking based inter-frequency Idle cell-reselection for eMTC and CE mode UEs , consider target frequencies with same CN type as registered CN type are higher priority than frequencies with supported CN type different from registerd CN type.****Proposal 2. Adapt SIB5-BR enhancements to include CN type supported for inter-frequencies as assistance information for inter-frequency idle cell reselection.** **Squal < ThreshServing, LowQ and****Proposal 3. For high priority inter-frequency Idle cell-reselection for eMTC UEs in normal coverage , use new parameter Qoffsetfreq\_cn\_type for neighbor cell evaluation criteria when inter-frequency cell is connected to different type of core network than registered CN type.** **Squal > ThreshX, HighQ + Qoffsetfreq\_cn\_type during a time interval TreselectionRAT****Proposal 4. For low priority inter-frequency Idle cell-reselection for eMTC UEs in normal coverage , use new parameter Qoffsetfreq\_cn\_type for neighbor cell evaluation criteria when inter-frequency cell is connected to different type of core network than registered CN type.**  **Squal < ThreshServing, LowQ and Squal > ThreshX, LowQ + Qoffsetfreq\_cn\_type during a time interval TreselectionRAT****Proposal 5. For ranking based inter-frequency NB-IoT and eMTC Idle cell-reselection , use new parameter *Qoffsetfreq\_cn\_type* for neighbor cell ranking criteria evaluation when inter-frequency cell is connected to different type of core network than registered CN type.** ***Rs = Qmeas,s + Qhyst – Qoffsettemp + QoffsetSCPTM*** ***Rn = Qmeas,n - Qoffset – Qoffsettemp + QoffsetSCPTM - Qoffsetfreq\_cn\_type*****Proposal 6. Enhance SIB5-NB to include CN type (EPC & 5GC) connectivity supported by different NB-IoT neigbor cell frequnecies.****Proposal 7. In SIB1-BR/NB, support inter-frequnecy CN type connectivity configuration per PLMN and/or common across all PLMNs in the list** |

This issue was disused as part of email discussion [108#97] for how to minimize ping-pong between CN types in RRC\_IDLE/RRC\_INACTIVE. This topic was postponed in RAN2#109e.

**Discussion Point P4: Do companies agree with above proposals P1-P7 from [6]?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| QC | Yes | In last RAN2 meeting, it was postponed. There are deployment scenarios, where inter CN ping pong can happen. NAS based solution does not work for all cases. AS based enhancements are needed to mitigate ping-pong issue. Note that Non-BL UEs in CE mode, BL UEs, NB-IoT UEs used ranking based idle cell reselection and frequency priority can not be used.  |
| Huawei | No |  |
| Ericsson | No | We still don't see there is a use case which needs to be addressed really, and as brought up during earlier discussions, there are ways to minimize such issues e.g. though network planning and network configuration.  |
| SONY | Partly Yes | We prefer a simple solution by just adding CN-type to SIB4&5, as described in R2-1915237, at RAN2#108 meeting |
| LG | No |  |
| Turkcell | Yes | Qoffsetfreq can bring flexibility to operators.  |
|  |  |  |

Yes : 2 companies

Partly Yes : 1

No : 3 companies

Operator commented that it gives flexibility for deployment.

**Proposal 7: RAN2 to further discuss about solution for how to minimize idle mode CN ping-pong issue and proposals from R2-2002609.**

|  |  |  |
| --- | --- | --- |
| [9] | Ericsson | Title: AS RAI and optimization of release[Observation 1 If AS RAI is provided from the UE indicating that no subsequent DL and UL data transmission is expected, or only a single downlink data transmission subsequent to this uplink data transmission is expected, the eNB can release the UE immediately.](#_Toc32833822)[Observation 2 If AS RAI is provided from the UE indicating that no subsequent DL and UL data transmission is expected, or only a single downlink data transmission subsequent to this uplink data transmission is expected, the ng-eNB can release the UE immediately.](#_Toc32833823)[Observation 3 UE power consumption is not optimized if eNB waits for an acknowledgement from the MME/AMF when UE indicates AS RAI implying that no further data are expected from the S-GW and therefore the eNB can initiate the suspension of the S1 connection and the deactivation of the S1-U bearers immediately.](#_Toc32833824)[Proposal 1 From RAN2 standpoint, it would be beneficial if eNB releases the UE immediately, i.e., without waiting for an acknowledgement from the MME/AMF if the UE indicates AS RAI implying that no further data are expected from the S-GW.](#_Toc37376076)[Proposal 2 Send a LS to SA2 to communicate the evaluation above and take the suggestion into account. Also indicate there is a risk that CN may need to release the UE context in RAN to make the UE reachable for the CN and ask if there is a way to minimize this risk in order to secure that the UE power consumption is the lowest possible.](#_Toc37376077)**Draft LS provided in [13]** |

**Discussion Point P5: Do companies agree with above proposals P1-P2 from [9] ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| QC | No | UE AS RAI is assistance info only. Ng-eNB shall not release RRC connection without getting ACK from AMF. AMF only knows if there is any pending signalling , SMS, any other data and UE may not know all this NW pending data.If ng-eNB prematurely releases RRC connection without waiting for AMF ACK, if there is any pending DL data, SMS, Signalling in AMF then AMF has to page UE and another connection setup is needed. Which adds more signalling overhead and additional UE power consumption.This issue was discussed in SA2 for almost 4 meeting and it was decided not to allow ng-eNB to release RRC connection without contacting AMF. This is more of network system issue than RAN2 issue and we don’t see any need to discuss this issue in RAN2.SA2 agreed CR : [**S2‑1910765**](https://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_135_Split/Docs/S2-1910765.zip) |
| Huawei | No | As indicated by QC, this has been discussed in SA2 for several meetings and we should not reopen the discussions.Note that with the agreed SA2 solution, the additional ‘delay’ is 20ms based on RAN3 LS for EDT in rel-15. The impact on UE power consumption is negligible compared to the overall system impact.  |
| Ericsson | Yes | We agree that the AS RAI is for assistance information. We think in principle it should be up to (ng-)eNB to decide. If eNB does not know anything about whether there is pending data in the DL, it would not release the UE. We think it is possible for the eNB to know that, however such discussion should take place in SA and thus the need to send the LS to indicate that it would be beneficial from RAN2 perspective. The intention of the discussion here is to convey RAN2 view that leaving the release up to eNB can have benefits when it comes e.g. to UE power consumption. Unfortunately, SA2 did not consider consulting RAN2 on whether such would be beneficial earlier. From RAN2 perspective, there can be benefits for UE power consumption with possible quicker release and in principle we think RAN should be in charge of releasing the UE especially for RAN features such as EDT and PUR. |
| SONY | Yes | We agree with the combination of P1 and P2, where SA2 can further discuss and improve the solution they currently have agreed on, that has not been fully aligned with RAN2. |
| LG | Yes | AS RAI is based on upper layers information. We don’t think RAN should always check with the MME/AMF. If there would be pending signalling or data, it will be rare cases. So, we think immediate release is beneficial for UE power consumption.  |
|  |  |  |
|  |  |  |

No : 2 companies

Yes : 3 companies

From rapporteur point of view, this is system level issue discussion than RAN2 alone. As far as I know, this issue was extensively discussed in SA2 already by taking all aspects into consideration. Another aspect is if ng-eNB prematurely releases RRC Connection based on AS RAI indication and if there is potential state mismatch between ng-eNB and AMF. If ng-eNB prematurely releases RRC connection without waiting for AMF ACK, if there is any pending DL data, SMS, Signalling in AMF then AMF has to page UE and another connection setup is needed. Which adds more signalling overhead and additional UE power consumption.

But there is no con consensus in this offline discussion.

**Proposal 8: RAN2 to further discuss whether to send LS to SA2 about how ng-eNB decides to release RRC connection based on AS RAI received from UE (i.e without waiting for any ACK from AMF).**

# 5 Summary

**Summary proposals for easy agreements:**

**Proposal 1: RAN2 agrees to introduce enhancements for early eMTC UE capability retrieval (i.e after Msg3 reception) by ng-eNB from AMF.**

**Proposal 2: RAN2 agrees to send an LS to SA2, CC: RAN3, CT1 asking them to introduce enhancements for early eMTC UE capability retrieval (i.e after Msg3 reception) by (ng)-eNB from AMF/MME and LS includes motivation and RAN2 agreements.**

**Proposal 2.1 : For eMTC connected to 5GC, adopt 40 bit truncated 5G-S-TMSI as UE Identity in RRC Connection Request Message.**

**Proposal 2.2 : RAN2 agrees that “m and n” values for truncated 5G-S-TMSI are provided to UEs in 5G NAS layer (same solution adopted for NB-IoT CP Optimization Re-establishment).**

**Proposal 2.3 : Introduce an indicator in SIB1 to indicate whether eMTC UEs connected to 5GC are allowed to use truncated 5G-S-TMSI as UE identity in Msg3.**

**Proposal 2.4 : If truncated 40 bit 5G-S-TMSI is used in Msg 3 for eMTC UE connected to 5GC, there is no need for including ng-5G-S-TMSI-Part2 in Msg 5.**

**Proposal 2.5 : For R16 eMTC/5GC UEs, it is mandatory to support truncated 5G-S-TMSI as UE identity in Msg3 without any UE capability.**

**Proposal 3: For non-EDT/non-PUR cases, when Rel-16 AS RAI triggered by upper layers is not included in order to avoid data segmentation, then the Rel-16 AS RAI is not allowed to be cancelled.**

**Proposal 3-1: UE in RRC\_CONNECTED is allowed to send Rel-16 RAI without any UL data.**

**Proposal 3-2: Rel-14 AS RAI is not configured for the UE connected to 5GC.**

**Proposal 4: For eMTC connected to 5GC, when UE enters into either RRC\_INACTIVE state or UP CIoT 5GC Optimization RRC suspension, RRC has to clearly indicate whether RRC entered in RRC\_INACTIVE state or UP Optimization RRC suspension to 5G NAS.**

**Proposal 5: eMTC/5GC UEs are not required to acquire SIB25-BR of target cell after handover**

**Proposal 6: RAN2 to discuss whether SIB25-BR can be provided during HO signalling procedure, or whether to leave it to ng-eNB implementation**

**Summary proposals for discussion during online meeting:**

**Proposal 7: RAN2 to further discuss about solution for how to minimize idle mode CN ping-pong issue and proposals from R2-2002609.**

**Proposal 8: RAN2 to further discuss whether to send LS to SA2 about how ng-eNB decides to release RRC connection based on AS RAI received from UE (i.e without waiting for any ACK from AMF).**

# 6 List of referenced documents

[1] [R2-2002610](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002610.zip) Early UE capability retrieval enhancements for eMTC/5GC

[2] [R2-2001474](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109_e%5CDocs%5CR2-2001474.zip) Report - Email discussion [108#96][NB-IoT/eMTC R16] Finalise details on RAI, RAN2#109-e, February 2020

[3] [R2-2001797](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109_e%5C%5CDocs%5C%5CR2-2001797.zip%22%20%5Co%20%22http%3A//www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109_eDocsR2-2001797.zip) [AT109e][309][NBIOT/eMTC] RAI whether AS RAI should be provided in case including AS RAI would lead to data segmentation, RAN2#109-e, February 2020

[4] [R2-2002214](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_109_e/Docs/R2-2002214.zip) LS on suspend indication to the NAS, RAN2#109-e, February 2020

[5] [R2-1914802](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_108/Docs/R2-1914802.zip) UE identity for CIoT/5GC UP Optimization and RRC indication to upper layers, RAN2#108, November 2019

[6] [R2-2002609](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002609.zip)  Idle Mode cell reselection based on CN type supported

[7] [R2-2002610](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002610.zip) Early UE capability retrieval enhancements for eMTC/5GC

[8] [R2-2002611](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002611.zip) [Draft] LS on early UE capability retrieval for eMTC connected to both EPC and 5GC

[9] [R2-2003428](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003428.zip) AS RAI and optimization of release

[10] [R2-2003430](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003430.zip) LS on AS RAI and optimization of release

[11] [R2-2002929](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002929.zip)  Draft reply LS on suspension indication to 5G NAS

[12] [R2-2003796](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003976.zip)  [Pre109bis-e][NBIOT/eMTC] Summary of eMTC/NB-IoT connected to 5GC

[13] TS 23.502 Procedures for the 5G System (5GS)

[14] R2-11805963: Report of email discussion [101#65][LTE/MTC R15] Lower power class UE (ZTE)

[15] R2-2002607: Report of [Post109e#47] Connection to 5GC open issues