3GPP TSG-RAN WG2 Meeting #109e R2-200xxxx

Online, 24 February – 6 March 2020

**Agenda item: 7.1.12**

**Source: Huawei (offline email discussion rapporteur)**

**Title: [AT109e][419][eMTC/NB-IoT] Connection to 5GC: Open Issues (Huawei)**

**Document for: Report**

# 1 Scope of the offline email discussion

This document contains the summary of the offline email discussion  [AT109e][419][eMTC/NB-IoT] Connection to 5GC: Open Issues”, as indicated below:

* [AT109e][419][eMTC/NB-IoT] Connection to 5GC: Open Issues (Huawei)

 Scope: Further discussion to address the remaining issues, i.e., proposals S1-5, S2-2, S3-1, and identify potential agreements.

 Intended outcome: Report with a list of proposals categorized as agreeable, need further discussion, postpone. The outcome can be provided in R2-2001885

 Deadline: Tuesday, Mar 3rd 17:00 CET

 Schedule: Wednesday, Mar 4th, 06:30 - 07:30 CET

Connection to 5GC was discussed in RAN2#109e based on R2-2002014 [1] with the following agreements:

**Agreements**

- DRBs are resumed upon receiving RRCConnectionResume in UP optimization when connected to 5GC.

- When idle mode eDRX is not configured, eMTC UEs in RRC\_INACTIVE monitor the paging occasions according to the shortest of the cell default paging cycle, the UE specific DRX (if configured), and the RAN paging cycle (if configured).

- When idle mode eDRX is not configured, eMTC UEs in RRC\_INACTIVE cannot be configured with values 5.12 sec and 10.24 sec

- DRB resumption for EDT for eMTC UEs connected to 5GC follows the same principle as in EPC, i.e.:

­ drb-ContinueROHC is provided in RRCConnectionRelease message triggering the suspension in RRC\_IDLE. The flag applies to all DRBs.

­ When resuming the DRBs for EDT, RRC procedure text triggers PDCP re-establishment and provides NR PDCP with the drb-ContinueROHC indication received in RRCConnectionRelease message.

The document discusses S1-5, S2-2, S3-1 in [1]

# 2 Discussion

## 2.1 Paging in RRC\_INACTIVE when idle mode eDRX is configured

**[1] Proposal S1-5:** Offline discussion on paging in RRC\_INACTIVE for eMTC UEs configured with idle mode eDRX:

* option 1: UE monitors paging occasions (POs) during CM-IDLE PTW according to the min {UE specific DRX cycle, default DRX cycle, RAN paging cycle} and monitor paging occasions outside CM-IDLE PTW according to RAN paging cycle.
* option 2 :
* If extended RAN paging cycles (i.e. 5.12, 10.24 Sec) are configured, UE monitors paging occasions according to RAN paging cycle
* If extended RAN paging cycles (i.e. 5.12, 10.24 Sec) are not configured, UE monitors paging occasions according to the min {UE specific DRX cycle, default DRX cycle, RAN paging cycle}

For details on the options, please refer to [3], [4] for option 1 and [2] for option 2.

It is proposed to discuss first the feasibility, pros and cons of the two options and then indicate company’s preference.

**Discussion Point P1-1: Indicate whether option 1 is feasible as well as the pros and cons of this option.**

|  |  |  |
| --- | --- | --- |
| **Company** | **is it feasible?** | **Comments** |
| QC | No for Option 1.  | **Option 1**: In RRC\_INACTIVE state, CN paging is sent by AMF only when there is state mismatch and is considered as error scenario.UE in RRC\_INACTIVE state does not have to maintain idle eDRX cycle based POs. When RAN paging cycle is configured, POs of RAN paging cycle will overlap with some of idle mode eDRX POs. Just for monitoring CN paging as per idle eDRX POs, there is no need for RRC\_INACTIVE UE to wake in every PO as per idle mode eDRX PTW (which is power inefficient for UE). Due to state mismatch error scenario , if any CN page is received by ng-eNB from AMF, ng-eNB can buffer and send to UE as per RAN paging cycle POs . * In RRC\_INACTIVE state, CN page delivery delay is not critical but UE power saving is more important.
* Maintaining different POs for CN and RAN paging adds unwanted UE complexity without any major benefit

Note that RRC\_INACTIVE PTW was not agreed due to fact that there is no need for UE to wake multiple times within PTW and RRC\_INACTIVE short eDRX cycles (5.12, 10.24 sec) are not too long and page delivery latency is not a major concern.In R15 eLTE RRC\_INACTIVE case (there is no idle eDRX support), UE does not monitor POs separately for CN and RAN pages.In summary option 1 adds UE complexity, unwanted new PO monitoring rules for CN and RAN page monitoring separately, higher UE power consumption, unnecessary optimization for monitoring error scenarios triggered CN pages. |
| ZTE | Yes for Option 1 | We have concern on the feasibility of option 2, not only considering the UE complexity.Firstly, we disagree QC’s comments that it’s error scenario that CN paging is sent by AMF. Per our understanding, for eLTE or RRC\_INACTIVE, core network may trigger Ng interface release at any time if it can assume there has no pending data. Ng-RAN can response to core network with a release complete message and keep aligned IDLE state with core network. At the same time, there has no way for Ng-RAN to inform UE about this core network release. So the UE would still be in RRC\_INACTIVE state. One possible way for Ng-RAN to make all state alignment may be to paging the UE, establish the RRC connection and then release the UE to IDLE completely. It’s obviously not the preferred way. That’s also why we have the agreement that *“eMTC UEs in RRC\_INACTIVE monitor RAN initiated paging and CN initiated paging via I-RNTI and 5G-S-TMSI respectively”.* Secondly, even for the case that idle mode eDRX is not configured, the above core network release scenario should be taken into account. Therefore, we have the agreement that “*eMTC UEs in RRC\_INACTIVE monitor the paging occasions according to the shortest of the cell default paging cycle, the UE specific DRX (if configured), and the RAN paging cycle (if configured)*”*.* For each PO, UE needs to monitor CN paging or RAN paging. The third and most important point is, as we have mentioned in the above core network release scenario, Ng-RAN would response to core network and transit to IDLE state, we think it’s impossible for Ng-RAN to buffer CN paging as the Ng-RAN would have no any idea about RAN paging cycle. Ng-RAN can only send paging to UE according to default paging cycle and the UE specific DRX*.* If option 2 is agreed, UE would monitor PO by only using RAN paging cycle. And if CN paging cycle is smaller than RAN paging cycle, the CN paging cannot be received and cause paging retransmission from network. The paging may be finally successful at the overlapping point of the RAN paging cycle and CN paging cycle. But it’s obviously paging delay and unnecessary Ng and Uu interface signalling overhead would still be caused. The more CN paging cycle is smaller than RAN paging cycle, the more serious paging delay and signalling overhead. Therefore, per our understanding, both option 2 and the required Ng-RAN data buffering are infeasible. If companies cannot agree such understanding, we (strongly) suggest to send LS to RAN3 to confirm whether and how to support Ng-RAN buffering for this scenario.Back to Option 1, per our understanding, the case that idle mode eDRX is configured and during the PTW is same as the case that idle mode eDRX is not configured, so the UE should have same process on monitoring both CN paging and RAN paging with correct cycle, e.g., to monitor the paging occasions according to the shortest of the cell default paging cycle, the UE specific DRX (if configured), and the RAN paging cycle (if configured). Outside the PTW, as no CN paging would be sent, the UE can only monitor RAN paging by using RAN paging cycle. Therefore, we think it’s straightforward to adopt Option 1.Finally, we cannot see any essential difference in UE process between Option 1 and Option 2. Also taking into account all the existing agreements, we cannot understand why Option 1 would cause additional UE complexity. |
| Huawei | Yes for option 1 | We agree that CN paging in RRC\_INACTIVE state is as mismatch scenario. However, it is not a rare scenario as there are multiple cases specified in SA2 specification that lead to this scenario. If a CN page is received by ng-eNB from AMF, the ng-eNB cannot link the 5G-STMSI received in the paging message to one UE I-RNTI (assuming that the UE is in RRC\_INACTIVE in the eNB), thus buffering at the eNB is not possible and the eNB will send the paging message to the UE according to the eDRX cycle and PTW provided in the CN page request.If the UE does not monitor according to the minimum of (cell paging DRX and UE specific DRX) during the PTW, then there will be paging escalation and paging miss. For example, if the PTW is configured to 10.24s and the RAN paging cycle to 10.24s, there is no possibility for paging escalation at the AMF and the UE will miss the paging if the first paging attempt is not in the cell where the UE is camping.It is correct that in R15 eLTE RRC\_INACTIVE case, UE does not monitor POs separately for CN and RAN pages, but this is because the UE monitors according to the shorter of the three values. If we do the same for eMTC, then there is no power optimisation and there is no point of having value 5.12 and 10.24 for the RAN paging cycle. |
| Ericsson | Yes | We don't understand why it would not be feasible – there can be differences when it comes to the solutions regarding e.g. power consumption but that shouldn't make this solution infeasible?The only downside can be somewhat larger power consumption – but it is also not clear it will be significantly different and would depend on the configuration – e.g. with long idle eDRX difference would be negligible, considering RAN paging would happen much more frequently. The solution is not different from following idle mode eDRX so there should be no added complexity from UE implementation side. Agree with ZTE and HW comments that state mismatch is not a rare error scenario and something that needs to be taken into account, otherwise there is risk of missed pages and impacts e.g. in the paging strategy implementation on CN side. There are multiple different possible scenarios for CN paging as e.g. shown in [3]. |

**Discussion Point P1-2: Indicate whether option 2 is feasible as well as the pros and cons of this option.**

|  |  |  |
| --- | --- | --- |
| **Company** | **is it feasible ?** | **Comments** |
| QC | Yes for Option 2 | **Option 2:** with this option, UE is required to maintain POs based on RAN paging cycles (i.e 5.12, 10.24 sec) and no need to maintain separate POs for CN and RAN Page monitoring. For saving UE power, network can configure 5.12, 10.24 sec short eDRX cycles. In every PO as per RAN paging cycle, UE determines whether received page is RAN or CN page based on paging identity received and this does not cause any additional processing and no additional power consumption.If RAN paging cycle values (320ms, 640ms, 1.28 sec, 2.56 sec) are configured then UE follows legacy mechanism of min {UE specific DRX cycle, default DRX cycle, RAN paging cycle}.In summary, this option simplifies UE implementation, no need to have separate POs for CN and RAN page monitoring, no need for UE maintaining idle mode eDRX and RAN paging cycles in INACTIVE state, higher UE power saving, simplified spec rules. |
| ZTE | No for Option 2 | We have concern on the feasibility of option 2. See the details in our comments for **Discussion Point P1-1.** |
| Huawei | No for option 2 | see our answer to discussion P1-1For this option to work, the only way for the eNB is to configure the RAN paging cycle shorter or equal to the minimum of (Default cell paging cycle and UE specific DRX), which means that the extended RAN paging cycle values will never be used. |
| Ericsson | No | Agree with HW, this would be feasible only if RAN paging cycle always overlaps with possible paging from CN, but effectively this would mean there is no extended DRX.  |

Conclusion: TBC

Proposal: TBC

**Discussion Point P1-3: Please indicate your company’s preference.**

|  |  |  |
| --- | --- | --- |
| **Company** | **option 1 / option 2** | **Comments** |
| QC | Option 2 | See above comments. |
| ZTE  | Option 1 |  |
| Huawei | Option 1 |  |
| Ericsson | Option 1 |  |

Conclusion: TBC

Proposal: TBC

## 2.2 Remaining aspects related to DRB resumption

**[1] Proposal S2-2**: Offline discussion on remaining aspects related to DRB resumption, covering:

* full configuration
* particularities of NR PDCP

It is proposed to discuss the issues raised in [5] and also to indicate additional issues if any.

**Full Configuration during MO-EDT**

In [5], it is indicated that full configuration will trigger the release followed by establishment of all layer 2 entities in both UE and the ng-eNB and that, for EDT, it means that the data transmitted in MSG3 are lost. It is proposed to capture this case in stage 2.

**Proposal**: If RRCConnectionResume message received in response to MO-EDT includes fullConfig, then the UE shall consider that the data were not successfully transmitted.

**Discussion Point P2-1: Indicate whether you agree or not with the proposal and provide justifications.**

|  |  |  |
| --- | --- | --- |
| **Company** | **do you agree with the proposal (yes/no)** | **Comments** |
| QC | yes |  |
| ZTE | TBD | We think more discussion may be needed. We are not crystal clear what’s the case to send RRCConnectionResume with fullConfig, e.g., is it possible to send RRCConnectionSetup in this case? So we are not sure whether it is necessary to consider that the data transmission is failed in this case. |
| Huawei | yes |  |
| Ericsson | FFS | It not totally clear in which all cases *fullConfig* would be used used for RRConnectionResume. If this is considered as an error case, i.e. eNB cannot decode the UL transmission, then there could be potential data loss (although, as we have previously discussed in MO-EDT context, we think data loss should be tried to be avoided in such case as well). However, does *fullConfig* always mean data was not received correctly? As this is about EDT, eNB could have processed and forwarded the data part already even when asking for full configuration after Msg3. Therefore, it doesn't seem correct to always consider the data was not successfully transmitted.  |

Conclusion: TBC

Proposal: TBC

**DRB suspension with NR PDCP**

In [5], it is mentioned that there is a new procedure ‘PDCP Suspend’ triggered at the time of suspension to RRC\_INACTIVE, which resets the COUNT. In [5], it is proposed to use the same procedure for the UP optimisation for eMTC UEs connected to 5GC.

**Proposal**: PDCP Suspend is triggered at the time of suspension to RRC\_IDLE for eMTC UEs connected to 5GC.

**Discussion Point P2-2: Indicate whether you agree or not with the proposal and provide justification.**

|  |  |  |
| --- | --- | --- |
| **Company** | **do you agree with the proposal (yes/no)** | **Comments** |
| QC | yes | With new security keys being used for resume operation, (as NCC was given to UE in RRC Connection Release msg), resetting COUNT does not cause any security issue.  |
| ZTE | Yes |  |
| Huawei | yes | if PDCP suspend procedure is not used, then we need to change NR PDCP to reset the COUNT at the time PDCP is re-established |
| Ericsson | yes |  |

Conclusion: TBC

Proposal: TBC

**DRB resumption for non-EDT**

In [5], it is described that in rel-15 eLTE, upon reception of RRCConnectionResume to resume a connection from RRC\_INACTIVE, there is no automatic trigger of PDCP re-establishment nor specific handling for ROHC continuation. The related actions are triggered by the setting of the respective flags in nr-radioResourceConfig. In [5], it is proposed to follow the same approach for eMTC connected to 5GC for non-EDT.

**Proposal:** DRB resumption for non-EDT for eMTC UEs connected to 5GC follows the same principle as in RRC\_INACTIVE, i.e.:

* When resuming the DRBsfor non-EDT, RRC procedure text does not trigger PDCP re-establishment.
* PDCP re-establishment and ROHC continuation for each DRB are triggered by the presence of the respective flags in *RRCConnectionResume* message as specified in TS 38.331 [82], clause 5.3.5.6;

**Discussion Point P2-3: Indicate whether you agree or not with the proposal and provide.**

|  |  |  |
| --- | --- | --- |
| **Company** | **do you agree with the proposal (yes/no)** | **Comments** |
| QC | yes |  |
| ZTE | Yes |  |
| Huawei | yes |  |
| Ericsson | yes |  |

Conclusion: TBC

Proposal: TBC

**SRB1 resumption**

In [5], it is described that, in Rel-15 eLTE, to allow full configuration in RRCConnectionResume message, SRB1 is configured with default RLC and PDCP configuration when resuming the connection. In [5], it is proposed to follow the same approach for NB-IoT and eMTC connected to 5GC.

**Proposal**: When resuming the RRC connection, the default RLC configuration and default (NR) PDCP configuration is applied to SRB1 for eMTC and NB-IoT UEs connected to 5GC.

**Discussion Point P2-4: Indicate whether you agree or not with the proposal and provide justifications.**

|  |  |  |
| --- | --- | --- |
| **Company** | **do you agree with the proposal (yes/no)** | **Comments** |
| QC | yes |  |
| ZTE | Yes |  |
| Huawei | yes |  |
| Ericsson | yes |  |

Conclusion: TBC

Proposal: TBC

**NR PDCP configuration for SRB1**

In [5], it is described that, in Rel-15 eLTE, UE implicitly changes to NR-PDCP for SRB1 upon reception of RRCConnectionSetup in response to RRCConnectionResumeRequest. In [5], it is proposed to follow the same approach for eMTC connected to 5GC.

**Proposal**: Upon fallback to RRC connection establishment procedure during RRC connection resumption, eMTC UEs implicitly change to NR-PDCP for SRB1.

**Discussion Point P2-5: Indicate whether you agree or not with the proposal and provide justifications.**

|  |  |  |
| --- | --- | --- |
| **Company** | **do you agree with the proposal (yes/no)** | **Comments** |
| QC | ?? | When UE resume from RRC\_INACTIVE state, UE sends RRC Connection Resume Req msg over SRB0.For 5GC connectivity, UE always uses NR-PDCP for SRB1, SRB2 and all DRBs. Even when UE gets RRC Connection Seup msg, UE will If the UE is resuming the RRC connection from RRC\_INACTIVE, the UE shall set the contents of *RRCConnectionResumeRequest* message as follows:………………..2> apply the default configuration for SRB1 as specified in 9.2.1.1;2> apply the default NR PDCP configuration as specified in TS 38.331 [82], clause 9.2.1 for SRB1;I am not sure what is meant by term “change to NR PDCP for SRB1”. Since UE is not changing PDCP type from LTE PDCP to NR PDCP type in this case.  |
| ZTE |  | Similar question as mentioned by QC. |
| Huawei | yes | In order to have full configuration in RRCConnectionResume message, SRB1 configuration should be aligned between UE and eNB and thus should be set to the default configuration, i.e. the SRB1 stored configuration is not restored before reception of MSG4. |
| Ericsson |  | Also not clear to us what the "change" refers to exactly? Does it refer to only this text or something else (in 5.3.3.4 in TS 36.331):2> use NR PDCP for all subsequent messages received and sent by the UE via SRB1; |

Conclusion: TBC

Proposal: TBC

**Other**

**Discussion Point P2-6: Indicate any other potential issues related to the use of NR PDCP for eMTC UEs connected to 5GC**

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |
|  |  |

Conclusion: TBC

Proposal: TBC

## 2.3 Aligning Cat M definition with LTE-M indicator

[1] **Proposal S3-1**: Discuss the change in the e-mail discussion on the running eMTC 36.306 running CR or postpone to next meeting

In [6], it indicated that clarification in TS 36.306 is essential to ensure LTE-M indicator serves the purpose it is intended for. A text proposal is provided for inclusion in the eMTC running CR to TS 36.306.

**Proposal:** Changes proposed in section 2 of [6] be included in the eMTC running CR to TS 36.306.

**Discussion Point P3-1: Do you agree with the text proposal and do you have any comments on the suggested text**

|  |  |  |
| --- | --- | --- |
| **Company** | **Do you agree with the text proposal**  | **Comments** |
| QC | yes | We are ok to capture it as part of running CR as well.  |
| ZTE | Yes |  |
| Huawei | Yes but | we don’t understand why ‘A UE indicating Category M2 shall also indicate Category M1.’ has been deleted in the first changeFor NOTE 4, we wonder whether this could lead to backward incompatibility issue. instead could just say that any other optional category is ignored by E-UTRAN |
| Ericsson | No | We also don't understand why the text should be removed from 4.1A.Also there doesn't seem to be need for the changes in Table 4.1A-6. We had the discussion about this in previous meeting and agreed to capture clarification in chairman's notes, we don't think anything else is needed.  |

Conclusion: TBC

Proposal: TBC

# 3 Summary

**Conclusions:**

TBC

# 4 List of referenced documents

[1] [R2-2002014](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_109_e/Docs/R2-2002014.zip) Summary of contributions for connection to 5GC (AI 7.1.12) Huawei discussion

[2] [R2-2000538](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_109_e/Docs/R2-2000538.zip) Page monitoring in RRC\_INACTIVE state with short eDRX Qualcomm India Pvt Ltd

[3] [R2-2000645](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_109_e/Docs/R2-2000645.zip) Discussion on paging of RRC\_INACTIVE for eMTC connected to 5GC Huawei, HiSilicon, Ericsson

[4] [R2-2001211](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_109_e/Docs/R2-2001211.zip) FFSs for supporting short eDRX in RRC\_INACTIVE for eMTC in 5GC ZTE Corporation, Sanechips

[5] [R2-2000646](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_109_e/Docs/R2-2000646.zip) SRBs and DRBs handling for NB-IoT and eMTC connected to 5GC Huawei, HiSilicon

[6] [R2-2000311](http://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2000311.zip) Text proposal for 36.306 to align Cat M definition with LTE-M indicator Qualcomm