3GPP TSG-RAN WG2 Meeting #110 Tdoc R2-2005945

Online, June 1st – 12th 2020

Agenda: 7.2.3

Source: Ericsson (Summary rapporteur)

Title: [ATT110-e][313] PUR open issues – Phase 3

Document for: Discussion, Decision

# 1 Introduction

This document provides the summary of the following email discussion:

* [AT110-e][313][NBIOT/eMTC] PUR open issues (Ericsson)

 Scope: Finalise PUR open issues based on [R2-2005726](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2005726.zip)

 Intended outcome: Report in [R2-2005936](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2005936.zip), Phase 2 report in [R2-2005942](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2005942.zip), Phase 3 report in R2-2005945

 Deadline: phase 1 – June 2 16:00 UTC. Phase 2 – Friday 1000 UTC, Phase 3 – Wednesday 8th 1000 UTC

The document covers phase 3 of the PUR open issues discussion, including remaining aspects of CP-PUR configuration and MAC/RRC details.

# 2 Discussion

## 2.1 CP configuration

During RAN2#110-e the following have been agreed on CP-PUR configuration:

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| * It is up to eNB implementation how UE and PUR configuration are linked according to the configured PUR resources.
* **For CP-PUR, RAN2 intends to address the case of reconfiguration/release and 'm' counting.**
	+ **FFS: which mechanism is adopted**
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The following was captured in chairman's notes on specific mechanism:

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| **CP configuration****Rapporteur proposal Q7: It is up to eNB implementation how UE and PUR configuration are linked according to the configured PUR resources.****Rapporteur proposal Q8a: For CP-PUR, RAN2 intends to address the case of reconfiguration/release and 'm' counting so that PUR works properly.****Rapporteur proposal Q8b: Discuss further which mechanism is adopted to address the issues mentioned in Proposal Q8a.*** ZTE thinks a short identifier doesn’t work, so a new identifier seems safer. Ericsson thinks that sounds like the UP solution so don’t prefer this approach. QC thinks this solution would also work but would be good to avoid sending the same information twice. Nokia thinks a PUR RNTI could be part of the identifier + some additional bits. Ericsson thinks we don’t need an identifier but a the limitation could be fine
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The discussion on which mechanism to adopt to address the issues brought in e.g. [9] for the CP-PUR configuration is not concluded yet. The earlier offline discussion can be found in the Appendix for reference.

The following lists the solutions which have been brought up for discussion during RAN2#110-e, companies are asked to provide further input on the options to conclude the discussion.

**Companies are asked to provide their view on pros and cons of each of the solutions, and what would be the impact on signalling (i.e. RRC messages) or on procedures or on other aspects.**

* Option 1: Store *pur-Config* in a container in MME. The UE identifier is S-TMSI which is provided in Msg3 (to MME). After receiving the initial UE message MME provides the PUR configuration, if it exists, to eNB over S1 signaling. (cf. Appendix / HW reply for further details)

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| Company | Pros and cons? Impact on signalling / procedures / other? |
| ZTE | If the PUR configuration is stored in MME, firstly, eNB should send the full(or partial) PUR configuration to MME once the D-PUR resource is (re)configured or released. Secondly, MME should store the full(or partial) PUR configuration for a possible long time till it’s explicitly released by the eNB. Thirdly, in order to fulfill the requirement of skipping the “m“ counting for UE in RRC\_CONNECTED, the PUR configuration needs to be delivered from MME to eNB every time the UE configured with CP-PUR resources enters into RRC\_CONNECTED state.

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| Pros: | 1. This option will have no additional overhead in the air interface DL signalling for providing PUR configuration and no additional overhead in the air interface UL Msg5.  |
| Cons: | 1. Even we try to make use of the existing message, at least a UL S1 signalling and a DL S1 signalling would be modified and have additional signalling overhead, e.g., for uploading PUR configuration to MME or retrieving PUR configuration from MME respectively. 2. PUR configuration stored in MME is obvious redundant with the PUR configuration stored in eNB. 3. The PUR configuration needs to be uploaded from eNB to MME every time the PUR configuration is reconfigured or released. And the PUR configuration needs to be delivered from MME to eNB every time the UE configured with CP-PUR resources enters into RRC\_CONNECTED state.4. This option needs cross-WG (RAN2/RAN3/SA2) LS exchanging and specification work. |

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| Ericsson | In general we agree with ZTE comments. This approach was discussed earlier couple of times already and was not pursued back then. Pros:* No need for additional signaling in AS layer
* No new identifier is needed

Cons:* Would require further cross-WG work
* Requires MME involmenent in PUR procedures which can be avoided with other solutions.
* Requires update of S1 signaling (related to above two)
* For correct 'm' count the config needs to be delivered to eNB for each RRC connection
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| Qualcomm | As explained by ZTE and Ericsson, this option is less preferable due to impact to other WGs. |
| Huawei, HiSilicon | Agree with above analysis but do not think most of the aspects are Cons.In general we think this option is “equivalent” to option 2, i.e. the eNB needs information about PUR configuration to link it with the proper UE in RRC connected mode. The only difference is that in option 1 the information is from the MME while in option 2 it is from the UE. If there has to be signalling overhead, we prefer S1 overhead to reduce power consumption impact on the UE. There is no new procedure required but only a container is needed in the existing procedure.We do not see any technique issue on Option 1. We agree it needs cross WGs work and relies on MME support of the container. |
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* Option 2: Solution discussed in [9] where information on PUR grant/resources would be provided from UE to eNB. UE identifier in this case would be the information provided to eNB and it would be provided in Msg5, after which eNB can link UE to its PUR configuration. (cf. Appendix / ZTE replies for further details)

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| Company | Pros and cons? Impact on signalling / procedures / other? |
| ZTE | In this option, combination of part of existing PUR configuration can be used as unique PUR resources “identifier“ as following:

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| NB-IoT | eMTC |
| pur-StartTime: ~at most **30 bits,** can be smaller for shorter periodicity)ul-CarrierFreq-r16: **~25bits**npusch-SubCarrierSetIndex: **~7bits**npusch-CyclicShift-r16: **~1bits** | pur-StartTime-r16: ~at most **30 bits**, can be smaller for shorter periodicitypur-FreqInfo: **~12bits**  ce-ModeA: prb-AllocationInfo-r16: ~10bits ce-ModeB: ~11bitspusch-CyclicShift-r16: **~1 bits** |

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| Pros: | 1. This option have no impacts to other working groups.2. This option will not introduce new PUR resource dimension. 3. This option will have no additional overhead in the procedure for providing PUR configuration, e.g., in the DL. |
| Cons: | 1. A little big additional signalling overhead (about 63bits for eMTC and 43bits for NB-IoT) is in the UL Msg5 (*RRCConnectionSetupComplete* or *RRCReestablishmentComplete* (without cell change)) every time the UE configured with CP-PUR resources enters into RRC\_CONNECTED state. |

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| Ericsson | Pros:* Changes contained between UE / eNB.
* Does not require defining a new "identifier", however…

Cons:* …in practice this is implicitly a new UE identifier for CP solution which is not according to the principles of how CP solution is defined and how it is supposed work (i.e. as transparent to eNB as possible).
* Requires changes in RRC signaling (e.g. Msg5), increases overhead in uplink with tens of bits which is non-negligible especially in uplink and in situations where UE is in bad coverage (i.e. when higher number of repetitions is needed).
* For EDT case the eNB would not know whether UE has a PUR configuration.
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| Qualcomm | Unncessarily high overhead as already described in previous phases of the discussion. Also, „grant“ should not be used as „identfier“.Does not solve the problem for CFS-PUR, for which the above given examples will be exactly the same for the UEs sharing the resources. |
| Huawei, HiSilicon | Pros:* No need for cross-WG work
* No new identifier is needed

Cons:* More than 60 bits signalling overhead every time the UE establish RRC conncection not using PUR (which is a common case).
* Agree with Ericsson on EDT case, this is a critical issue.
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* Option 3: Solution in [1] where UE would be able to request change to or release of PUR configuration only when it establishes RRC connection using the configured PUR resources. UEs do not count 'm' when UE is in RRC\_CONNECTED only when PUR resources were used to establish the connection. No additional UE identifier needs to be specified. (cf. Appendix / Ericsson replies for further details)

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| Company | Pros and cons? Impact on signalling / procedures / other? |
| ZTE | Request for reconfiguration/release of PUR resource would be mainly according to the change of UE’s service pattern. We assume such request would generally occur before the configured PUR resources. For example, the UE may want to request shorter PUR periodicity (e.g. change from once a day to once every two hours). If UE is only allowed to send PUR request in a RRC connection using the configured PUR resources and if this configured PUR resources is some kind of far away from the current time point (as previous PUR periodicity is large), the UE would not be able to send out the request timely. That means such PUR request feature is almost unusable.Moreover, “m” counting is mainly used to figure out and deal with the “abnormal” situations that the UE is fail for PUR transmission or the service is temporarily cancelled. The “m” counting would finally cause PUR release. That’s why we have the agreement that it needs to skip “m” counting in the normal case that UE establish a legacy connection and data can be sent in this connection. So we don’t think it’s unsuitable to revert this agreement. If “m” counting cannot be skipped for some legacy RRC connections (not on PUR resources), we can foresee more PUR release caused by unsuitable “m” counting.Furthermore, without link between PUR resource with a UE in RRC\_CONNECTED, it would be infeasible for eNB to dynamically schedule this PUR resource, e.g., to the connection of this UE or to other UEs. But this will be feasible in other three options and achieve kind of benefit for resources efficiency.

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| Pros: | 1. This option have no impacts to other working groups.2. No additional UE identifier needs to be specified.  |
| Cons: | The Cons for this option are not just overhead or complexity, but mainly about feasibility. We may need more evaluation on impacts to other features, e.g. PUR request or “m” counting:1. As mentioned above and also summarized during phase 2 discussion by some companies, PUR request only in a RRC connection using the configured PUR resources would add unnecessary restriction to the reconfiguration/release scenarios or even make PUR request feature unusable.2. If “m” counting cannot be skipped for some legacy RRC connections (not on PUR resources), we can foresee more PUR release caused by unsuitable “m” counting.3. Having kind of restriction on flexibly resources scheduling. |

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| Ericsson | We should further consider the practical aspects of PUR and how/when UEs would request PUR configuration and how it would be configured. In our view UEs typically would ask for PUR configuraion only in the case they have well-established communication pattern with periodic uplink transmissions. In cases UEs would need to change the configured PUR pattern (which we think should be relatively rare), it would still be possible using the configured PUR opportunity. In case the UE wants to transmit earlier (e.g. due to changed pattern), it can do so e.g. using EDT and eventually during the next PUR it can ask for a configuration change.If the UE would require frequent updates of PUR config, PUR should not be used as there would be no power consumption benefit, on the contrary. We expect that in practice eNB would configure PUR only in very clear cases of periodic UL traffic. Furthermore we do not think the configured periodicity will be very long considering the impact on eNB and that PUR would not be more beneficial compared to EDT from power consumption point of vie for very long periodicites as has been shown earlier. Thus, in practice, we don't think the UE would need to wait very long (relatively speaking) for the opportunity to change PUR configuration.Due to similar reasons as above, we don't think 'm' counting is an issue especially in CP-PUR case, as in practice UEs using PUR should only in rare occasions need to establish RRC connection using other than resources than PUR. A larger 'm' can be configured if needed in any case.Pros:* No identifier needs to be used
* No changes in signalling / RRC
* No additional overhead
* Aligned with the agreement "It is up to eNB implementation how UE and PUR configuration are linked according to the configured PUR resources."

Cons:* The UE can only request change/release to PUR config when it uses the PUR resources for connection establishment.
* 'm' count is increased during connection after "normal" RRC connection establishment.
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| Qualcomm | As already described in previous phases, current specifiction does not even allow for the UE to start connection just to send PUR request unless the RRC connection is triggered by something else. Would need CT1 work to enable this.Further, if the next PUR is far in the future, it does not make sense for the UE to wait for that occurance. |
| Huawei, HiSilicon | Pros:* No need for cross-WG work
* No new identifier is needed
* No signalling overhead

Cons:* Very big restriction on the release scenario. This means the UE cannot send release request as it has no traffic. In this case, the NW can only wait for the ‘m‘ counter to release PUR.
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* Option 4: Specify a new identifier for CP-PUR. One option is to include PUR-RNTI in the identifier, additionally including information/bits to differentiate between UEs which have been configured with the same PUR-RNTI. The identifier would be provided in PUR request message, after which eNB would be able to update/release the PUR configuration. (cf. Appendix / QC replies, also online discussion)

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| Company | Pros and cons? Impact on signalling / procedures / other? |
| ZTE | As we have mentioned during online, due to that PUR-RNTI share same RNTI space with other RNTIs, we assume not much PUR-RNTI can be allocated. The rate of PUR-RNTI being multiplexed by UEs may be high. Therefore, we think 4 bits additional RNTI resolution identifier must not enough, so we have assumption that at least 12 bits additional RNTI resolution identifier would be feasible. subAlt1 for Option 4: PUR-RNTI + at least 12 bits, or even 16bits additional RNTI resolution identifier as unique PUR resources“identifier“.

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| Pros: | 1. This option have no impacts to other working groups.2. Relative smaller additional DL signalling overhead, compared with subAlt2 for Option 4. |
| Cons: | 1. This option will introduce a new PUR resource dimension, e.g., 12 bits additional RNTI resolution identifier. 2. Additional 12 bits signalling overhead in the procedure for providing PUR configuration, e.g., in the DL, compared with other options. 3. A little big additional signalling overhead (16bits PUR-RNTI + 12bits additional RNTI resolution identifier) in the UL Msg5 (RRCConnectionSetupComplete or RRCReestablishmentComplete) every time the UE configured with CP-PUR resources enters into RRC\_CONNECTED state. |

subAlt2 for Option 4: a new 20bits identifier as unique PUR resources “identifier“. Some companies have concern that such identifier looks like resumeID. We understand it’s much simpler as it’s no need to conside the cross-eNB case.

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| Pros: | 1. This option have no impacts to other working groups.2. Relative smaller additional signalling overhea (20bits) in the UL Msg5 every time the UE configured with CP-PUR resources enters into RRC\_CONNECTED state, compared with subAlt1 for Option 4. |
| Cons: | 1. This option will introduce a new PUR resource dimension, e.g., a new 20bits identifier. 2. Additional 20bits signalling overhead in the procedure for providing PUR configuration, e.g., in the DL, compared with other options.  |

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| Ericsson | Pros and cons and expected impacts are similar in Options 2 and 4 with some differences e.g. related to the amount of overhead. Pros:* Changes contained between UE / eNB.
* New identifier can be considered "cleaner" in principle and potentially smaller overhead cf. Option 2

Cons:* Is based on a new identifier, which in practice means specifying a new UE identifier for CP solution which is not according to intention or principle of CP solution. Difference between CP and UP solutions starts to fade and benefit of CP would not be so clear anymore.
* It is not clear how long the identifier should be. If PUR-RNTI is used additional bits needed to differentiate UEs. The more bits we add, the more overhead we have.
* Requires changes in RRC signaling and increases overhead in uplink
* If the identifier is provided only in PUR request, 'm' counting would not work, unless agreement is reverted.
* For EDT case the eNB would not know whether UE has a PUR configuration.
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| Qualcomm | We are fine with both alternatives of this option.We prefer 4.1. In 4.1, we do not think 12 bit additional resolution ID is needed. That would means eNB multiplexing 4096 UEs with the same PUR-RNTI – that is not a valid scenario in our view. If 4 bit is not enough, that can be increased by some additional bits, but 12 is simply not needed.Alternatively, 20 bit new identifier is also ok.To reduce the overhead even further, we think the agreement that „m“ is paused during RRC connected can be reverted. That way this identifier is included only in PUR Configuration Request message (either with setup request or release request) and is not needed to be included otherwise. |
| Huawei, HiSilicon | Same view as Qualcomm. We are also fine with this option but think the previous agreement should be reverted and then the UE only needs to include the identifier in PUR configuration request message. |
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**Which of the above solutions is your preference, or would you prefer some other solution?**

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| Company | Preferred solution | Comments  |
| ZTE | More prefer Option 2, acceptable to subAlt2 for Option 4 | These two options have higher feasiblity and less specification impacts. |
| Ericsson | Option 3 | We don't think a new UE identifier should be introduced for CP-PUR as there is an alternative.We prefer to leave the linking of UE and PUR configuration up to eNB, as we have agreed. Option 3 fullfills this principle, while Options 2 and 4 do not. We think the restrictions do not result in a real disadvantage in practical scenarios, see our reply in Option 3. |
| Qualcomm | Option 4 (preferable Alt 4.1 but acceptable Alt 4.2) | Simple and less overhead. Mostly in eNB control as the added identifiers in configuration is optional. In 4.1, if PUR-RNTI is not multiplexed, no additional overhead in DL.No impact to other WGs for both alternatives. Solves the issue for CFS-PUR also (note that from RAN2 point of view we do not differentiate D-PUR and CFS-PUR in the specs). Other options introduce cross-WG issues or unncecessarily high signalling overhead. |
| Huawei, HiSilicon | Option 4 if the identifer is only included in PUR request message | Option 1 is acceptable for us as there is no technique issue. But it is true that it needs work in other WGs and it relies on MME support of the container.Option 2 is not preferred as the signalling overhead is very big. It cannot work in EDT case.Option 3 is not preferred as UE cannot request PUR release.Option 4 is acceptable to us if the identifier is only included in PUR Configuration request message. |
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## 2.2 Remaining issues on MAC-RRC interaction

The following have been agreed on MAC-RRC related questions during RAN2#110-e:

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| Corrections / clarifications on MAC/RRC:* RRC layer calculates the exact PUR timing and provides the information to MAC in the form of UL grant. Details of the timing of providing this information to MAC layer is up to UE implementation.
* *pur-ResponseWindowSize* is provided to MAC when lower layers are configured to use PUR.
* If *pur-Config* is not present in RRC release, *pur-TimeAlignmentTimer* is kept running.
	+ **FFS whether clarification is needed in RRC for the case *pur-Config* is present but does not contain PUR TA timer configuration.**
* Clarify that PUR configuration is excluded in clause 5.3.12 in TS 36.331 when releasing the radio resource configuration.
* **FFS check in MAC that *pur-TimeAlignmentTimer* is running when transmitting HARQ feedback for PUR response message.**
* **FFS whether clarifications are needed for s**p**ecification text when "configuring lower layers to use PUR" regarding PUR-RNTI and TA timer configuration.**
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The earlier comments related to issues listed as FFS in the agreements can be found in the Appendix.

**Do you think a further clarification is needed in RRC for the case *pur-Config* is present but does not contain PUR TA timer configuration (in *RRCConnectionRelease* message)?**

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| Company | View  | Comments |
| ZTE | Yes | We are fine to clarify this, e.g., according to QC’s suggesetion in phase2 discussion. |
| Ericsson | Yes | We think it should be clear that when there is no PUR TA timer then TA timer is not used. Can be further clarified whether this means PUR TA timer is not used in this case.  |
| Qualcomm | Yes | It was agreed that it should be explicitly possible to disable use of TA validation based on TA timer for PUR. Currently this is Need OR. So we think it is better to say when it is not included, the timer is running with value infinity. Alternatively, the timer is not applicable when released should be clarified. |
| LG | Yes | We would like to futher clarify this because:according to the folliwng two parts, the TA timer is not considered if it is not configured in pur-config. * 36.331 section 5.3.3.19: the UE checks TA validity if TA timer is configured
* 36.331 section 6.3.2: If *pur-TimeAlignmentTimer* is not configured, TA validation based on idle mode TA timer is not applicable.

However, as QC mentioned previously, the paramter is Need ON, which means if the parameter is absent, the UE may need to continue to use the existing value.  |
| Huawei, HiSilicon | Yes | We have tried in v1 as following:1> if the *RRCConnectionRelease* message includes the *pur-Config*:2> if *pur-Config* is set to *setup*:3> store or replace the PUR configuration provided by the *pur-Config*;3> configure or release *pur-TimeAlignmentTimer* inMAC in accordance with the presence of *pur-TimeAlignmentTimer*;3> start maintenance of PUR occasions as specified in 5.3.3.x; |
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Most companies have had the view that it should be checked whether *pur-TimeAlignmentTimer* is running before transmitting uplink HARQ feedback to PUR response message.

During earlier discussion ZTE brought up the case that if PUR TA timer has been expired, what would happen to the HARQ feedback, i.e. would it be generated at all? Rapporteur also wonders what would happen in such case, would the UE then just omit the HARQ ACK, or would it need to do a RA to transmit it?

**Please clarify what kind of check should be added in MAC regarding *pur-TimeAlignmentTimer* and transmitting HARQ feedback:**

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| Company | View  | Comments |
| ZTE |  | What we suggested during the online discussion is to clarify whether need to check legacy *timeAlignmentTimer* before transmitting uplink HARQ feedback to PUR response message. If purely based on the following current specification text, we understand the condition that legacy *timeAlignmentTimer* stops or expires may be considered as fulfilled before transmitting uplink HARQ feedback to PUR response message. That may cause uplink HARQ feedback to PUR response message cannot be generated:*- if the timeAlignmentTimer, associated with the TAG containing the serving cell on which the HARQ feedback is to be transmitted, is stopped or expired:**- do not indicate the generated positive or negative acknowledgement to the physical layer.**- else:**- indicate the generated positive or negative acknowledgement for this TB to the physical layer.*So we think a clarification may be needed that this condition of checking legacy *timeAlignmentTimer* is not applied to PUR transmission case (or to exclude PUR transmission from checking legacy *timeAlignmentTimer* before transmitting uplink HARQ feedback) - *except for transmission on preconfigured uplink grant for PUR:* *- if the timeAlignmentTimer, associated with the TAG containing the serving cell on which the HARQ feedback is to be transmitted, is stopped or expired:**- do not indicate the generated positive or negative acknowledgement to the physical layer.**- else:**- indicate the generated positive or negative acknowledgement for this TB to the physical layer.*Moreover, for *pur-TimeAlignmentTimer*, as it would be checked before initiation of PUR transmission, and as we think it’s rare case that *pur-TimeAlignmentTimer* expires during PUR transmission, we think it’s no need to checked whether *pur-TimeAlignmentTimer* is running before transmitting uplink HARQ feedback to PUR response message. |
| Ericsson |  | We have similar view as ZTE, i.e. if PUR transmission was initiated, then it is unlikely the PUR TA timer would expire until PUR response is received. It should be noted the PUR TA timer length is relatively long and correspons to PUR periodicity.We brought up the alignment issue between UE and eNB and the timer start earlier and then it was considered not an issue as the PUR TA timer should cover the next PUR occasion (i.e. including possible retransmissions and response). Otherwise, if the timer would expire, what should the UE do in case it cannot generate HARQ feedback? What should eNB do?  |
| Qualcomm |  | Agree with Ericsson that there can be misalignment between the timers and that is not a big issue. But the UE behaviour should be clear even in the case of potential misalignment of the timer. From UE point of view, if the timer has expired, it should not transmit HARQ feedback.The IDLE mode and CONNECTED mode TA timers should be considered independent. For other communications, PUR TA timer need not be checked, for PUR, only PUR TA timer needs to be checked. For example:*- except for transmission using PUR, if the timeAlignmentTimer, associated with the TAG containing the serving cell on which the HARQ feedback is to be transmitted, is stopped or expired; or**- for transmission using PUR, if the pur-TimeAlignmentTimer is stopped or expired;**- do not indicate the generated positive or negative acknowledgement to the physical layer.**- else:**- indicate the generated positive or negative acknowledgement for this TB to the physical layer.* |
| LG |  | We also think that idle mode and connected mode TA timers should be considered independent. We also agree that PUR TA timer expiry during PUR transmission may be a rare case.If the condition to check UL timing alignment before transmitting HARQ feedback for PUR transmission is specified, we think the serving cell RSRP changes should be also considered. *- for transmission using PUR, if the pur-TimeAlignmentTimer is stopped or expired; or**- for transmission using PUR,* since the last TA validation, if the serving cell RSRP has increased by more than *rsrp-IncreaseThresh or has decreased by more than rsrp-DecreaseThresh as conformed by upper layers;**- do not indicate the generated positive or negative acknowledgement to the physical layer.* |
| Huawei, HiSilicon |  | We tend to agree with Ericsson after further thinking. Although PUR TA timer is also about timing alignment, it seems different with the leagcy TA timer used in RRC connected mode. The PUR TA timer is more likely a high level timer to us (simialrly to T300). Maybe the UE only needs to check PUR TA timer before initiating the procedure. There seems no need to check bofore sending ACK. |
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For discussion what should be provided to lower layers after RRC triggers PUR transmission, two different specific aspects have been brought up: Should the PUR-RNTI be explicitly mentioned in RRC when configuration is provided and whether a clarification should be added so that PUR TA timer value is not provided when lower layers are configured for PUR.

**Please provide your view on 1) should PUR-RNTI be explicitly mentioned in RRC procedure when configuring lower layers and 2) is it clear PUR TA timer is configured only when *pur-Config* is received or should it be clarified further it should be not provided when triggering PUR transmission:**

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| Company | View on 1) | View on 2)  | Comments |
| Ericsson | Yes | We think it is clear already, however can be clarified if changes are made in RRC when PUR transmission is triggered.  |  |
| Qualcomm | No, PUR-RNTI is part of the configuration so it is included unless stated otherwise. | Needs clarification as this is part of the configuration and it is considred to be provided to lower layers unless stated otherwise. |  |
| LG | NoSame view with Qualcomm | NoRRC configures PUR timer only when pur-config is received. | However, we are ok to further update the specificaiton if other companies think there is ambiguity.  |
| Huawei, HiSilicon | No | Yes | For 1), we think the current text covers all PUR configuration needed by lower layers. If we need to mention PUR-RNTI, we should mention everything.For 2) it is clear already. Same as above, if we exclude PUR TA timer upon initiation, do we exclude RSRP thresholds? |
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# 3 Summary

The following is the summary and rapporteur proposals for the Phase 3 of the discussion:

**TBD**

# 4 References

1. [R2-2004632](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs//R2-2004632.zip), [E906, E907] Remaining open issues in PUR, Ericsson, RAN2#110, June 2020

1. [R2-2004633](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs//R2-2004633.zip), Draft LS reply on PUR open issues and working assumption, Ericsson, RAN2#110, Unknown, June 2020

1. [R2-2004817](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs//R2-2004817.zip), Remaining issue on NB-IoT Preconfigured resources, ITL, RAN2#110, June 2020

1. [R2-2005019](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs//R2-2005019.zip), Discussion on start offset and requested TBS for PUR, Huawei, HiSilicon, RAN2#110, Unknown, June 2020

1. [R2-2005020](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs//R2-2005020.zip), RRC-MAC interactions for PUR, Huawei, HiSilicon, RAN2#110, June 2020

1. [R2-2005021](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs//R2-2005021.zip), Discussion on RAN1 LSs for PUR, Huawei, HiSilicon, RAN2#110, June 2020

1. [R2-2005022](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs//R2-2005022.zip), [Draft] Reply LS on PUR working assumption for NB-IoT and eMTC, Huawei, RAN2#110, Unknown, June 2020

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1. [R2-2005035](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs//R2-2005035.zip), Remaining FFSs for PUR, ZTE Corporation, Sanechips, RAN2#110, June 2020

1. [R2-2005206](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs//R2-2005206.zip), [H810] [H840] [H854] PUR start time offset, Qualcomm Incorporated, RAN2#110, June 2020

1. [R2-2005569](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs//R2-2005569.zip), Remaining issue of D-PUR TA timer in RRC, ASUSTeK, RAN2#110, June 2020

1. [R2-2005570](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs//R2-2005570.zip), PUR configuration maintenance during RRC state transition, ASUSTeK, RAN2#110, June 2020

1. [R2-2005571](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs//R2-2005571.zip), HARQ feedback in RRC\_IDLE, ASUSTeK, RAN2#110, June 2020

# Appendix

Q8: Should RAN2 address the cases mentioned above (in [1], [9]) and in P12? If yes, what is the preferred mechanism?

|  |  |  |
| --- | --- | --- |
| Company | Yes / no | Comments (e.g. preference and details of mechanism) |
| Thales | Yes | We would prefer mechanism outlined in [9] for CP-PUR, i.e. enable the eNB to link the UE and its PUR configuration properly so that reconfiguration and m count works accordingly/as agreed.  |
| Huawei, HiSilicon | Yes | Proposal in [1] adds restriction to the reconfiguration/release scenarios.Porposal in [9] will cause very big signaling overhead for the UE as the UE needs to send PUR configuration (more than 100 bits in NB-IoT, even larger in eMTC) to the eNB everytime it establishes RRC connection.If this issue needs to be addressed, we would like to suggest our previous proposal in R2-2000640 as an Option 3, i.e. storing pur-Config in a container in the MME. Upon receiving the Initial UE message including S-TMSI, the MME forwards the container with the PUR configuration, if any, to the eNB in the S1 DL NAS TRANSPORT message or S1 CONNECTION ESTABLISHMENT INDICATION message.In this case, the issue can be addressed without adding restriction to the reconfiguration/release scenarios and additional signaling overhead to the UE. |
| ZTE | Yes | If RAN2 would not address the cases mentioned above, it may cause misalignment between UE and eNB or even no response from eNB to UE's request.We think the proposed way in [1] would be too restricted for eNB or UE’s implementation. So we still prefer the proposed way in [9]. |
| LG | Yes | We support the solution in [1] to avoid complexity.  |
| Ericsson | Yes | As proposed in [1]: UE using CP PUR should request configuration change only when it has initiated the connection establishment using PUR resources.Change 'm' counting rules for RRC\_CONNECTED and for CP PUR so that 'm' is not counted only when UE established RRC connection using PUR resources. |
| Qualcomm | Yes | Proposal in [1] restricts the possibility to send PUR request when in CONNECTED mode and allows in only certain conditions which is not consistent with what has been agreed before. E.g. if the UE has a large UL data now, wants to go to connected and also ask for PUR release/reconfig which would otherwise be after 12 hours, that would be undue restriction to not allow to ask for release/reconfig now.Proposal in [9] Providing the Grant info back does not always solve the problem (e.g. shared grant). It needs further discussion on what parts need to be provided, e.g. maybe MCS does not make sense but time/frequency information need to be clear.Even from the principle point of view, better way is to send back the “identifier(s)” instead of “grant”. So, we think the following would solve the issue:* PUR-RNTI is mandatory in PUR-Config for configuration (can be delta signalled for reconfig).
* eNB can tag the PUR config with PUR-RNTI by implementation, given that sTMSI is not currently assumed to be stored by eNB, and that sTMSI might change from the time the UE first went to CONNECTED (regardless of with or without already having PUR Config) before the time PUR config is provided (which is done at the end of CONNECTED session with a release message).
* If network wants to share PUR-RNTI across different UEs, add another identifier, e.g. RNTI resolution identifer in the PUR-Config which can be a couple of bits depending on maximum how may UEs would share a same RNTI.
* UE includes PUR-RNTI (and the resolution ID if provided in config) in the PUR request message (for both config or release request). It is already clear the request message is always/only sent in CONNECTED.
 |
| Nokia |  | Agree with QC “UE should not be restricted to use only the messages sent over PUR resource for reconfiguration or release.Complete information of grant is not needed for the network to know the resource. Identifier with some additional information to uniquely identify the PUR is sufficient. |
| ZTE2 |  | Agree with above concerns for proposal in [1].Some clarification for proposal in [9]:* As PUR-RNTI share same RNTI space with other RNTIs, we assume not much PUR-RNTI can be allocated. The rate of PUR-RNTI being multiplexed by UEs may be high. Based on such consideration, if go for the QC’s suggestion, we think length for the additional new RNTI resolution identifer need to be long in order to differentiate more UEs. Moreover, this also looks like to introduce a “new PUR resource” dimension. Such “new PUR resource” also need to be (additionally) provided to the UE in the PUR configuration that will cause unnecessary signalling overhead.
* Per our understanding for physical layer spec, for the sake of uplink demodulation, the combination of time domain/frequency domain/code domain resources need to be unique for the UEs. So we believe it’s already feasible and more reliable to only use (part) of existing PUR resources as “identifier” to uniquely identify a UE. Then why new resource is needed?
* We disagree with HW’s concern on large number bits for such PUR resources “identifier”. The following is our assumption for NB-IoT and eMTC:

|  |
| --- |
| PUR resources “identifier” for NB-IoT (~total 63bits) |
| pur-StartTime-r16 (~at most 30 bits, can be smaller for shorter periodicity)ul-CarrierFreq-r16 (~25bits)npusch-SubCarrierSetIndex-r16 (~7bits)npusch-CyclicShift-r16 (~1bits) |

|  |
| --- |
| PUR resources “identifier” for eMTC (~total 43bits) |
| pur-StartTime-r16 (~at most 30 bits, can be smaller for shorter periodicity)pur-FreqInfo-r16 CHOICE { ce-ModeA SEQUENCE { prb-AllocationInfo-r16 BIT STRING (SIZE(10)) }, ce-ModeB SEQUENCE { prb-AllocationInfo-r16 BIT STRING (SIZE(8)), locationCE-ModeB-r16 INTEGER (0..5) } }  (~12 bits)pusch-CyclicShift-r16 (~1 bits) |

* One thing need to be clarify is that the definition for *pur-StartTime* in PUR resources “identifier” is similar as that *pur-StartTime* in *PUR-Config-r16*, but not totally same. The reference H-SFN for *pur-StartTime* in PUR resources “identifier” would be the H-SFN corresponding to the last subframe of the first transmission of Msg5.
* Moreover, we disagree with QC that such “identifier” can be provided via the PUR request message as this cannot handle the “m” counting issue.
 |
| Ericsson2 |  | Regarding use of PUR-RNTI as the identifier, we have similar concerns as in ZTE2 reply.Also, we don't support specifying a new identifier (e.g. as in Nokia reply) for the CP solution. To us the intention should be to make it work without such, otherwise we would be almost replicating the UP solution.Additionally, we don't support HW proposal on MME involvement.To us the method we propose in [1] is not a big restriction as the UE functionality is not restricted when it comes to sending data outside of PUR occasion. The restriction only applies to when the UE wants to request change in PUR configuration. In practice we don't think this will be a serious restriction considering a likely PUR use case would be for UEs which most of the time would only use the allocated PUR resources. If PUR configuration would need frequent updates/releases any power consumption savings would be mostly negated thus PUR should not be used for such use cases to start with. |
| Qualcomm2 |  | Regarding ZTE’s comment on overhead:Let’s say 4 additional bits are added for resolving RNTI collision. That is total 20 bits because RNTI is 16 bits. That is enough to address roughly a million UEs. That has generally been the upper bound on number of UEs in any MTC system design.ZTE clarified that the PUR resource “identifier” in their proposal is about just ~43bits! Then complaining that 20 bits is “unnecessary signaling overhead” is contradictory. (For downlink, that would add ~4 bits, ok, may be big deal in some cases, but not here, because RAN2 discussed in the last online session and decided that adding a “couple of bytes” for the sake of moving one field to other IE without any difference in UE behavior and any technical reason whatsoever was ok even when we were opposing and explaining!)And, apologies but we didn’t understand this comment “Moreover, we disagree with QC that such “identifier” can be provided via the PUR request message as this cannot handle the “m” counting issue.” Wondering, in ZTE’s proposal, which message is used to send the “grant information” (~43 bits) for identification at the eNB. Our understanding so far was, that is also proposed to be sent with PUR request message. Please confirm if the proposal is otherwise.Regarding proposals in [1] and [9], we already commented above and do not want to repeat. |
| Nokia2 |  | Identification the PUR resource using PUR-RNTI comes from the possibility of reuse of PUR-RNTI across UE. The reuse is possible only across allocations having sufficient gap between PUR occasions for reception of PDCCH including retransmission. For simple case, GNB may implement unique PUR-RNTI for each of the UE having PUR without need to take care of collision of PDCCH monitoring. In case if not sufficient additional identifier can be included. Or the reuse based on PUR occasion can be considered only if PUR-RNTI space is already exhausted.Even in case of reuse of PUR-RNTI, with additional index the UE resource sharing the PUR-RNTI can be identifier. In our view, additional bits to identify the UE sharing same PUR-RNTI will be sufficient instead of sending complete PUR configuration for this purpose.Otherwise, only time domain location is sufficient rather than the complete PUR grant information.As way forward network can decide on whether PUR-RNTI+additional-bits or complete resource information is needed for the identification. |

Discuss the following remaining details of MAC-RRC interaction:

a) Should PUR-RNTI be explicitly provided when configuring lower layers to use PUR (after RRC triggers PUR transmission)?

Q10: Views on Proposal 15 a) – e)

|  |  |  |
| --- | --- | --- |
| Company | View on a) | Comments |
| Huawei, HiSilicon | Agree with the intention | But we think the current wording in RRC has covered PUR-RNTI, i.e. configures the lower layers to use PUR. With this sentence, MAC can get all configuration which is needed, similarly to RA/EDT. |
| LG | Yes |  |
| Ericsson | Yes | We think it would be clearer to have it explicitly visible in RRC specification when the PUR-RNTI is provided from RRC to MAC. Note that in current MAC PUR-RNTI is explicitly deleted after PUR transmission. In RA/EDT there is no RNTI allocation from RRC to MAC, but configuration of specific resources (e.g. PRACH etc.).  |
| Qualcomm | Yes | Except for PUR TA timer, everything else can be provided each time „configuring lower layers to use PUR“. So, in our mind, as also commented in the ASN.1 RIL, the main question is whether any further clarification is needed that PUR TA timer is not provided to MAC again for each PUR occasion. I.e., whther it is clear based on current RRC and MAC CRs that MAC needs to update TA timer only when RRC recieves PUR config in release message. |
| ASUSTeK | Yes |  |
| ZTE2 | Yes | Generally agree with the QC’s understanding that except for PUR TA timer, everything else can be provided each time “configuring lower layers to use PUR“. |

c) How to address restarting *pur-TimeAlignmentTimer* in MAC if *pur-Config* is not present in RRC release?

|  |  |  |
| --- | --- | --- |
| Company | View on c) | Comments |
| Huawei, HiSilicon | NULL | The timer will keep running unless it is released explictly. The timer should not be restarted upon reception of RRC release message regardless pur-Config is present or not.5.8        MAC reconfigurationWhen a reconfiguration of the MAC entity is requested by upper layers, the MAC entity shall:-    upon addition of an SCell, initialize the corresponding HARQ entity;-    upon removal of an SCell, remove the corresponding HARQ entity;-    for timers apply the new value when the timer is (re)started;-    when counters are initialized apply the new maximum parameter value;-    for other parameters, apply immediately the configurations received from upper layers. |
| LG | NULL | PUR timer should not be restarted if pur-config is not included in RRCConnectionRelease. |
| Ericsson | TBD | We should clarify what is the intention when UE is released without *pur-Config*, e.g. wouldn't the UE have valid TA during connected? But on the other hand, as the timer also indicates the validity time for PUR configuration, it could be kept running if not explicitly restarted.  |
| ASUSTeK | Adopt the text proposal in [11]. | If PUR TA timer is not restarted upon entering IDLE, it may expire too early (although this may be a rare case). |
| ZTE2 | NULL | We disagree with the Observation in [11]. Anyway It’s possible that TA command MAC CE can be sent along with RRC release message, then *pur-TimeAlignmentTimer* would be restarted. So no need of additional process.We are not clear about HW’s comment why this is related to MAC reconfiguration? |
| Ericsson2 |  | Agree with HW, LG, ZTE that no change is needed. |
| Qualcomm2 |  | Disagree with Huawei’s explanation. If the PUR-Config is included/setup, but the timer is not, it is indeed “explicitly released” because of Need OR. The timer is indeed restarted with the value if PUR TA timer is included in release message (which is only included if PUR-config is included) or with infinite value (i.e, not applicable) if PUR-config is present/setup but TA timer is absent.Therefore, in RRC, 5.3.8.3, following update is needed:3> configure MAC in accordance with the *pur-TimeAlignmentTimer*;should be updated to the effect of *if present, configure the timer; if absent, do not use TAT (or consider infinity)*. Recall that *if not configured, TAT based validation is not used* was previously captured in the field description, but based on company comments that it would be clarified in the procedural text, that was deleted. |

e) Should additional check if *pur-TimerAlignmentTimer* is running be added to MAC when transmitting HARQ feedback for PUR response message?

|  |  |  |
| --- | --- | --- |
| Company | View on e) | Comments |
| Huawei, HiSilicon | Yes | But we are not sure the wording in the TP is fully correct:- if both the *timeAlignmentTimer* and *pur-TimeAlignmentTimer*, associated with the TAG containing the serving cell on which the HARQ feedback is to be transmitted, are stopped or expired:- do not indicate the generated positive or negative acknowledgement to the physical layer.In RRC\_Connected, is that possible the legacy TA timer is stopped but the PUR TA timer is still running? If yes, the proposed wording seems not correct as the UE can still send HARQ feedback in this case. |
| Ericsson | Don't think this is needed |  |
| ASUSTeK | Yes | We agree with Huawei’s view that it is possible that the legacy TA timer is stopped but the PUR TA timer is still running in connected. Exact change to TS 36.321 could be discussed later if this issue is confirmed. |
| ZTE2 | Yes | Firstly, as we think it’s rare case that *pur-TimeAlignmentTimer* expires during PUR transmission, we don’t think the process to *pur-TimeAlignmentTimer* similar as that *timeAlignmentTimer* expires is needed. Moreover, we agree with HW’s comments that the proposed change is incorrect.Secondly, we agree there has another issue that the existing description about HARQ/ACK cannot be sent when *timeAlignmentTimer* is stopped or expired may have impacts on PUR transmission in RRC\_IDLE. E.g., such condition “*timeAlignmentTimer* is stopped or expired” can be considered also to be fulfilled in the PUR transmission case, therefore, it may cause that HARQ/ACK for PUR transmission cannot be generated.Our suggestion is just to exclude the PUR transmission from this process. The change example is as following:- except for transmission on preconfigured uplink grant for PUR: *- if the timeAlignmentTimer, associated with the TAG containing the serving cell on which the HARQ feedback is to be transmitted, is stopped or expired:**- do not indicate the generated positive or negative acknowledgement to the physical layer.**- else:**- indicate the generated positive or negative acknowledgement for this TB to the physical layer.* |
| Ericsson2 |  | OK to us to clarify this considering there is support.  |
| Qualcomm2 | Yes | In IDLE mode, pur-TAT should be still valid if configured before sending the HARQ feedback for RRC release msg in response to PUR. But, as commented above also, this should not interfere with (connected-mode) TA timer. In connected mode, only *timeAlignmentTimer* should be checked. |
| LG | Yes | Clarification is needed. |