3GPP TSG-RAN WG2 Meeting #110 Tdoc R2-2005936

Online, June 1st – 12th 2020

Agenda: 7.2.3

Source: Ericsson (Summary rapporteur)

Title: [ATT110-e][313] PUR open issues

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)

      Status: Not Started

      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

      Deadline: phase 1 – June 2 16:00 UTC

This version has tables for company inputs

Original introduction from R2-2005726:

This document provides a summary of proposals and topics discussed in [1] - [13] for PUR.

The proposals from the submitted documents have been grouped per topic, summarized and rapporteur proposals are made for decision or further discussion.

The following RILs are discussed in this document: [E906, E907, H810, H811, H840, H841, H854].

The following was conclusion of PUR discussions during RAN2#109bis-e:

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| --- |
| RAN2#109bis-e agreements:  RRC:   * For both NB-IoT and eMTC, the value range of pur-TimeAlignmentTimer-r16 is INTEGER (1..8), i.e. 1~8 \* PUR periodicity. * All PUR parameters are stored in the eNB. RAN2 has not identified any parameters that must be stored in the MME. * Revert the previous working assumption, PUR grant is maintained in RRC. * The handling of ‘m’ counter is moved from MAC to RRC. * For pur-Periodicity-r16 and requestedPeriodicity-r16, confirm that the value range is {hsf8, hsf16, hsf32, hsf64, hsf128, hsf256, hsf512, hsf1024, hsf2048, hsf4096, hsf8192, spare5, spare4, spare3, spare2, spare1} for both NB-IoT and eMTC. * For both NB-IoT and eMTC, PUR request indicates requested start time/offset of PUR in H-SF level. * FFS: 2-level offset need and details for pur-StartTime-r16. * Requested PUR TBS values:   + - For the requested PUR TBS in eMTC and NB-IoT, the minimum value is b328.     - FFS: other details. * FFS: It is up to eNB implementation how to link CP-PUR configuration to each UE in RRC\_IDLE according to PUR resource.   MAC aspects:   * Remove the Editor’s Note “FFS whether restarting the window is indended” from 36.321. * Remove the Editor’s Note “FFS what is the impact of PUR in this section” from 36.321.   h  RRC-MAC interactions:   * No further MAC-RRC interaction on TA validation is needed. Remove the Editor’s Note “How RRC indicates to MAC that TA is valid or instructs MAC to use PUR” from 36.321. * Remove the references to PUR TA timer validation in section 5.4.7.1 from 36.321. * PUR release due to RACH initiation on a new cell is captured in RRC. * PUR configuration is released when the UE initiates RA procedure on a new cell for all purposes. * RRC configures the lower layers to use PUR grant upon initiation of transmission using PUR. * FFS: implicitReleaseAfter handling and other RRC-MAC interaction details.   Other:   * Confirm that transmission using PUR cannot be used for signalling, i.e. mt-Access and mo-Signalling cannot be used for transmission using PUR. * From RAN2 point of view PUR (re-)configuration can be provided to the UE for the CP solution without AS security enabled.   + - No consensus to send an LS to SA3. * PUR-RNTI is used as the name of RNTI used for PUR. |

# 2 Discussion

## 2.1 [H811, H841] TB sizes

Details of possible requested PUR TB sizes were discussed in RAN2#109bis-e, but it remains open on what are the maximum values supported and what should be the granularity. Following are the proposals on this topic in [1][4][9]:

* For LTE-M, maximum requested PUR TBS value is 2984 bits and for NB-IoT maximum is 2536 bits.[1] (Ericsson)
* UE may request any supported TBS value between the minimum and maximum value allowed for PUR in the PUR configuration request.[1] (Ericsson)
* The value range of requestedTBS in NB-IoT is {b328, b408, b504, b584, b680, b808, b936, b1000, b1128, b1256, b1384, b1608, b1800, b2024, b2280, b2536}.[4] (Huawei, HiSilicon)
* The value range of requestedTBS in eMTC is {b328, b408, b504, b600, b712, b808, b936, b1000, b1352, b1544, b1736, b1992, b2152, b2344, b2792, b2984}.[4] (Huawei, HiSilicon)
* For eMTC, 7bits are used for requestedTBS to support all the TBS between b328 and b2984.[9] (ZTE Corporation, Sanechips)
* For NB-IoT, 6bits are used for requestedTBS to support all the TBS between b328 and b2536.[9] (ZTE Corporation, Sanechips)
* For eMTC, it’s suggested to treat pusch-NB-MaxTBS as an eNB capability and to move the pusch-NB-MaxTBS indication from UE-specific PUR configuration into SIB.[9] (ZTE Corporation, Sanechips)

All companies propose the same maximum values for *requestedTBS*, therefore:

1. Maximum value for *requestedTBS* for eMTC is b2984 and for NB-IoT b2536.

On granularity, two companies propose that all values between b328 and the maximum value should be supported, and one company thinks reduced set of 16 values should be enough. The remaining discussion seems to be mostly about whether the *requestedTBS* uses 4 bits for 16 values or 6/7 bits for 64/128 values:

1. For *requestedTBS* code points, choose between a range of, e.g., 16 values or full list of TB sizes from b328 to b2984 (eMTC) or to b2536 (NB-IoT).

Additionally, in [9] it is proposed that *pusch-NB-MaxTBS* in *pur-Config* is moved to SIB. The concern in [9] is that such indication would be "late" if provided in *pur-Config.* Rapporteur would like to note that *ce-pusch-NB-MaxTBS* is already configured in *PUSCH-ConfigDedicated,* therefore there should be no issue. Thus, no proposal is made.

Update after NB-IoT session on June 1st 2020:

P1 above was agreed. Remaining discussion is to choose between the options above (P2).

**Q1: For *requestedTBS*, which value range should be supported:**

1. 16 values, e.g. as proposed in [4]:
   1. For NB-IoT: {b328, b408, b504, b584, b680, b808, b936, b1000, b1128, b1256, b1384, b1608, b1800, b2024, b2280, b2536}
   2. For eMTC: {b328, b408, b504, b600, b712, b808, b936, b1000, b1352, b1544, b1736, b1992, b2152, b2344, b2792, b2984}
2. Full list of possible TB sizes, i.e. values supported by RAN1 table between 328 and 2984 (eMTC) or 2526 (NB-IoT)
   1. Please elaborate on how the signaling would look like

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| --- | --- | --- |
| Company | 1) or 2) | Comments |
| Thales | 1) | This is the signaling for the requestedTBS size. A range of 16 values we believe is sufficient. Signaling stays simple/smaller compared to all possible TBs sizes and applications can deal with such set. Increasing options on the requestedTBS size, does not make it more likely that especially that one would finally be assigned by eNB. On a smaller set maybe yes.. |
| Huawei, HiSilicon | 2) | 2) allows the UE to provide more accurate information to avoid unnecessary padding. 2) has larger signaling overhead but considering that the additional signaling overhead is not so big (e.g. 6 bits in NB-IoT, only 2 more bits than 1) ) and the PUR request will not happen very often, we are fine with 2). |
| ZTE | 2) | Firstly, we want to clarify that even the network may not completely match the allocated resource with the requested TBS, it’s obvious the finer the granularity of the requested TBS, the more beneficial it is for resource scheduling efficiency, e.g., less padding. The eNB tends to allocate the smallest resources that matches with the requested TBS, also with the real service requirement.  About the signalling, we have had considered the possibility of referring RAN1 table but found it may be not suitable as there are several duplicated values in the table. So we think ENUMERATED type is still needed.  For eMTC, initially it’s about 68 values and 7 bits is needed. If there may have concern that too many spare values for 7 bits length, we can remove a few values that are only 16 bits away from the adjacent values. The suggestion is as following with change mark:  requestedTBS-r16 ENUMERATED { b328, b344, b376, b392, b408, b424, b440, b456, b472, b488, b504, b536, b568, b584, b616, b648, b680, b712, b744, b776, b808, b840, b872, b904, b936, b968, b1000, b1032, b1064, b1096, b1128, b1160, b1192, b1224, b1256, b1288, b1320, b1352, b1384, b1416, b1480, b1544, b1608, b1672, b1736, b1800, b1864, b1928, b1992, b2024, b2088, b2216, b2280, b2344, b2408, b2472, b2536, b2600, b2664, b2728, b2792, b2856, b2984, spare1}  For NB-IoT, initially it’s about 40 values. So all the values can be allowed with 6 bits length and several spare values:  requestedTBS-r16 ENUMERATED {b328, b344, b376, b392, b408, b424, b440, b456, b472, b488, b504, b536, b552, b568, b584, b600, b616, b680, b712, b744, b776, b808, b872, b936, b1000, b1032, b1096, b1128, b1192, b1224, b1256, b1352, b1384, b1544, b1608, b1736, b1800, b2024, b2280, b2536, spare14, spare13, spare12, spare11, spare10, spare9, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1} |
| LG | 2) |  |
| Ericsson | 2) | We don't see any particular reason to limit the request siignaling, the size should not be a issue. For clean configuration, the request can include requested value by indexing the TBS table 7.1.7.2.1-1 in TS 36.213. N\_PRB can be indicated with 3 bits and I\_TBS with 6 bits, with restriction of TBS in range [328, 2984] for eMTC and in similar way for NB-IoT. |
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## 2.2 [H810, H840] PUR offset

Another issue left FFS in RAN2#109bis-e is how the PUR starting time is exactly configured. The UE may request an offset, and the NW configures the starting time in *pur-StartTime.*

The following are the proposals related to this topic:

* Working assumption on maximum PUR time offset is not confirmed. UE can request offset up to 1024 H-SFNs and eNB can configure pur-StartTime up to 1024 H-SFNs from the current time instant.[1] (Ericsson)
* For configuring pur-StartTime, adopt a structure with different levels to indicate H-SFN, SFN and SF.[1] (Ericsson)
* UE can request the time offset on H-SFN level.[1] (Ericsson) **[Rap: Agreed already in RAN2#109bis-e]**
* Further discuss what level of granularity is used for different levels for request of the PUR offset and the configuration of pur-StartTime.[1] (Ericsson)
* For both NB-IoT and eMTC, the value range of pur-StartTime is INTEGER (0..81919). The value is in number of sub-frames by step of (pur-Periodicity / 8).[4] (Huawei, HiSilicon)
* For both NB-IoT and eMTC, the value range of requestedTimeOffset is {hsf8, hsf16, hsf32, hsf64, hsf128, hsf256, hsf512, hsf1024, hsf2048, hsf4096, hsf8192, spare5, spare4, spare3, spare2, spare1}.[4] (Huawei, HiSilicon)
* It’s suggested to agree the following definition for pur-StartTime-r16:[9] (ZTE Corporation, Sanechips)

pur-PeriodAndStartTime-NB-r16 ::= SEQUENCE {

offsetHSF ::= CHOICE {

offsetWithinPeriodHsf128 INTEGER (0..127),

offsetWithinPeriodHsf256 INTEGER (0..255),

offsetWithinPeriodHsf512 INTEGER (0..511),

offsetWithinPeriodHsf1024 INTEGER (0..1023),

offsetWithinPeriodHsf2048 INTEGER (0..2047),

offsetWithinPeriodHsf4096 INTEGER (0..4095),

offsetWithinPeriodHsf8192 INTEGER (0..8191),

},

offsetSubframe INTEGER (0..1023)

} OPTIONAL, --Need ON

* Confirm that level-1 information regarding PUR start time is an offset relative to a reference H-SFN.[10] (Qualcomm Incorporated)
* The reference H-SFN is the H-SFN corresponding to the subframe of the last PDSCH repetition for the first transmission of the RRC release message including the PUR (re)configuration.[10] (Qualcomm Incorporated)
* LSB of the reference H-SFN is included in the PUR (re)configuration message.[10] (Qualcomm Incorporated)

**Reference H-SFN for start time**

Only [10] contains a proposal regarding the reference time and whether the offset should be relative or absolute time instead. [1] and [9] also mention time reference but provide no explicit proposals. However, there seems to be common understanding on that the offset should be relative to the time of configuration. [10] further proposes to fix the reference H-SFN to last PDSCH repetition of the RRC release message transmission, and to provide 1-bit LSB information to avoid potential misalignment between UE and the eNB regarding the reference H-SFN.

The reference as suggested in [10] can be the starting point of the discussion and as the proposals are new, RAN2 should further discuss whether additional clarifications are needed for proper alignment between eNB and UE:

1. Confirm that PUR starting time configuration in *pur-StartTime* is an offset relative to a reference H-SFN.
2. *pur-StartTime* reference is the H-SFN corresponding to the last subframe of the first transmission of RRC release message containing *pur-Config.*
3. Discuss whether alignment of the reference H-SFN between eNB and UE requires further clarification.

Q2: Do you support Proposals 3 and/or 4, i.e. relative offset to a reference H-SFN, or would you prefer configuration using absolute value instead? If you support relative offset, do you further think H-SFN alignment requires further clarification?

Note this question can be related to Proposals 7 and 8 below especially on deciding relative vs. absolute configuration.

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| Company | Preference | Comments |
| Thales | Support 3,4 | Pur-StartTime based on reference H-SFN i.e. as relative reference to RRC release message providing the configuration should be fine. |
| Huawei, HiSilicon | P3 and P4 | Relative vs. Absolute offset depends on the maximum value of the start offset. If the maximum value for the start offset is larger than 1024 HSFN in NB-IoT (256 HSFN in eMTC), we think relative offset is better to avoid misalignment issue.  According to our reply to Q4, we prefer relative offset. |
| ZTE | relative offset | Per our understanding, PUR start time would be possible at any time during the configured PUR periodicity. As the UE can only send PUR request during RRC\_CONNECTED, if the requested H-SFN offset is not so large while the connection lasts a little long, it may be possible for the network to miss the first requested PUR occasion and have to assign PUR grant around the next requested PUR occasion. The next requested PUR occasion may be far away from the time of provision of PUR configuration, especially in the case of large PUR periodicity. Therefore, we think it must allow the configured H-SFN to be beyond one full H-SFN cycle (1024 H-SFNs), e.g., the maximum configured H-SFN offset would be allowed to be same as maximum PUR periodicity.  As mentioned in [10], if it’s allowed the configured H-SFN to be beyond one full H-SFN cycle and considering the H-SFN can wrap around one or more times before the first PUR occasion, the absolute H-SFN for start time would be not enough for UE to calculate the first PUR occasion as it cannot know how many H-SFN wrap arounds needs to be skipped. So we think absolute H-SFN is not feasible.  In a summary, we are fine with the proposal 3 and proposal 4.  For the issue of relative offset mentioned in [10], even we think it may be mainly for some rare case, e.g., the transmission of RRC release message in eNB is at the boundary of a H-SFN and then the transmission at eNB and successfully reception of RRC release message at UE are just in the different H-SFNs, we still agree it needs to be resolved. We are fine with the related proposal in [10], e.g., 1-bit LSB of the reference H-SFN is included in the PUR (re)configuration message. |
| LG | Relative | We support P3 and P4 |
| Ericsson | Absolute, but conditional on P7/Q4. | If we agree to revert the working assumption on maximum offset, then absolute reference to H-SFN can be easily used and it shouldn't have issues with syncronization.  Otherwise, with full offset range up to PUR periodicity (i.e. longer than one full cycle of H-SFNs) it should be relative offset and then we should discuss what is the definition of reference H-SFN, in general P4 seems fine. On P5, we are not convinced that a further clarification is needed, we can further discuss this. |
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Parameter *pur-StartTime*

On the *pur-StartTime* structure, the following options have been brought up as examples and in proposals in the submitted contributions and/or proposals:

In [1]:

pur-StartTime-r16 ::= SEQUENCE {

pur-startHSFN-r16 ENUMERATED {0, 256, 512, 768},

pur-startSFN-r16 INTEGER {0..1023},

pur-startSubframe-r16 INTEGER {0..9}

}

In [4]:

pur-StartTime-r16 INTEGER (0..81919)

OPTIONAL, --Need ON

pur-Periodicity-r16 ENUMERATED {hsf8, hsf16, hsf32, hsf64, hsf128, hsf256,

hsf512, hsf1024, hsf2048, hsf4096, hsf8192,

spare5, spare4, spare3, spare2, spare1}

| *PUR-Config(*-*NB)* field descriptions |
| --- |
| ***pur-StartTime***  Indicates the value of the time offset for the first PUR occasion, i.e. the time gap from reception of D-PUR configuration to the first PUR occasion. Value is in number of sub-frames by step of (*pur-Periodicity* / 8). |

The corresponding proposal:

* For both NB-IoT and eMTC, the value range of pur-StartTime is INTEGER (0..81919). The value is in number of sub-frames by step of (pur-Periodicity / 8). [4] (Huawei, HiSilicon)

And in [9]:

pur-PeriodAndStartTime-NB-r16 ::= SEQUENCE {

offsetHSF ::= CHOICE {

offsetWithinPeriodHsf128 INTEGER (0..127),

offsetWithinPeriodHsf256 INTEGER (0..255),

offsetWithinPeriodHsf512 INTEGER (0..511),

offsetWithinPeriodHsf1024 INTEGER (0..1023),

offsetWithinPeriodHsf2048 INTEGER (0..2047),

offsetWithinPeriodHsf4096 INTEGER (0..4095),

offsetWithinPeriodHsf8192 INTEGER (0..8191),

},

offsetSubframe INTEGER (0..1023)

} OPTIONAL, --Need ON

The structures are different, but all have in common multiple (2 or 3) levels and that the highest level is H-SFN level and lowest level is subframe level. One example additionally has a separate level for SFN. The key issue is what granularity should be specified at each level vs. the size of the configuration in bits. In particular, it should be decided whether all or any H-SFN can be indicated within maximum range and whether all or any subframe within higher level step size can be indicated.

1. Adopt a multi-level structure for *pur-StartTime.* Highest level indicates H-SFN and lowest level indicates subframe. FFS whether SFN level is needed.

Q3: Do you support Proposal 6?

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| Company | Yes / no | Comments |
| Thales | Yes | However, first transmission according to PUR should be done at **PUR-periodicity+ pur-StartTime**. UE is in dedicated negotiating PUR configuration. For power saving reasons it also provides information it wants to transmit in one go, hence next information is available in PUR-periodicity so PUR start Time should start at D-PUR periodicity+pur-StartTime. (R2-2000250 fig. 1)  Example Ue has periodicity hsf64 (about 11 minutes), requested and provides in said dedicated session already the data to the server. So for the next hsf64 it has nothing to transmit (data are generated/provided only once every 11 minutes), so starting PUR should be interpreted as D-PUR periodicity+pur-StartTime. |
| Huawei, HiSilicon | Yes |  |
| ZTE | Yes | Per our understanding, the pur-StartTime is used to calculate the first PUR occasion. We are not clear why it’s D-PUR periodicity+pur-StartTime? This should be for the following PUR occasions, not the first PUR occasion.  Moreover, as mentioned by rapporteur, in our proposal [9], the value range for *offsetSubframe* is incorrect. We confirm it should be any subframe covered by one H-SFN. So the maximum value should be 1024\*10-1 = 10239, e.g., as following:  offsetSubframe-r16 INTEGER {0..10239}  With the correction, we think such integrated definition for radio frame /subframe is almost same as the following proposal in [1], e.g., with same value range and requests same 14 bits signalling:  pur-startSFN-r16 INTEGER {0..1023},  pur-startSubframe-r16 INTEGER {0..9}  We are fine with above either way for radio frame/subframe definition.  For proposed way in [4], we still concern the possible large interval between the allowed subframe offset, especially in the case of large PUR periodicity. |
| LG | Yes |  |
| Ericsson | Yes | We also don't understand why the first occasion should be at periodicity + startTime? |
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There is a working assumption on that PUR time offset has the same range as maximum PUR periodicity. However, in [1] it is argued and proposed that there should be no need for longer offsets than e.g. 1024 H-SFNs. No other papers explicitly mention this working assumption but this seems to be implicitly assumed in other proposals e.g. in [4] and [9]. The following proposals can be discussed together, i.e. what should be the range and how many code points should be supported – the full range e.g. like in [9] or some other set like in [1] or [4]:

1. Discuss whether working assumption: "Maximum PUR time offset should be the same as maximum PUR periodicity" is confirmed.
2. Discuss and choose the value range and code points for H-SFN in *pur-StartTime.*

Q4: Should RAN2 confirm working assumption: "Maximum PUR time offset should be the same as maximum PUR periodicity" (Proposal 7)? Please elaborate what value range and code points should be adopted for H-SFN in *pur-StartTime* (Proposal 8).

Note that it might be beneficial to discuss P7 before P3,4,5 above.

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| Company | Confirm WA (P7)? | What value range should be adopted (P8)? |
| Thales | Yes/No | Range of one maximum PUR offset being one D-PUR periodicity is fine but it needs to last from maximum PUR periodicity to 2x maximum PUR periodicity. |
| Huawei, HiSilicon | Yes | It is proposed in [1] that the maximum value should be smaller than 1024 HSF (about 3 hours). This is based on the assumption that the UE can request PUR within 3 hours before it wants to use PUR. However, we are not sure this is feasible as 1) the UE cannot establish RRC connection only for PUR request. 2) the eNB may configure PUR to the UE without PUR request.  Thus we think the working assumption makes sense and should be confirmed.  For the values of the HSFN level offset, we think (0..8191) (13bits) can be baseline. If we want to optimise the signaling overhead, similar way as we used for C-DRX offset in NB-IoT can be considered (proposal in [4]) |
| ZTE | Yes | As mentioned in our comments for Q2, we understand PUR time offset should be configured according to PUR periodicity, and Maximum PUR time offset can be the same as maximum PUR periodicity. Therefore, we suggest the following joint definition for PUR periodicity and offset H-SFN:  offsetHSF ::= CHOICE {  offsetWithinPeriodHsf128 INTEGER (0..127),  offsetWithinPeriodHsf256 INTEGER (0..255),  offsetWithinPeriodHsf512 INTEGER (0..511),  offsetWithinPeriodHsf1024 INTEGER (0..1023),  offsetWithinPeriodHsf2048 INTEGER (0..2047),  offsetWithinPeriodHsf4096 INTEGER (0..4095),  offsetWithinPeriodHsf8192 INTEGER (0..8191),  } |
| LG | Yes |  |
| Ericsson | No | We think range of up to one full range of H-SFN (up to 1024 H-SFN) should be more than enough and would provide opportunity to request configuration up to 2.9 hours earlier. We would be fine with even shorter range. As additional benefit, in this case we could directly indicate the absolute starting H-SFN using values 0-1023 as indicated in SI (See Q2 above).  We don't understand why UE couldn't establish RRC connection for PUR request (see HW reply), especially as we have the following agreement:   * UE is not restricted from initiating RRC Connection for the purpose of sending PUR request (i.e. this agreement has no impact to legacy RRC Connection Establishment / Resume procedures). |
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For the subframe level, different approaches are brought up in [1] [4] [9]: Full range of subframes within H-SFN, a sparser set of subframes e.g. every second/fourth or similar, and sparser set based on a function depending on *pur-Periodicity*. One paper additionally proposes to use SFN level with further discussion needed for granularity.

1. Discuss and choose the value range and code points for subframe level (and SFN level, if needed) in *pur-StartTime.*

Q5: Input to Proposal 9:

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| Company | Comments (value range for SF level, need for SFN level?) |
| Thales | From UE perspective intending to provide its data once very D-PUR periodicity a a Pur-StartTime being function of the D-PUR periodicity, every n-th subframe would be fine. |
| Huawei, HiSilicon | Same comments as above, the following can be baseline to cover all possilbe HSFN/SFN/subframes:   * HSF (0..8191) 13bits * SFN (0..1023) 10bits * Subframe (0..9) 4bits   If we want to optimise the overall signaling overhead for the start offset, similar way as we used for C-DRX offset in NB-IoT can be considered (proposal in [4]) |
| ZTE | As mentioned in the comments for Q3, we are fine with following either way for offset subframe definition:  offsetSubframe-r16 INTEGER {0..10239}  or  pur-startSFN-r16 INTEGER {0..1023},  pur-startSubframe-r16 INTEGER {0..9}  Moreover, we think clarification for the start point for this offsetSubframe (e.g. kind of reference subframe) is needed. A simple way may be to set the subframe #0 of the first radio frame in the start H-SFN (start H-SFN = reference H-SFN + offset H-SFN) as the reference subframe. The final start subframe would be equal to “reference subframe + offsetSubframe“. |
| Ericsson | For example  pur-StartTime-r16 ::= SEQUENCE {  pur-startHSFN-r16 ENUMERATED {0, 256, 512, 768},  pur-startSFN-r16 INTEGER {0..1023},  pur-startSubframe-r16 INTEGER {0..9}  }  We can further discuss the granularity and code points on each level. Also, depending on the details SFN level might not be needed. |
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Based on the outcome of the discussion, the final structure can be specified in TS 36.331.

**Requested offset**

It has been agreed earlier that the requested offset is done on H-SFN level. It seems reasonable and is discussed or implicitly assumed in the papers the configuration can be the same as the highest (H-SFN) level of the *pur-StartTime* configuration.

1. Requested offset has the same range as the agreed H-SFN level of *pur-StartTime.*

**Q6: Do you support Proposal 10?**

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| Company | Yes / no | Comments |
| Thales | Yes | Requested offset can have same range as pur-StartTime+PUR-periodicity, in case UE has as provided its data in the connection session negotiating the PUR |
| Huawei, HiSilicon | Conditional yes | If we go with HSFN (0..8191) for pur-StartTime, 13 bits is too big signaling overhead from request perspective. |
| ZTE | Yes | UE is allowed to request offset according to the requested PUR-periodicity. |
| Ericsson | Yes |  |
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## 2.3 CP configuration

The following have been proposed related to the open issue on how eNB should link UE and its CP-PUR configuration:

* It is up to eNB implementation how UE and PUR configuration are linked together in RRC\_IDLE.[1] (Ericsson)
* UEs configured with CP-PUR can send PUR request message, e.g. to request a change or release PUR configuration, only by establishing RRC connection using its PUR occasion.[1] (Ericsson)
* UEs configured with CP-PUR do not count skipped 'm' in RRC\_CONNECTED only when they have used a PUR occasion to establish the RRC connection. Otherwise, when RRC connection is established using any other resources, skipped 'm' are counted also in RRC\_CONNECTED.[1] (Ericsson)
* It is up to eNB implementation how to link PUR configuration to each UE according to PUR resources.[3] (ITL)
* It’s suggested RAN2 to agree that eNB links CP-PUR configuration to each UE according to PUR resource by implementation.[9] (ZTE Corporation, Sanechips)
* It’s suggested RAN2 to discuss and agree that UE needs to send its PUR grant info (e.g. pur-StartTime, ul-CarrierFreq, npusch-CyclicShift) to eNB when UE enters into RRC\_CONNECTED.[9] (ZTE Corporation, Sanechips)

In the submitted papers and based on the discussions during the previous meeting, most if not all companies seem to now agree that it should be up to eNB how to link the UE and the CP-PUR configuration, i.e., it is not tied to any particular identifier. All papers [1], [3] and [9] mention the eNB can link the resource according to the used PUR resources.

1. It is up to eNB implementation how UE and PUR configuration are linked according to the configured PUR resources.

Q7: Do you support Proposal 11?

|  |  |  |
| --- | --- | --- |
| Company | Yes / no | Comments |
| Thales | Yes |  |
| Huawei, HiSilicon | Yes |  |
| ZTE | Yes |  |
| LG | Yes |  |
| Ericsson | Yes |  |
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It is further discussed in [1] and [9] that eNB might not be able to link UE to possible PUR configuration when it is in RRC\_CONNECTED, if the UE established RRC connection using other resources than those configured for PUR. This means PUR couldn't be reconfigured or released if eNB would not be able to link the UE and PUR configuration, and 'm' couldn't be counted properly (per current agreements, 'm' should not be counted while UE is in RRC\_CONNECTED if the PUR occasion is not used). To solve these issues:

* [1] proposes that PUR can be reconfigured or released only by using the configured PUR resources to establish RRC connection, and that 'm' would not be counted only when PUR resources were used to establish connection, but 'm' would be counted otherwise when other resources were used to establish the connection.
* [9] proposes UL grant information, i.e. the configured resources, are sent (back) to eNB when establishing RRC connection so the eNB can link the UE and its PUR configuration properly, and reconfiguration/release of PUR and 'm' counting would work properly in this case.

RAN2 should discuss whether these issues should be addressed and how:

1. For CP-PUR, RAN2 intends to address the case of reconfiguration/release and 'm' counting so that PUR works properly. FFS to choose between the proposed solutions.

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. |
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## 2.4 [H854, E906, E907] MAC-RRC interaction

The following proposals have been submitted on other issues remaining in MAC or RRC or addressing MAC-RRC interaction issues:

* Capture calculation of Nth consecutive PUR occasion in TS 36.331 based on the provided example formula and the agreed structure and range of pur-StartTime.[1] (Ericsson)
* RRC provides pur-ResponseWindow size configuration to MAC when RRC configures lower layers for transmission using PUR.[1] (Ericsson)
* PUR-RNTI is explicitly configured when RRC configures lower layers for transmission using PUR.[1] (Ericsson)
* RRC provides the information of PUR timing in the form of UL grant to MAC layer in a way there is no need to provide and store pur-Periodicity and pur-StartTime in MAC layer.[1] (Ericsson)
* Handling of pur-ImplicitReleaseAfter is already captured in the currently endorsed specifications, eMTC TS 36.331 CR is aligned with the NB-IoT version.[1] (Ericsson)
* Similarly to RA and EDT, MAC determines the next available subframe containing PUR according to pur-Periodicity and pur-StartTime provided by RRC.[5] (Huawei, HiSilicon)
* RRC configures MAC with the previously stored pur-TimeAlignmentTimer (if any), if pur-Config is not present in the currently received RRC release message.[11] (ASUSTeK)
* RAN2 to discuss whether there is a need of adopting explicit exclusion to avoid PUR (in MAC and/or in RRC) been impacted when releasing all radio resources, or to confirm (through at least chairman’s note) that there is no impact of PUR on “release all radio resources” in section 5.3.12 of the RRC spec.[12] (ASUSTeK)
* In RRC\_IDLE, MAC entity decides whether to indicate HARQ feedback to the physical layer based on whether the pur-timeAlignmentTimer is running or not.[13] (ASUSTeK)

**Timing information / UL grant for PUR**

[1] and [5] discuss how the UL grant or timing information is provided to MAC layer from RRC layer and what should be captured in RRC and MAC specifications. [1] suggests to provide "UL grant" with timing information and [5] suggests to use similar mechanism as for RA/EDT, i.e. that MAC calculates the timing of the resources.

1. Capture calculation of PUR timing based on *pur-Periodicity* and *pur-StartTime* in TS 36.331 and remove Editor's note. FFS exact details.
2. Discuss whether MAC layer should also calculate exact PUR timing or whether RRC layer provides the information to MAC in the form of UL grant.

Q9: View on Proposal 14 – should MAC layer calculate the exact PUR timing or is it calculated in RRC layer and provided to MAC layer?

Proposal 13 can be further addressed once more details on *pur-StartTime* are agreed.

|  |  |  |
| --- | --- | --- |
| Company | MAC or RRC? | Comments (e.g. how and when information MAC needs is provided from RRC layer) |
| Huawei, HiSilicon | MAC | We think the PUR occasion is subframe level thus should be determined by MAC. Following similar approach in RA/EDT:  *- determine the next available subframe containing PRACH permitted by the restrictions given by the prach-ConfigIndex (except for NB-IoT), the PRACH Mask Index (except for NB-IoT, see clause 7.3), physical layer timing requirements, as specified in TS 36.213 [2], and in case of NB-IoT, the subframes occupied by PRACH resources related to a higher enhanced coverage level (a MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH subframe);*  The information needed in MAC can be provided when RRC configures MAC to use PUR. |
| LG | MAC | We agree with the Huawei comments.   * We think the PUR occasion is subframe level thus should be determined by MAC.   The information needed in MAC can be provided when RRC configures MAC to use PUR. |
| Ericsson | Only RRC | If RRC layer calculates the exact timing, we think this should be provided to MAC after PUR has been triggered in "grant". How such grant is defined would be up to UE implementation but should contain the PUR timing so that it doesn't need to be explicitly recalculated in MAC, and would keep MAC as mush agnostic to PUR configuration as possible. |
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**Other configuration information and remaining issues for PUR and MAC-RRC interaction**

The remaining proposals are suggested to be discussed further, either online, offline discussion or together with the corresponding CR discussions:

[1] proposes and [5] observers that *pur-implicitReleaseAfter* is captured already in the specifications and no further changes are needed. Therefore, no further proposal is provided on this.

[1] further discusses and proposes to explicitly provide PUR-RNTI when lower layers are configured for PUR and that *pur-ResponseWindowSize* is configured at the same time (i.e. not earlier when receiving *pur-Config*).

On TA timer for PUR, [11] proposes that RRC should configure MAC with previous TA timer in case there is no new *pur-Config* in the RRC release message in order to restart the PUR timer in case new configuration is not provided. [5] also discusses TA timer and observes the necessary interactions are already captured.

[12] brings up possible issue when RRC layer releases RRC connection, whether in such case *pur-Config* should be explicitly excluded, i.e. in "release all radio resources, including release of MAC configuration…" in RRC clause 5.3.12.

[13] proposes to add condition on checking whether *pur-TimeAlignmentTimer* is running when transmitting HARQ feedback in uplink.

1. 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.). |

b) Should *pur-ResponseWindowSize* be provided to MAC when *pur-Config* is received or when lower layers are configured to use PUR?

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| --- | --- | --- |
| Company | View on b) | Comments |
| Huawei, HiSilicon | when lower layers are configured to use PUR | This parameter is only used during transmission using PUR. Thus it can be provided to MAC when lower layers are configured to use PUR |
| LG | Yes |  |
| Ericsson | When lower layers are configured | Can be provided when lower layers are configured to avoid specifying storage in MAC during RRC\_IDLE outside of PUR transmissions. |

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

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| --- | --- | --- |
| 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 reconfiguration  When 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. |

d) Should PUR configuration be explicitly excluded in clause 5.3.12 in RRC when releasing the radio resource configuration?

|  |  |  |
| --- | --- | --- |
| Company | View on d) | Comments |
| Huawei, HiSilicon | No | We think PUR configuration is a different type of configuration. Thus it should not be covered by “all radio resouces“ in section 5.3.12.  2> release all radio resources, including release of the MAC configuration, the RLC entity and the associated PDCP entity and SDAP (if any) for all established RBs; |
| Ericsson | Good to clarify | Good to clarify in TS 36.331 that radio resource release doesn't apply to PUR configuration. |
|  |  |  |

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 |  |
|  |  |  |

## 2.5 RAN1 LSs

RAN2 has received two LSs from RAN1. One is a reply to earlier RAN2 questions on how repetition adjustments using DCI should be handled in [R2-2004342](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2004342.zip) and the other one is a new LS on RAN1 working assumption related to prioritization of CSS monitoring vs. PUR occasion in [R2-2004345](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2004345.zip). The following are related proposals:

* When repetition adjustment is provided in DCI, UEs PUR configuration is adjusted correspondingly by RRC layer. RAN2 specifies MAC-RRC interaction capturing this.[1] (Ericsson)
* Reply to RAN1 that from RAN2 perspective the working assumption on prioritizing PUR over monitoring CSS is OK.[1] (Ericsson)
* Send a reply LS to RAN1 confirming the feasibility of the working assumption on search space priority in PUR.[6] (Huawei, HiSilicon)
* Define (N)PUSCH repetition number for PUR as a one-shot parameter, i.e. it is only provided to PHY once.[6] (Huawei, HiSilicon)

For the working assumption on prioritization related to search space monitoring, it is proposed RAN2 confirms feasibility from RAN2 point of view:

1. Confirm the feasibility of RAN1 working assumption on search space priority, send a reply LS to RAN1.

On the repetition adjustment, two opposing views are provided in the submitted documents and considering also during earlier discussion there was no consensus, thus RAN2 should discuss which way to adopt and make corresponding specification changes if needed:

1. Choose between updating RRC configuration based on DCI repetition adjustment or storing the adjustment in PHY layer and using the latest value either from DCI or RRC.
2. Update specifications related to DCI repetitions adjustment, if needed, and communicate RAN2 outcome to RAN1.

Update after NB-IoT session on June 1st 2020:

Proposal 16 was agreed and wen have agreed to send an LS back to RAN1.

Remaining discussion is regarding Proposal 17, i.e. which way to adopt and how it would work from RAN2 point of view in detail.

Q11: View on Proposal 17 (i.e. update RRC configuration or adjustment is stored in PHY layer)

|  |  |  |
| --- | --- | --- |
| Company | View on P17 | Comments (e..g further details how it should work) |
| Huawei, HiSilicon | Update RRC configuration | We think updating RRC configuration is cleaner.  In PHY, we think there is no concept of storing parameters, especially in IDLE mode. |
| ZTE |  | We prefer to update RRC configuration based on DCI repetition adjustment and let only RRC maintain the latest value. |
| Ericsson | Update RRC | In our understanding the "adjustment" is absolute value so in the end we think it would be cleaner to update RRC configuration with the value and use that for following PUR occasions and use this value when configuring lower layers. |

# 3 Summary and grouping of proposals

The following proposals are made based on the submitted contributions on PUR, grouping is done per topic as above and further to "easy" agreements and proposals which likely require further discussion:

**TB sizes:**

For agreement:

**Proposal 1 Maximum value for *requestedTBS* for eMTC is b2984 and for NB-IoT b2536.**

Further discuss:

**Proposal 2 For *requestedTBS* code points, choose between a range of, e.g., 16 values or full list of TB sizes from b328 to b2984 (eMTC) or to b2536 (NB-IoT).**

**PUR offset / start time:**

For agreement:

**Proposal 3 Confirm that PUR starting time configuration in *pur-StartTime* is an offset relative to a reference H-SFN.**

**Proposal 6 Adopt a multi-level structure for *pur-StartTime*. Highest level indicates H-SFN and lowest level indicates subframe. FFS whether SFN level is needed.**

**Proposal 10 Requested offset has the same range as the agreed H-SFN level of *pur-StartTime*.**

Further discuss:

**Proposal 4 *pur-StartTime* reference is the H-SFN corresponding to the last subframe of the first transmission of RRC release message containing pur-Config.**

**Proposal 5 Discuss whether alignment of the reference H-SFN between eNB and UE requires further clarification.**

**Proposal 7 Discuss whether working assumption: "Maximum PUR time offset should be the same as maximum PUR periodicity" is confirmed.**

**Proposal 8 Discuss and choose the value range and code points for H-SFN in *pur-StartTime*.**

**Proposal 9 Discuss and choose the value range and code points for subframe level (and SFN level, if needed) in *pur-StartTime*.**

**CP configuration**

For agreement:

**Proposal 11 It is up to eNB implementation how UE and PUR configuration are linked according to the configured PUR resources.**

Further discuss:

**Proposal 12 For CP-PUR, RAN2 intends to address the case of reconfiguration/release and 'm' counting so that PUR works properly. FFS to choose between the proposed solutions.**

**MAC-RRC interaction and other related topics**

Further discuss:

**Proposal 13 Capture calculation of PUR timing based on *pur-Periodicity* and *pur-StartTime* in TS 36.331 and remove Editor's note. FFS exact details.**

**Proposal 14 Discuss whether MAC layer should also calculate exact PUR timing or whether RRC layer provides the information to MAC in the form of UL grant.**

**Proposal 15 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)?**

**b) Should *pur-ResponseWindowSize* be provided to MAC when *pur-Config* is received or when lower layers are configured to use PUR?**

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

**d) Should PUR configuration be explicitly excluded in clause 5.3.12 in RRC when releasing the radio resource configuration?**

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

**Proposals related to RAN1 LSs:**

For agreement:

**Proposal 16 Confirm the feasibility of RAN1 working assumption on search space priority, send a reply LS to RAN1.**

Further discuss:

**Proposal 17 Choose between updating RRC configuration based on DCI repetition adjustment or storing the adjustment in PHY layer and using the latest value either from DCI or RRC.**

**Proposal 18 Update specifications related to DCI repetitions adjustment, if needed, and communicate RAN2 outcome to RAN1.**

# 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

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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

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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