3GPP TSG-RAN WG2 #116-e draftR2-210ABCD

**Electronic meeting, 1st – 12th November 2021**

Agenda Item: 8.12.3.1

Source: Apple Inc.

Title: [Draft] Summary of [AT116-e][105][RedCap] eDRX cycles aspects (Apple)

Document for: Discussion and Decision

# Introduction

The document summarizes the following offline discussion:

* [116-e][105][RedCap] eDRX cycle aspects (Apple)

Initial scope: Discuss proposals in AI 8.12.3.1 (skipping those on INACTIVE eDRX >10.24sec and on pure ASN.1 aspects)

Initial intended outcome: Summary of the offline discussion with e.g.:

§  List of proposals for agreement (if any)

§  List of proposals that require online discussions

§  List of proposals that should not be pursued (if any)

Initial deadline (for companies' feedback): Tuesday 2021-11-02 2000 UTC

Initial deadline (for rapporteur's summary in R2-2111335): Wednesday 2021-11-03 00:00 UTC

Proposals marked "for agreement" in R2-2111335 not challenged until Wednesday 2021-11-03 1100 UTC will be declared as agreed via email by the session chair (for the rest the discussion will continue online during the CB session).

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# Discussion

## Topics that are likely to have consensus

#### Max eDRX cycle length for INACTIVE

As noted in [1][6][8][12], SA2 confirmed that eDRX cycle length of >10.24sec is not considered for Rel-17.

In SA2’s LS to RAN2 (S2-2106978), SA2 provided their agreements on eDRX for RRC Inactive:

|  |
| --- |
| * For RRC Inactive, SA2 agreed to support eDRX of up to 10.24s. * Regarding eDRX extension beyond 10.24s for RRC Inactive, SA2 did not agree to support it in Rel-17 and instead will study potential solutions in Rel-18. |

1. Do companies agree that max eDRX cycle length for RRC Inactive is 10.24s in Rel-17?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes / No** | **Comments** |
| MediaTek | Yes |  |
| DENSO | Yes | Agree to respect SA2 decision. |
| Xiaomi | Yes | Respect SA2 decision |
| OPPO | Yes |  |
| LGE | Yes |  |
| Huawei, Hisilicon | Yes |  |
| Apple | Yes |  |
| Sequans | Yes |  |
| Vivo | Yes |  |
| CATT | Yes |  |
| ZTE | Yes |  |
| Qualcomm | Yes |  |
| Intel | Yes |  |
| Ericsson |  | Based on the outcome of the discussion in SA2, it is clear that, from system standpoint, the maximum possible value for eDRX cycle in RRC\_INACTIVE is limited to 10.24 sec in Rel-17. However, we think that RAN2 can progress according to agreements and specify support for longer cycles already in Rel-17 from RAN standpoint. Then it would be up to SA2 to enable this functionality in a later release. |

#### Relation between INACTIVE and IDLE eDRX configurations

RAN2 has reached agreement the following two configurations are not supported. According to [9] it is better to explicitly capture the restriction (which was FFS from last meeting).

Agreements via email - from offline 105 third round

1. RAN2 considers the configuration as an invalid case, where INACTIVE eDRX cycle is configured but IDLE eDRX cycle is not configured. FFS whether to capture this restriction in RAN2 spec.
2. RAN2 considers the configuration as invalid case, where INACTIVE eDRX cycle is longer than IDLE eDRX cycle. FFS whether to capture this restriction in RAN2 spec.

In [6], one company proposes that TS38.304 can include a table depicting the interpretation of the DRX cycle in different configurations, along with adding a NOTE to the configurations that are not allowed, including the above.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **UE**  **in** | **eDRX configured by upper layer** | **eDRX configured by RRC layer** | **UE specific (e)DRX configured by**  **upper layer** | **UE specific (e)DRX configured by**  **RRC layer** | **Default DRX value** |
| **RRC\_IDLE** | **None** | **None** | Applies if it is the shortest of the configured ones (legacy operation). | | |
| **Less or equal to 1024 rf** | **None, or**  **any value** | Applies | NA | NA |
| **More than 1024 rf** | **None, or**  **any value** | Applies during PTW if it is the shortest of the configured ones. | NA | Applies during PTW if it is the shortest of the configured ones. |
| **RRC\_INACIVE** | **None** | **None** | Applies if it is the shortest of the configured ones (legacy operation). | | |
| **Less or equal to 1024 rf** | **None** | FFS-1 | FFS-1 | FFS-1 |
| **Less or equal to 1024 rf** | **Less or equal to 1024 rf** | Applies if it is the shortest of the configured ones. | | NA |
| **Less or equal to 1024 rf** | **More than 1024 rf** | NA (note-1) | NA (note-1) | NA (note-1) |
| **More than 1024 rf** | **None** | * During CN configured PTW, applies if it is the shortest of the configured ones. * Outside of CN configured PTW, NA | * During CN configured PTW, applies if it is the shortest of the configured ones. * Outside of CN configured PTW, FFS-2 | * During CN configured PTW, applies if it is the shortest of the configured ones. * Outside of CN configured PTW, FFS-2 |
| **More than 1024 rf** | **Less or equal to 1024 rf** | * During CN configured PTW, applies if it is the shortest of the configured ones. * Outside of CN configured PTW, NA | * During CN configured PTW, applies if it is the shortest of the configured ones. * Outside of CN configured PTW, applies eDRX one | * During CN configured PTW, applies if it is the shortest of the configured ones. * Outside of CN configured PTW, NA |
| **More than 1024 rf** | **More than 1024 rf** | NA (note-2) | NA (note-2) | NA (note-2) |

1. Companies are requested to provide views on the below:

**2.1** Add to TS 38.304 the above table summarizing how T is determined for a UE in RRC\_IDLE and RRC\_INACTIVE with different DRX cycle configurations.

**2.2** Agree to capture the configuration restrictions from the below into the specification?

Agreements via email - from offline 105 third round

RAN2 considers the configuration as an invalid case, where INACTIVE eDRX cycle is configured but IDLE eDRX cycle is not configured.

RAN2 considers the configuration as invalid case, where INACTIVE eDRX cycle is longer than IDLE eDRX cycle.

**2.3** If yes to 2.2, agree to include this in the table from 2.1?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Company’s name** | **Do companies agree to** | | | **Comments, suggestions if any, for each of the items** |
| **2.1** | **2.2** | **2.3** |
| MediaTek | No | Yes | No | We are concerned that the table could be confusing and difficult to maintain. Agreements can be captured in a note. |
| DENSO | Y | Y | Y | Support to capture the table, e.g. in the Annex section to see the whole picture of possible eDRX configurations. |
| Xiaomi | No | Yes | No | We do not think a table is needed as long as we put it clearly in the context of the spec. |
| OPPO | No | Yes | No | We think it would be sufficient to capture t he configuration restrictions as notes in the spec. |
| LGE | No | Yes | No | We think simple description to reflect the agreements is enough. |
| Huawei, Hisilicon | FFS | Yes | FFS | We think a table would be helpful to describe the T used by the UE in the different eDRX combination. However, we think the table could be simplified e.g. the three columns could be merged in one, giving the definition of T within and outside the PTW |
| Apple | Yes | Yes | Yes | Some form of table is better. |
| Sequans | Y | Y | Y | While the table can be improved somewhat to be made even clearer, we think it does a very good job of clarifying a complex issue. We don’t see why these agreements should be captured as notes, it makes them sound like a recommendation when they are explicit restrictions. |
| vivo | No | Yes | No | We think it is not a good idea to capture and maintain such table in the specification.  We could agree a tale to summarize all possible cases and corresponding behaviours.  Regarding the table itself, we tend to describe it in a way like LTE regarding the determination of T, for example as below, an example in case when eDRX configured by upper layer is more than 1024 rf and RRC layer doesn’t configure the eDRX:   |  |  |  |  | | --- | --- | --- | --- | | **UE\_in** | **eDRX configured by upper layer** | **eDRX configured by RRC layer** | **T** | | **RRC\_INACTIVE** | **More than 1024 rf** | **None** | * During CN configured PTW, T is the shortest of UE specific DRX cycle, if configured by upper layer, UE specific (e)DRX configured by   RRC layer, default DRX value.  -outside PTW, FFS |   Regarding the configuration restriction, we think it could be captured as a note in the specification. |
| CATT | FFS | Yes | FFS | Normative text should explicitly capture the RAN2 agreement. In addition a table could help summarizing all cases, although this is not typical usage in specifications. However we find the above table unclear as it mixes DRX and eDRX configurations in 4th and 5th columns. |
| ZTE | No | Yes | No | The configuration restrictions can be captured either in 38.300 or in field description in 38.331.  Regarding the table, we think it is not needed and may be hard to maintain. We prefer to describe different cases in normal text in 38.304. |
| Qualcomm | No | Yes | No | We think that for 38.304, it is better to capture different combinations of configurations in text, which typically can be made more precise than entries in a table. Maybe such a table can be considered for 38.300?  We prefer to capture the configuration restrictions as notes in 38.304. |
| Intel | Yes | See comment | See comment | We understand that it would be helpful if TS 38.304 includes a table summarizing how T is determine for a UE in RRC\_IDLE and RRC\_INACTIVE depending on whether eDRX cycle is configured and whether UE is monitoring paging inside or outside the CN configured PTW (e.g. as shown in above Table or other kind of summary table).  In addition, this table could describe the combination of eDRX configurations not expected by the UE (i.e. those not allowed or not supported for Rel-17). However we do not think that corresponding restriction needs to be defined in TS 38.331. |
| Ericsson | FFS | Yes | FFS | A table might be beneficial but similar to HW we think that it should be simplified if it is agreed to be captured. For now, we suggest focusing on closing the outstanding FFSs first and come back to others such as this one if time permits to discuss the best possible way to capture the agreements in the specifications. |

#### RAN and CN paging PO non-overlap topic

In [9] one company brings out the CN/RAN PO non-overlap issue from the below formula:

*The PF and PO for paging are determined by the following formula:*

*SFN for the PF is determined by:*

*(SFN + PF\_offset) mod T = (T div N)\*(UE\_ID mod N)*

*Index (i\_s), indicating the index of the PO is determined by:*

*i\_s = floor (UE\_ID/N) mod Ns*

According to definition of N (the number of total paging frames in T), different T results in different N. Thus, the PO determined for RRC\_IDLE and RRC\_INACTIVE may be different if Ns is not 1.

In NR control plane discussion in last RAN2 meeting, following agreement is reached to address this problem, with the solution being that the **UE in RRC\_INACTIVE should use the same i\_s to determine PO as for RRC\_IDLE**:

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| --- |
| * **We introduce a solution, from R17, where the following is the baseline:**    + - **R2-2109077 Solution 2 (i.e. UE in RRC \_INACTIVE should use the same i\_s to determine PO as for RRC \_IDLE) is supported to address the RAN and CN paging PO non-overlap problem.**     - **UE capability should be introduced to indicate support for using the same i\_s in PO determination in RRC \_INACTIVE state as in RRC \_IDLE state.** |

In the same paper from [9], the company proposes that for the below 4 cases, the same solution from NR control plane discussion should be applied for eDRX as well.

1. Companies are requested to provide views on the below sub-proposals:

**3.0 : Do companies think that the PO determination for non-overlapping CN/RN case is also valid and should be applied for eDRX?**

**If yes, do companies agree with the below:**

**3.1 : When IDLE eDRX and INACTIVE eDRX are configured and both cycles are no longer than 10.24s, PO is determined by IDLE eDRX.**

**3.2 : When IDLE eDRX is configured and is no longer than 10.24s, INACITVE eDRX cycle is not configured, PO is determined by IDLE eDRX.**

**3.3: During CN PTW when IDLE eDRX is configured and longer than 10.24s, and INACTIVE eDRX is configured, PO is determined by the shortest value of default paging cycle and UE specific paging cycle if configured by upper layer.**

**3.4 : During CN PTW when IDLE eDRX is configure and is longer than 10.24s, INACTIVE eDRX cycle is not configured, PO is determined by the shortest value of default paging cycle and UE specific paging cycle if configured by upper layer.**

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| --- | --- | --- | --- | --- | --- | --- |
| **Company’s name** | **Do companies agree to** | | | | | **Comments, if any** |
| **3.0** | **3.1** | **3.2** | **3.3** | **3.4** |
| MediaTek | Yes | Yes | Yes | Yes | Yes | It seems that PO mismatch issue can also exist in some eDRX cases, which can be resolved similar to the legacy I-DRX solution: do not consider RAN paging for PO determination. |
| DENSO | Y | Y | Y | Y | Y |  |
| Xiaomi | Y | Y | Y | Y | Y | We agree with this intention. |
| OPPO | Y | Y | Y | Y | Y | RAN2 has reached agreement to address this problem for DRX, we think this is also a value issue for eDRX. |
| LGE | Y | Y | Y | Y | Y |  |
| Huawei, Hisilicon | Yes | Yes | Yes | yes | yes | We agree the UE in RRC\_INACTIVE uses the same i\_s to determine PO as for RRC\_IDLE in case of RRC state mismatch.  To be consistent with agreements in last meeting, the term “UE specific paging cycle” in 3.3 and 3.4 are suggested to be updated with “UE specific DRX cycle” |
| Apple | Y | Y | Y | Y | Y |  |
| Sequans | Y | Y | Y | Y | Y |  |
| vivo | Y | Y | Y | Y | Y | We agree the PO determination for non-overlapping CN/RN case is also valid. |
| CATT | Yes | Yes | Yes | Yes | Yes | The issue indeed exists and can be addressed by the proposed solutions |
| ZTE | Y | Y | Y | Y | Y | The CN and RAN paging PO non-overlapping issue also exists in the listed eDRX configurations. We think the same solution for non-eDRX configuration should be reused for eDRX cases. |
| Qualcomm | Yes | Yes | Yes | Yes | Yes |  |
| Intel | Y | Y | Y | Y | Y |  |
| Ericsson | Y | Y | Y | Y | Y |  |

In the same paper from [9], the company also proposes a UE capability for both eDRX and non eDRX supporting UEs. While the moderator thinks that the support for non-eDRX supporting UEs might be out of scope of the RedCap session, it is wise to get views from companies:

1. Assuming that the PO determination for non-overlapping CN/RN case is also valid and should be applied for eDRX, companies are requested to provide views on the below:

**4.1 : Since a new UE capability is already agreed to be supported for non-eDRX UEs, the UE capability on PO determination for non overlapping CN/RN case for eDRX supporting UEs, is needed**

**4.2 : (assuming a ‘yes’ for 4.1) the support of eDRX by the UE also indicates the UE capability on PO determination for non overlapping CN/RN case and no new capability is needed. Pls note: there is no explicit capability (so far) for eDRX support in RAN.**

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| --- | --- | --- | --- |
| **Company’s name** | **Do companies agree to** | | **Comments, suggestions if any, for each of the items** |
| **4.1** | **4.2** |
| MediaTek | Yes | Yes | We assumed that eDRX capability would anyway be introduced in Rel-17. As the PO mismatch problem will not be present for eDRX from the beginning, and all UEs supporting eDRX would apply the solution in DP 3, a separate capability is not needed. |
| DENSO | Y | Y | The new UE capability for non-eDRX UE together with the eDRX capability via NAS can cover the eDRX non-overlapping CN/RN case. |
| Xiaomi | Y | Y | UEs supporting e-DRX in R17 would naturally apply the solution to avoid mismatching. |
| OPPO | Yes | Yes | We share the same view as MediaTek. |
| LGE | Y | Y |  |
| Huawei, Hisilicon | FFS | FFS | We agree with the intention that eDRX UEs support the new PO determination.  Now, since eDRX is a new feature in R17, we prefer that the new PO determination is a fundamental part of eDRX supporting UEs. In other words, there is no need for a UE capability on PO determination for non overlapping CN/RAN case for eDRX supporting UEs. It is implicit by the support of eDRX. |
| Apple | Y | Y |  |
| Sequans | FFS | FFS | Agree with HW |
| vivo | N | N | In our view, the UE supports eDRX cycle and the capability on PO determination for non overlapping CN/RN case are two separate aspects for a UE, i.e., if a UE supports PO adjustment for non overlapping CN/RN case, then no matter it works in DRX mode or eDRX mode, it can deal with the non overlapping issue.  Besides, we also think there is no need to introduce explicit capability signalling on whether UE supports eDRX as in LTE. When UE and the CN negotiate the eDRX cycle with NAS signalling, the UE includes an extended idle mode DRX parameters information element in the Registration Request message to implicitly inform CN it supports eDRX. |
| CATT | Yes | Yes |  |
| ZTE | Y | Y | For eDRX, there is no mismatching issue before R17. So we can assume a UE supporting eDRX also supports the new PO determination in RRC\_INACTIVE state, and separate capability is not needed. |
| Qualcomm | Yes | Yes |  |
| Intel | See comment | See comment | Our understanding is that UE would require signaling its capability support for eDRX in RRC\_IDLE and/or RRC\_INACTIVE. |
| Ericsson | No | No | It is not clear to us what 4.1 is proposing, we don’t think there is a need for an indication that PO is determined with respect to non-overlapping CN/RN. If UE supports eDRX it should be implicit that it follows the Rel-17 rules for the overlapping case. |

#### PTW\_Start calculation

In the last meeting, progress in terms of agreements were done on PH and PTW\_end calculation, and the PTW length and step length are also agreed.

But for PTW\_start the below working assumption with the FFS was reached:

|  |
| --- |
| **Working Assumption:**   1. When IDLE eDRX cycle is longer than 10.24s, CN PTW\_start calculation formula defined in LTE is re-used as the baseline, as below. FFS whether CN PTW\_start position could be configurable by network and in case which node decides the N value. Note: this formula would be revisited if INACTIVE eDRX cycle can be above 10.24s   PTW\_start denotes the first radio frame of the PH that is part of the PTW and has SFN satisfying the following equation:  SFN = 1024/N\* ieDRX, where  ieDRX = floor(UE\_ID\_H /TeDRX,H) mod N  FFS N = 4 or 8, FFS if N can take other values |

Regarding the value of N, the companies views are divergent. [4][6][14] prefer the LTE operation with N=4, while [8][9][13] prefer a fixed value of N=8, while some other companies are ok with a configurable value, and some also propose that this value is given to the CN by RAN.

The moderator would like to first check if there are any objections to the working assumption and then proceed to get company views on the value of N.

1. companies are requested to provide views on the below:

**5.1 : Do companies object to the working assumption?**

**If no to 5.1:**

**5.2 : N=4?**

**5.3 : N=8?**

**5.4 : N= 4 or 8, configurable by the RAN**

**5.5 : N can be other values, configurable by the NW (pls add info in comments).**

**5.6 : RAN informs CN about N (if N is variable)**

**5.7: N can be configurable by CN**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Company’s name** | **Do companies agree to** | | | | | | | **Comments, if any** |
| **5.1 (object to WA)?** | **5.2**  **N=4** | **5.3**  **N=8** | **5.4**  **N=4 or 8 configurable by RAN** | **5.5**  **N can have other values configurable by RAN** | **5.6**  **RAN informs CN about N (if N is variable)** | 5.7  **N can be configurable by CN** |
| MediaTek | No |  | Yes |  |  |  |  | In Rel-17, for simplicity, we can go with N=8, that resolves unused time gaps during PTW, and has minimal impact on signalling/CT1. |
| DENSO | N | N | N | Y | Open | N |  | On 5.5, fine to add more values, albeit there are not any other values than 4 and 8 proposed from our side.  On 5.6, CN should decide the value of N, instead of RAN, since the other eDRX parameters (eDRX cycle, PTW length) are determined by CN in case of LTE eDRX. |
| Xiaomi | No | Yes |  |  |  |  |  | We think currently using the LTE way is sufficient.  If we want to change this, we need to confirm with CT1/SA2 first. |
| OPPO | No |  |  |  |  |  | Yes | It seems our proposal from [2] is missing.  In our view, making N value configurable is more flexible compared to using a fixed N value.  For a RedCap UE configured with an eDRX cycle longer than 10.24s, CN should be aware of UE’s PTW start so that CN could send paging just before the occurrence of the start of PTW or during PTW to avoid storing paging messages in gNB. If N is determined by gNB, we might have different N values to be used in different cells, meaning a UE configured with eDRX may have different PTW\_start in different cells. This would lead to CN implementation complexity or gNB implementation complexity when CN needs to page a UE within multiple cells.  So we think N value in the PTW\_start calculation formula is configured by CN. |
| LGE | N | Y |  |  |  |  |  | We think legacy LTE calculation is fine, but if majority want to use N=8, it’s acceptable. |
| Huawei, Hisilicon | No | Yes | FFS | No | No | No |  | We think that only a small portion of UEs will be configured with a PTW equal to 1.28s, so we do not see this a problem. And we prefer N =4  We could accept N=8 if this is the majority view  We cannot agree with a configurable value as this will impact all parts of the system, CN, gNB and UEs for no obvious benefit |
| Apple | No |  | Y |  |  |  |  | It is the simpler option. |
| Sequans | No | Yes | Yes | No | No | No |  | Prefer fixed N=8, it has only benefits. Configurable N, has many complications and little actual benefit, even if configured by CN (which would probably be the lesser evil in that case). |
| vivo | N | N | Y | N | N | N |  | We don’t see the need to make N configurable by RAN or CN.  In our understanding, the easiest way is to make N is a static number, since the minimum PTW length is 1.28s, N=8 is reasonable. |
| CATT | N | N | N | Y | N | N | N | Having it configurable provides RAN flexibility to either fill all time resources or to stick to legacy (LTE) configuration |
| ZTE | No | See comments | Yes | No | No | No | No | In LTE, the minimum PTW length is 2.56s, so N=4; But in NR, we have agreed the minimum PTW length is 1.28s, that is why N=8 should be considered.  N=4 will cause gaps between PTWs, but if majority companies agree with N=4, we are fine.  However, we did not see benefits in solutions (5.4, 5.5, 5.6). Making it configurable requires coordination between CN and RAN in order to have the same PTW start among gNBs, which brings more complexity. |
| Qualcomm | No |  | Yes |  |  |  |  | We share the same view as ZTE |
| Intel |  |  | y | y |  | See comment |  | Q5.1 is a little confusing. We are ok with WA although we have slightly preference towards option 5.3 or 5.4  If 5.4. is agreed, RAN2 could inform SA2/CT1 about its agreement and ask whether this information needs to be provided from RAN to CN. |
| Ericsson | No | Yes | No | No | No | No | No | Similar view with HW; it does not seem to be beneficial or the benefits do not seem to be significant if N is configurable especially considering the impact on the system in overall. One should also consider, for example the IODT testing aspects. |

#### UE\_ID topic

Assuming the calculation from discussion point 5 is changed from working assumption to an agreement, there are some open items on the UE\_ID calculation (UE\_ID\_H as well as UE\_ID itself).

In [8][13][14], companies proposed that UE\_ID\_H follows the same hashed UE ID calculation from the UE\_ID formula from LTE. While in [3], one company proposes to change the UE\_ID used for eDRX claiming that UEs can be mapped only to 1024 POs and other POs will remain unused in eDRX with N=1024.

1. companies are requested to provide views on the below:

**6.1 : Do companies agree to the using the same LTE hashed UE\_ID calculation for UE\_ID\_H for NR?**

**6.2 : Separate from the PTW/PH (i.e., irrespective of whether PTW/PH is used or not) do companies agree to the proposal that for extended DRX, the UE\_ID is given by 5G-S-TMSI mod 4096**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company’s name** | **Do companies agree to** | | **Comments, suggestions if any, for each of the items** |
| **6.1** | **6.2** |
| MediaTek | Yes | Yes |  |
| DENSO | Y | Y | Although 6.2 is O.K, the similar issue is supposed to be discussed for the paging sub-grouping under the ePower saving WI. The details have to be discussed for further. |
| Xiaomi | Yes | Yes |  |
| OPPO | Yes | Yes |  |
| LGE | Y | Y |  |
| Huawei, Hisilicon | Yes | Yes | The use of 4096 is to distribute UEs into all the POs available. However, this should only be used when eDRX is configured and enable in the cell. |
| Apple | Y | Y |  |
| Sequans | Yes | Yes |  |
| vivo | Y | N | We agree to use the same LTE hashed UE\_ID calculation for UE\_ID\_H for NR.  Regarding the proposal, “for extended DRX, the UE\_ID is given by 5G-S-TMSI mod 4096”, we agree there is a problem that all UEs configured 1024 rf as eDRX cycle are aggregated in the first PO of PF. However, we don’t think the issue is severe, as the number of UEs configured with 1024 rf eDRX cycle won’t be huge and they could be equally distributed among different PFs. Besides, the same problem will occur in LTE, i.e, when both eDRX cycle configured by CN and RRC are 10.24s, then UE in RRC\_INACTIVE will monitor PO outside the CN PTW with T equal to 10.24s. |
| CATT | Yes | FFS | We think the issue exists, especially when eDRX=10.24s. And this option can solve the problem. But for the case when CN eDRX>10.24s, and RAN eDRX<10.24s or not configured, it doesn’t need to use the UE ID by 5G-S-TMSI mod 4096. |
| ZTE | Yes | Yes |  |
| Qualcomm | Yes | Yes |  |
| Intel | Yes | Maybe | We do not have strong view on this but considering that RAN2 agreed that the maximum PTW length is 40.96s when IDLE eDRX cycle is longer than 10.24s (like in NB-IoT), it seems reasonable to do MOD 4096 instead to better spread UE’s. |
| Ericsson | Yes | Yes |  |

## System Information Related

#### Applicable DRX cycle for SI modification period

In RAN2#113bis-e, RAN2 made the following agreements on eDRX acquisition period and about taking the LTE as the baseline.

1. RAN2 confirms that SI modification mechanism from LTE is used as a baseline for SI change (other than ETWS and CMAS), i.e. by using an eDRX acquisition period and a flag to indicate SI modification for eDRX in Short Message (e.g. systemInfoModification-eDRX)

There are several open items related to the eDRX acquisition period and if there would be any diff between eDRX in IDLE and INACTIVE, esp with different possible configurations. Also, the decisions made here affect the DRX cycle calculation (T) for the two open items (which would be discussed in the later sections).

We start with the topic of which DRX cycle the UE should compare with the modification period to decide if the eDRX acquisition period is to be used. [7] proposes to reuse the LTE method and the same theme is maintained in [13] as well. In [4] a different method is proposed.

1. companies are requested to provide views on the below:

**Which DRX cycle the UE uses for comparing with the modification period to decide if the eDRX acquisition period is to be used:**

**Op7.1 : LTE style : CN\_eDRX for both RRC\_IDLE and RRC\_INACTIVE**

**Op7.2 : CN eDRX for RRC\_IDLE, and RAN eDRX if configured for RRC\_INACTIVE (CN\_eDRX in RAN eDRX is not configured)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Company’s name** | **Do companies agree to** | | | **Comments, suggestions if any, for each of the items** |
| **Op 7.1** | **Op 7.2** | **Others (pls provide more info in comments)** |
| MediaTek |  | Yes |  | Because the difference between the maximum eDRX cycles for IDLE and INACTIVE is large, we think different values can be used unless there are any critical issues. |
| DENSO | Y | N |  | To simply the UE behaviour. Not sure if the SI update is critical for RedCap UEs. |
| Xiaomi | Y |  |  | Since currently the RAN e-drx cycle is below 10.24s, we can reuse LTE. We can further study if RAN e-DRX cycle beyond 10.24s is introduced. |
| OPPO | N | N | CN eDRX for RRC\_IDLE, and RAN eDRX if configured for RRC\_INACTIVE (RAN DRX if RAN eDRX is not configured) | For UE in RRC INACTIVE, since UE would always monitor for RAN paging based on RAN eDRX if configured for RRC\_INACTIVE or RAN DRX if RAN eDRX is not configured, we think it would be better to use RAN eDRX or RAN DRX to compare with the modification period. |
| LGE | Yes |  |  |  |
| Huawei, Hisilicon |  | Yes |  | In the case of IDLE eDRX being longer than MP and INACTIVE eDRX cycle being no longer than MP, the RRC\_INACTIVE UE will monitor PO with INACTIVE eDRX cycle outside PTW and would not miss legacy SI change indicator *systemInfoModification*.  So for RRC INACTIVE UE, the RAN eDRX if configured shall be used to compare with MP. |
| Apple | Yes | N |  | Prefer LTE style |
| Sequans |  | Yes |  | Agree with HW |
| vivo | N | N | **CN eDRX for RRC\_IDLE, and RAN eDRX if configured for RRC\_INACTIVE** | We assume there is a typo in Op7.2 ”**CN eDRX for RRC\_IDLE, and RAN eDRX if configured for RRC\_INACTIVE (CN\_eDRX if RAN eDRX is not configured)**”  In our view, for RRC\_INACTIVE, if RAN eDRX cycle is not configured, the UE won’t miss the SI change notification:   * when CN eDRX is not configured, UE in RRC\_INACTIVE monitors PO based on T= minimum {UE specific DRX cycle if configured, RAN paging cycle, default paging cycle} * when CN eDRX is no longer than 10.24s, UE in RRC\_INACTIVE monitors PO based on T= minimum {CN eDRX cycle, RAN paging cycle, default paging cycle} * when CN eDRX is longer than 10.24s, UE in RRC\_INACTIVE monitors PO outside PTW based on T= minimum {RAN paging cycle, default paging cycle(ffs)}   T is obviously no longer than the modification period in above cases. Hence there is no need using eDRX acquisition period.  And if RAN eDRX cycle is configured and no longer than modification period：   * when CN eDRX is no longer than 10.24s, UE in RRC\_INACTIVE monitors PO based on T= minimum {CN eDRX cycle, RAN eDRX cycle} * when CN eDRX is longer than 10.24s, UE in RRC\_INACTIVE monitors PO outside PTW based on T= RAN eDRX cycle.   In the two cases, we think only when RAN eDRX cycle is longer than 10.24s, the eDRX acquisition period will be used.  In summary, we support that:  **CN eDRX for RRC\_IDLE, and RAN eDRX if configured for RRC\_INACTIVE ~~(CN\_eDRX in RAN eDRX is not configured)~~** |
| CATT | Y | N |  | SI modification is applicable to both inactive UE and idle UE, so one common eDRX acquisition period should be used for idle UE and inactive UE. Taking this into consideration, for inactive UE configured with CN eDRX with/without RAN eDRX, one common DRX cycle used to compare SI modification period should be adopted. i.e. CN eDRX. |
| ZTE |  | See comments |  | Considering the smallest RAN eDRX cycle is 2.56s, it is possible CN eDRX cycle is longer than SI modification period but RAN eDRX cycle is not. In this case, it is reasonable to apply legacy SI update mechanism.  In addition, if RAN eDRX is not configured, but CN eDRX cycle and RAN paging cycle are longer than SI modification period, the UE may miss SI change notification too. In this case, the UE should also apply eDRX acquisition period mechanism.  So, we think Op7.2 should be revised to:  **Op7.2 : CN eDRX for RRC\_IDLE, and RAN eDRX if configured for RRC\_INACTIVE (~~CN\_eDRX~~ RAN paging cycle if RAN eDRX is not configured)** |
| Qualcomm |  | Yes |  |  |
| Intel |  |  | See comment | eDRX SI indication and modification period feature is critical when eDRX cycle is longer than BCCH modification period. Therefore option 7.2 seems preferable. However, it was agreed that “*RAN2 considers the configuration as invalid case, where INACTIVE eDRX cycle is longer than IDLE eDRX cycle*”. Therefore it seems sufficient with option 7.1 assuming that UEs configured with INACTIVE eDRX can tolerate similar SI notification delays as UEs configured with IDLE eDRX. |
| Ericsson |  | Yes |  |  |

#### eDRX acquisition period value

In [13] one company proposes that the eDRX acquisition period should be set to the maximum configurable value of the eDRX cycle, while in [2] an different view point is presented (which deviates from the LTE logic) in that the eDRX acquisition period is different for INACTIVE and IDLE (stating that UE monitors the RAN/INACTIVE paging cycle in INACTIVE, and that this can be used for SI change reception).

1. companies are requested to provide views on the below:

**Op 8.1 : eDRX acquisition period should be set to the maximum configurable value of the eDRX cycle**

**Op 8.2 : Introduce separate eDRX acquisition periods and SI modification indications for RRC idle UEs and RRC inactive UEs.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Company’s name** | **Do companies agree to** | | | **Comments, suggestions if any, for each of the items** |
| **Op 8.1** | **Op 8.2** | **Others (pls provide more info in comments)** |
| MediaTek | Yes | No |  | Inactive eDRX cycle can be compared against the existing SI modification period so that the UE will only use the longer value (e.g. eDRX acquisition period) if the Inactive eDRX cycle is longer than the existing SI modification period (unlikely as the Inactive eDRX values are quite short). |
| DENSO | Y | N |  | Same reason as the discussion point 7. |
| Xiaomi | Yes |  |  | The same as in LTE. |
| OPPO | No | Yes |  | For UEs in RRC inactive, if we follow the SI modification mechanism in LTE, a UE in RRC inactive configured with a CN eDRX longer than the modification period will acquire the update system information with a period much longer than the period the UE uses to monitor paging, which ends up with slow SI update. This may be acceptable to NB-IoT UEs who do not care much about the latency. However, we think this should be enhanced for NR UEs. We think a better solution would be to enable separate eDRX acquisition periods and SI modification indications for RRC idle UEs and RRC inactive UEs, and the eDRX acquisition periods for RRC idle UEs and RRC inactive UEs are 10485.76s and 10.24s, respectively. |
| LGE | Yes |  |  |  |
| Huawei, Hisilicon | Yes | No |  | We prefer reuse the LTE principle.  About Op 8.2, if different indications are applied, we wonder what changes would apply only to RRC INACTIVE UEs but not RRC\_IDLE UEs |
| Apple | Y | N |  | Same as LTE |
| Sequans | Yes | FFS |  | We are fine with LTE as baseline, but are OK to consider an enhancement if companies see the need |
| vivo | N | Y |  | Considering the upper bound of eDRX for RRC\_IDLE and RRC\_INACTIVE are 10485.76s and 10.24s, we think for RRC\_IDLE, the boundaries of the eDRX acquisition period are determined by H-SFN values for which H-SFN mod 1024 =0, and for RRC\_INACTIVE, the boundaries of the eDRX acquisition period are determined by SFN values for which SFN mod 1024 =0. |
| CATT | Y | N |  | We don’t think the additional complexity of 8.2 is justified. There is not much difference SI-wise between Idle and Inactive states, so the system works fine with 8.1. |
| ZTE | Yes | No |  | For 8.2, separate eDRX acquisition periods imply the system information update timing will be different for UEs in RRC\_IDLE and RRC\_INACTVIE, this brings more complexity to network side. |
| Qualcomm | Yes |  |  |  |
| Intel | Yes | No |  | We support option 8.1 understanding that this follows legacy LTE eDRX definition for this. |
| Ericsson | Yes | No |  |  |

It is the view of the moderator, that depending on the direction discussion topic 8 goes, further details on this in terms of applicability in various cases (if needed) would be discussed later.

#### On-Demand SI

In [3] one company proposes that the on-demand for SI acquisition for UEs with eDRX configuration. The moderator wants to check the companies view to see if this is worth pursuing.

1. Do companies agree that for SI update of eDRX UEs configured to use DRX cycle longer than modification period, on-demand SI request is reused, with details and further enhancements as FFS.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes / No** | **Comments** |
| MediaTek | Maybe | Whether on-demand SI request can also be used needs further discussion, and signaling overhead may need to be considered. However, LTE baseline (eDRX acquisition period) should be the baseline. |
| DENSO | No | For UEs configured with the long eDRX cycle, it can be assumed that the service is delay tolerant. Therefore, the delay of acquiring SIB is not so urgent. |
| Xiaomi | - | Not sure. LTE baseline e-DRX acquisition should be the baseline. |
| OPPO | No | Share the same view as DENSO |
| LGE | No | We think SI acquisition wouldn’t be so critical for RedCap UEs. |
| Huawei, Hisilicon | Yes |  |
| Apple | No | Not very crucial |
| Sequans | No | Agree with DENSO |
| vivo | N | We don’t think the SI change notification is urgent, to guarantee all UEs receive the notification, the latency of the new SI transmission inevitably will be longer. Introducing the enhancement will bring other problems, e.g. the network overhead. Hence, we think the enhancement is not needed. |
| CATT | No | Assuming the LTE mechanism that UE should acquire SI always before triggering the RRC establishment is reused (which is the most critical issue in our view), then there seems no need for using on-demand SI. |
| ZTE | No | Not all SIs are on-demand SI, the solution requires the UE to update some SI according to eDRX acquisition period, while to update other SI upon receiving the short message with *systemInfoModification-eDRX* (as proposed in [3]), this causes more complexity. |
| Qualcomm | See comment | LTE’s behavior can be used as baseline. Whether to use on-demand SI can be left to UE implementation. |
| Intel | Same as legacy | We would like that proponent companies explain why eDRX scenario would require different operation/specification than for a legacy UE in RRC\_IDLE or RRC\_INACTIVE on this regard. We believe that the features could be supported together unless specified otherwise |
| Ericsson | Yes |  |

## DRX (T) cycle determination for the FFS case

And finally the open item from the last meeting on the UE determination of T for the below FFS case. The arguments for/against both option-1/2 were already discussed in the last meeting.

Agreements online:

1. For RRC\_INACTIVE UE, when IDLE eDRX cycle is no longer than 10.24s and INACTIVE eDRX cycle is not configured, FFS which option below is adopted for paging monitoring:

Option 1: T is determined by the shortest of RAN paging cycle, IDLE eDRX cycle, and default paging cycle.

Option 2: T is determined by the shortest of RAN paging cycle and IDLE eDRX cycle.

1. For RRC\_INACTIVE UE, when IDLE eDRX cycle is longer than 10.24s and INACTIVE eDRX cycle is not configured, outside CN PTW, FFS which option below is adopted for paging monitoring:

Option 1: T is determined by the shortest of RAN paging cycle and default paging cycle.

Option 2: T is determined by RAN paging cycle.

While many companies (that have submitted papers on this) preferred op2 for both scenarios [13][12][9][8][7][5][2] (with main reason being that it’s aligned with LTE), in [1][4][6][14] op1 is preferred.

However, there are (at least in the moderator’s view) some items that might need consideration when discussing this topic:

1. The eDRX support is optional for the gNB (meaning there could be gNBs that support and configure to RedCap UEs, but do not support eDRX – so would NOT configure eDRX for INACTIVE)
2. We can have non RedCap UE supporting eDRX (this is not precluded as of now) and these UEs could be handle by gNBs that do not support RedCap (as well as gNBs that do).
3. Forcing the UE to include ‘default paging cycle’ into the determination of T implies that SI change update is important for the UE (redcap or non-redcap with eDRX support) and important enough to have the UE also monitor the default paging cycle outside of PTW: In other words, if the NW allowed the UE to operate in CN-eDRX mode, is the SI update critical for the UE during RAN inactive (while it isn’t during RAN eDRX – if configured by the gB).
4. Also the discussion on the SI update from 3.2 might be a factor in this discussion.

The moderator requests the companies to provide their (initial) view on which of Op1/Op2 is needed, also noting that the same option for scenarios is preferred (as also voiced in [15]).

1. Companies are requested to input which option for both the FFS scenarios:

|  |  |  |  |
| --- | --- | --- | --- |
| **Company’s name** | **Which option do companies prefer? (pls justify if the same option is not selected for both scenarios).** | | **Comments** |
| **Option for RRC\_INACTIVE without eDRX, while eDRX for IDLE is 10.24 or lower**  Op1: T is determined by the shortest of RAN paging cycle, IDLE eDRX cycle, and default paging cycle.  Op2: T is determined by the shortest of RAN paging cycle and IDLE eDRX cycle. | **Option for RRC\_INACTIVE without eDRX, while eDRX for IDLE is more than 10.24**  Op1: T is determined by the shortest of RAN paging cycle, and default paging cycle.  Op2: T is determined by the RAN paging cycle |
| MediaTek | Op2 | Op2 | Any possibility of missed SI change notification can be resolved by introducing an eDRX acquisition period.  Op2 aligns with LTE.  Op1 does not give the network any chance to configure the UE with T > default paging cycle, which reduces the benefit of eDRX in Inactive. |
| DENSO | Op2 | Op2 | If the service is delay tolerant for RedCap UEs, SI update may not be critical. |
| Xiaomi | Opt2 | Op2 | Op2 aligns with LTE. We do not see strong reason to deviate from LTE way. |
| OPPO | Opt2 | Op2 | We prefer to reuse LTE mechanism. |
| LGE | Op2 | Op2 |  |
| Huawei, Hisilicon | Option 1 | Option 1 | To avoid missing SI change indication( and having to check the VT before every access) |
| Apple | Op2 | Op2 | Same as LTE, no need to over-optimize. |
| Sequans | Opt 1 | Opt 1 | Agree with HW |
| vivo | Op2 | Op2 | The difference between the two options only occurs when RAN paging cycle is longer than default paging cycle. In this case, option 1 means T=default paging cycle and option 2 means T= RAN paging cycle. It is true that if the UE monitors PO as in option2, it may miss some PO when the SI change occurs. However, it is not a big issue as the SI change notification will repeat in modification period.  Thus, we think reusing LTE principle is straightforward. |
| CATT | Opt2 | Opt2 | SI update mechanism is primarily governed by the SI modification and eDRX acquisition periods, rather than default paging cycle. |
| ZTE | Op2 | Op2 | Same view as MediaTek |
| Qualcomm | Op1 | Op1 | If UE is in RRC Inactive and it is not configured with eDRX for RAN paging, it means network wants UE to monitor SI update per default paging cycle. Otherwise, it would have configured eDRX for RRC Inactive. |
| Intel | Option 1 | Option 1 | We understand that during this time a UE behaves same as legacy UE in RRC\_INACTIVE in which case UE monitors the shortest of all the configured/applicable DRX cycles (including default paging cycle) |
| Ericsson | Option 1 | Option 1 |  |

## Others

1. Any other relevant issues need to be discussed?

|  |  |
| --- | --- |
| **Company** | **Issue description** |
| Xiaomi | We want to confirm with people whether we need to differentiate gNB’s capability for idle mode e-DRX or for inactive mode e-DRX.  An example is UE with an idle mode e-DRX with a CN PTW moves to a gNB not supporting idle mode e-DRX will trigger CN PTW disabled while may be not impacted under a gNB not supporting inactive mode e-DRX. |
|  |  |
|  |  |

# Summary

TBD

# References

1. R2-2109449 Remaining issues on eDRX Qualcomm Incorporated discussion Rel-17 FS\_NR\_redcap
2. R2-2109495 Discussion on eDRX for RedCap Ues OPPO discussion Rel-17 NR\_redcap-Core
3. R2-2109537 UE\_ID for extended DRX cycle and SI update aspects Samsung Electronics Co., Ltd discussion Rel-17 NR\_redcap-Core
4. R2-2109578 eDRX for RedCap UE Huawei, HiSilicon discussion Rel-17 NR\_redcap-Core
5. R2-2109649 Discussion on e-DRX for Redcap Devices Beijing Xiaomi Mobile Softwar discussion
6. R2-2109671 Leftover issues for eDRX Intel Corporation discussion Rel-17 NR\_redcap
7. R2-2109699 Further Discussion on eDRX for NR RRC Inactive and Idle CATT discussion Rel-17 NR\_redcap-Core
8. R2-2109743 Discussion on eDRX for RedCap UEs vivo, Guangdong Genius discussion Rel-17 NR\_redcap-Core
9. R2-2109898 Discussion on eDRX for RedCap UE ZTE Corporation, Sanechips discussion Rel-17 NR\_redcap-Core
10. R2-2110151 Leftover issues on derivation of PTW\_start DENSO CORPORATION discussion Rel-17 NR\_redcap-Core
11. R2-2110331 Consideration on eDRX for RedCap UE Lenovo, Motorola Mobility discussion Rel-17
12. R2-2110584 Discussion on eDRX for RRC\_IDLE and RRC\_INACTIVE LG Electronics UK discussion Rel-17
13. R2-2110755 Remaining issues for eDRX MediaTek Inc. discussion Rel-17 NR\_redcap-Core
14. R2-2111099 Extended DRX for Reduced Capability UEs Ericsson discussion NR\_redcap-Core
15. R2-2111129 Remaining issues in paging monitoring Samsung discussion Rel-17