3GPP TSG-RAN WG2 Meeting #113 electronic R2-2102019

Online, January 25th – February 5th 2021

Source: CATT

Title: Summary of offline 109 - [REDCAP] eDRX cycles

Agenda Item: 8.12.3

Document for: Discussion and Decision

# Introduction

This contribution provides a summary of the following email discussion:

* [AT113-e][109][REDCAP] eDRX cycles (CATT)

Scope: Continue the discussion on eDRX cycles based on the proposals in [R2-2101242](file:///C:\Data\3GPP\Extracts\R2-2101242%20Summary%20of%20email%20discussion%20154%20-%20eDRX%20cycles.docx) marked as "continue in offline 109". Also discuss the 2.56s DRX operation in [R2-2101460](file:///C:\Data\3GPP\RAN2\Docs\R2-2101460.zip).

The intention of this offline is to describe options in the TR (possibly with pros and cons) and, whenever applicable/possible, also provide some recommendations (i.e. p4, p6 and p10 in [R2-2101242](file:///C:\Data\3GPP\Extracts\R2-2101242%20Summary%20of%20email%20discussion%20154%20-%20eDRX%20cycles.docx))

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

* + - List of proposals for agreement
    - List of proposals that require online discussions
    - Corresponding TP for the TR

Initial deadline (for companies' feedback): Monday 2021-02-01 16:00 UTC

Initial deadline (for rapporteur's summary in R2-2102019): Monday 2021-02-01 22:00 UTC

Proposals marked "for agreement" in R2-2102019 not challenged until Tuesday 2020-02-02 10:00 UTC will be declared as agreed by the session chair. For the rest the discussion will continue online.

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|  |  |
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# Discussion

As a follow-up of the offline #111 [1][2], the following agreements on eDRX for REDCAP UEs were achieved in RAN2#111-e:

Agreements:

1. RAN2 study eDRX mechanism for both RRC\_IDLE and RRC\_INACTIVE in this SI. ‎
2. For RRC\_INACTIVE, the DRX cycle is extended to 10.24s as baseline.

Agreements via email - from offline 111:

1. For RRC\_IDLE, the DRX cycle is at least extended to 10.24s. FFS on further extension ‎beyond 10.24s.
2. For RRC\_IDLE and/or RRC\_INACTIVE, if the NR DRX cycle range is extended beyond 10.24s, the LTE ‎eDRX mechanism beyond 10.24s (e.g., PTW, PH, etc.) is used as baseline when NR eDRX cycle is configured beyond 10.24s.

FFS:

1. For RRC\_IDLE and/or RRC\_INACTIVE, FFS on baseline mechanism when the configured NR eDRX cycle is less or equal to 10.24s

Then, the above FFSs were further progressed in RAN2#112-e where the following agreements were achieved on eDRX for Idle and Inactive:

1. For UE in RRC IDLE/INACTIVE and eDRX cycle is less than 10.24s, paging monitoring does not use PTW and PH, if any.
2. RAN2 will study whether lower values than 5.12s for eDRX cycle for RRC\_IDLE and RRC\_INACTIVE REDCAP UEs, e.g. 2.56s, can also be considered.
3. eDRX cycle extension in RRC\_IDLE beyond 10.24s for REDCAP UEs will be studied in this SI/WI. For UE in RRC IDLE and eDRX cycle is equal to 10.24s, among the solution options, we start from the assumption that paging monitoring does not use PTW and PH.
4. the eDRX cycle in RRC\_IDLE is extended up to 2621.44s for REDCAP UEs, as a baseline (longer value e.g. 10485.76s can also be considered)

Then in the first online GTW session of RAN2#113-e, the summary of the email discussion #154 [3] was discussed resulting in the further agreements:

Agreements:

1. Capture in the TR that from RAN2 perspective it is recommended for UE in RRC IDLE and eDRX cycle is equal to 10.24s, that paging monitoring does not use PTW and PH. Send an LS to SA2 to check this
2. Capture in the TR the related pros/cons aspects listed below (the list can be further checked and amended if needed):

Pros:

• It enables longer eDRX cycles needed by some RedCap UEs and yet allow other UEs that do not need long eDRX cycles (>10.24s) to reuse NR R16 eDRX implementation without additional development work and without a need for an explicit capability signalling.

• NR already has 10.24sec interval in C-DRX

• For 10.24 s and RRC\_INACTIVE similar solution was adopted for LTE in eMTC

Cons:

• It is different from LTE solution for eDRX cycle = 10.24s in RRC\_IDLE

• It will impact 5GC and RAN2 will need to inform/consult SA2/CT1

• UE can no longer have multiple opportunities to receive its paging during an eDRX cycle

1. Regarding the support of eDRX value up to 10485.76s, capture in the TR the pros/cons aspects listed below:

Pros

• The upper limit of the H-SFN (10bit) already is 10485.76s

• The CN already supports eDRX values up to 10485.76s

• It is future-proof

• No reason to artificially limit without technical concern

Cons:

• There are no REDCAP use cases that require eDRX cycles beyond 2621.44s

• Little power saving gain beyond 2621.44s. Simulation results show that the gain is saturated at around 40mins.

1. Capture in the TR that RAN2 recommends supporting a common design for handling eDRX cycle = 10.24s in RRC\_IDLE and RRC\_INACTIVE.

Per Chairman’s recommendation we will continue discussing in this offline the remaining proposals from [3] captured as “Continue in offline 109” in Chairman’s notes [4]. Related TPs are proposed in each section and are captured in the draft TP uploaded on the server.

It should also be noted that an LS was formely agreed to be sent to SA2/CT1 as follows [4]:

Proposal 14: Send an LS to CT1/SA2 informing them about RAN2’s preference to support eDRX cycles >10.24s in RRC\_INACTIVE and asking about feasibility.

* No need to discuss the content of an LS to SA2/CT1 as part of offline 109. An LS is needed, but the exact content will be discussed after the conclusion of offline 109

So we do not address it in this email discussion.

# eDRX in idle

### Solution for 10.24s - TP

We propose to capture the agreements #1, #2 and #4 from online GTW session listed in Section 3 and [4] in the updated TR [7] as follows (Section 8.3.1):

|  |
| --- |
| From RAN2 perspective, extended DRX can be specified and configured for RedCap UEs so that eDRX cycles at least up to 10.24 seconds can be used in RRC\_IDLE and in RRC\_INACTIVE states. For RRC\_IDLE, the baseline for possible extension of configurable eDRX cycles is up to 2621.44 seconds. Longer values, e.g. 10485.76 seconds can be considered further.  If extension of the eDRX cycles beyond 10.24 seconds is specified, a feasible extension mechanism is expected to be similar to what is specified for LTE. This mechanism would include the use of H-SFN, PH and PTW.  For RedCap UEs in RRC\_IDLE or RRC\_INACTIVE, if the eDRX cycle is less than or equal to 10.24 seconds, the paging monitoring configuration does not use PTW and PH. Specifically for 10.24s, the pros and cons of not using PTW and PH are as follows:  Pros:   * It enables longer eDRX cycles needed by some RedCap UEs and yet allow other UEs that do not need long eDRX cycles (>10.24s) to reuse NR R16 eDRX implementation without additional development work and without a need for an explicit capability signalling. * NR already supports 10.24sec interval in C-DRX * For 10.24 s and RRC\_INACTIVE similar solution was adopted for LTE in eMTC   Cons:   * It is different from LTE solution for eDRX cycle = 10.24s in RRC\_IDLE * It will impact 5GC and RAN2 will need to inform/consult SA2/CT1 * UE can no longer have multiple opportunities to receive its paging during an eDRX cycle |

**Q1: Do companies agree with above text proposal added to Section 8.3.1?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Apple | Yes | Looks good |
| Vivo | Yes, with comment | Regarding the length of eDRX part: “RRC\_IDLE, the baseline for possible extension of configurable eDRX cycles is up to 2621.44 seconds. Longer values, e.g. 10485.76 seconds can be considered further. ”, we suggest to wait for the conclusion below, as we anyway need to update it based on the following discussion. |
| Fraunhofer | Yes | Fine for us |
| Qualcomm | Yes | The TP looks fine to us. |
| Lenovo | Yes | Fine to us. |
| OPPO | Yes | The TP is fine to us. |
| Sharp | Yes |  |
| CATT | Yes | @ vivo: agree but this TP only captures agreements #1, #2 and #4. The discussion on upper bounds is in Section 3.1.3. I preferred to keep TPs independent of each other in this discussion. |
| Xiaomi | Yes | Fine to us. |
| Huawei | Yes |  |
| MediaTek | Yes |  |
| Convida | Yes |  |
| Futurewei | Yes |  |

### eDRX lower bound

For the lower bound, a first motivation to support down to 2.56s was that (at least some) REDCAP UEs should be able to support the reception of emergency broadcast services (e.g. ETWS primary notification) within the required delay budget (of 4 seconds), which is not possible with 5.12s eDRX cycle lengths (e.g. [9]). Then, although all companies indeed agreed in Q2-3 of [3] that (at least some) REDCAP UEs should be able to support the reception of emergency broadcast services, whether this requires that the eDRX cycle supports a lower bound of 2.56s was not the majority of views. Indeed, as expressed in the inputs to Q2-3 of [3] this could be achieved in a different manner, which we discuss below. In addition, [6] suggests a variant solution from using eDRX as follows: *For RedCap UEs if the NAS configures the UE with a 2.56 DRX cycle, the RedCap UE follows this DRX even when the RAN paging cycle is shorter*.

Therefore we think it is worth first capturing the *in-principle* common view that (at least some) REDCAP UEs should be able to support the reception of emergency broadcast services.

**Proposal 1: It should be possible for (at least some) REDCAP UEs to receive emergency broadcast services.**

**Companies who do not agree with the above proposal are invited to express their concerns.**

|  |  |
| --- | --- |
| Company | Argument(s) |
| Apple | Agree that atleast some should be able to receive EM broadcast |
| vivo | We agree with this high level principle. |
| Fraunhofer | We agree to this proposal |
| Qualcomm | We are fine with this proposal and think both cases (i.e. some RedCap UEs do not need to receive emergence broadcast) should be supported. |
| OPPO | Agree with this proposal. |
| Xiaomi | Agree |
| Huawei | Agree |
| MediaTek | Agree |
| Convida | We agree to this proposal |

Then, different ways of achieving this were expressed in inputs to Q2-3 of [3] as well as in [6] which can be classified as follows:

Option 1: eDRX supports a lower bound of 2.56s.

Option 2: For RedCap UEs, if the NAS configures the UE with a 2.56 DRX cycle, the RedCap UE follows this DRX even when the RAN paging cycle is shorter [6]. eDRX lower bound can be kept to baseline 5.12s.

Option 3: gNB can configure 2.56s default broadcasted DRX cycle for those RedCap UEs that need to receive emergency broadcast services and a shorter UE-specific RAN paging cycle for UEs with tighter latency requirements (e.g. smartphones). eDRX lower bound can be kept to baseline 5.12s.

Option 4: RedCap UEs that need to receive emergency broadcast services are not expected to be configured with eDRX, and no specific handling/configuration is required for those UEs.

Option 2 has in common with Option 1 that the UE does not need to follow shorter RAN (dedicated or default) paging cycle. Therefore we list the pros and cons for both together:

Options 1-2:

Pros

* It enables a mix of smartphones and wearables in the network, with an appropriate paging cycle configured for each of them.

Cons:

* This solution assumes such REDCAP UEs do not need to monitor gNB configured default broadcasted paging (and UE-specific RAN paging) cycles which presents a potential risk of UE missing SI change indicator.

Option 3:

Pros

* Consistent with the LTE solution.

Cons:

* A default broadcasted DRX value of 2.56s is expected seldom used in existing deployments supporting smartphones and requires configuring on top a UE-specific RAN paging cycle for each such smartphones.

Option 4:

Pros

* No specification or configuration impact.

Cons:

* Those REDCAP UEs do not benefit from any specific DRX/eDRX power saving.

**Proposal 2: Capture in the TR the above four options allowing REDCAP UEs to receive emergency broadcast services (and resulting recommended eDRX lower bound) and the associated pros/cons.**

**Companies who do not agree with the above proposal are invited to express their concerns.**

|  |  |
| --- | --- |
| Company | Argument(s) |
| Apple | First, we thank the rapporteur for considering this into email discussion!!  We agree to the options provided above. Another variant of option -3 is that gNB can configure a “separate” default RAN paging cycle for RedCap UEs (a new SI field), and this way, the legacy UEs do not need to follow the RAN paging cycle meant for RedCap (which can be longer). Which would essentially be option -2 for 2.56DRX ☺.  Our main aim is that there can be RedCap UEs which do not necessarily need to carry the overhead associated with eDRX (wearables) but benefit greatly from using 2.56 DRX, and so if NAS allows such config, these RedCap UEs would want to follow this DRX cycle. This would be completely independent from the NR RedCap eDRX feature altogether. SI reception and emergency broadcast “might” be missed in rare cases, but we can discuss if this needs addressing or not in work-item stage. |
| vivo | In our understanding, RedCap devices supporting PWS are not expected to be configured with eDRX (e.g. for wearable devices).  We could be fine to capture the above solutions in the TR if majority agree. |
| OPPO | For option 1, we think a ETWS or CMAS capable UE is not expected to be configured with eDRX. So we see no need to introduce lower bound for eDRX cycle.  For option 2, the UE may miss the SI modification.  For option 3, it would bring restriction on NW implementation.  In our view, the existing DRX mechanism could be used for RedCap UEs that expect to receive emergency broadcast services. |
| Sharp | We have no strong view on the options. Whether to ignore RAN paging cycle if eDRX is configured could be discussed separately, since it seems a common issue to reduce power, not related to the delay budget requirement of emergency broadcast services. |
| CATT | @vivo/OPPO: I suggest addressing your comment with adding Option 4. |
| Xiaomi | We are a little confused about the difference of option1 and option2. It seems UE’s behavior is the same, i.e., if the NAS configures the UE with a 2.56 DRX cycle, the RedCap UE follows this DRX.  Can rapporteur help us to clarify?  [CATT] The key difference (in my understanding) is that the 2.56s cycle is set, for option 1, by the eDRX cycle (e.g. TeDRX cycle of 256 radio frames, as in clause 7.3 of 36.304), and, for option 2, by the DRX cycle configured by NAS (UE specific DRX value configured by upper layers in 38.304 clause 7.1). The difference with clause 38.304 7.1 would be that, for RedCap UEs, the DRX cycle T would no longer be determined by the shortest of the UE specific DRX value(s), if configured by RRC and/or upper layers, and a default DRX value broadcast in system information, but would only be determined by the UE specific DRX value configured by upper layers. I agree with you that, as far as I understand, the main difference between both options is the configuration aspects but the two solutions are similar in the behavior. Apple is welcome to further comment/clarify/correct if I misinterpreted the proposal in [6]. |
| Huawei | We agree with above proposal but with some comments.  Option 2 requires a different way to determine the UE DRX cycle for REDCAP UEs in both the UE and the eNB. Potential risk of missing SI change indicator should be well handled for REDCAP UEs as stated in the cons.  In our understanding, option 3 is network implementation and NR supports this configuration. We think that the pros of option 3 is “There is no additional impacts”.  For Option 4, we think the motivation of UE specific DRX is latency reduction instead of UE power saving since LTE. Thus we do think only “eDRX” should be included in Cons.  Cons:  • Those REDCAP UEs do not benefit from ~~any specific DRX/~~ eDRX power saving. |
| MediaTek | We agree with the proposal to list the options in the TR.  From our perspective, regardless of which option is selected, it is preferable for the network to have the option to configure a RedCap UE with 2.56s paging cycle, while also configuring eMBB UEs with a lower value. |
| Convida | Agree with Huawei and OPPO. Option 2 requires a different way to determine the UE DRX cycle for REDCAP UEs in both the UE and the eNB. The UE may miss the SI modification. Option 3 variation proposed by Apple has spec impact since gNB can configure a “separate” default RAN paging cycle for RedCap UEs other than legacy UEs. Therefore, I think Option 3 needs some clarifications. |

**Text proposal:**

We propose to capture proposal #2 in the updated TR [7] as follows (Section 8.3.1):

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| --- |
| 8.3.1.1 eDRX in RRC\_IDLE For the lower bound of the eDRC cycle, one motivation to support down to 2.56s is that (at least some) REDCAP UEs should be able to support the reception of emergency broadcast services (e.g. ETWS primary notification) within the required delay budget (of 4 seconds), which is not possible with 5.12s eDRX cycle lengths. However other solutions exist allowing REDCAP UEs to receive emergency broadcast services without requiring eDRX to support lower cycle values than legacy LTE (5.12s):   * For RedCap UEs, if the NAS configures the UE with a 2.56 DRX cycle, the RedCap UE follows this DRX even when the RAN paging cycle is shorter. * gNB can configure 2.56s default broadcasted DRX cycle for those RedCap UEs that need to receive emergency broadcast services and a shorter UE-specific RAN paging cycle for UEs with tighter latency requirements (e.g. smartphones)   The former solution is similar to supporting eDRX cycle of 2.56s in that the UE does not need to follow shorter RAN (dedicated or default) paging cycle, and therefore has the same pros/cons: it enables a mix of smartphones and wearables in the network, with an appropriate paging cycle configured for each of them. However, these solutions assumes such REDCAP UEs do not need to monitor gNB configured default broadcasted paging (and UE-specific RAN paging) cycles which presents a potential risk of UE missing SI change indicator.  The latter solution is consistent with the LTE solution, but a default broadcasted DRX value of 2.56s is expected seldom used in existing deployments supporting smartphones and requires configuring on top a UE-specific RAN paging cycle for each such smartphones.  An even simpler solution consists in considering that RedCap UEs that need to receive emergency broadcast services are not expected to be configured with eDRX, and no specific handling/configuration is required for those UEs. But then, such REDCAP UEs do not benefit from any specific DRX/eDRX power saving. |

**Q2: Do companies agree with above text proposal added to Section 8.3.1?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Apple | Yes | Agree. Pls see if our comments in the previous response can be added as well. |
| vivo |  | See above question. |
| Fraunhofer | Yes |  |
| Qualcomm | Yes |  |
| Lenovo | Yes |  |
| OPPO | No | See our comment to P2. |
| CATT | Yes | @vivo/OPPO: see above TP update. |
| Xiaomi | Yes |  |
| Huawei | partially | Please see our comment for P2. ‘any specific DRX’ should be removed in the last sentence. |
| MediaTek | Yes |  |
| Convida | Yes with comments | Please see the comments for above question. |
| Futurewei | Yes |  |

**Summary:**

TBC

### eDRX upper bound

From companies’ inputs in [3] the following summary was derived:

|  |
| --- |
| **Summary from email disc #154:**  22 companies provided inputs on the topic of eDRX upper bound.  5/22 companies (Qualcomm, Intel, ZTE, Xiaomi, vivo) expressed concerns on supporting eDRX cycles higher than 2621.44s, mainly arguing REDCAP are not LPWA, so there is no requirement today for supporting larger eDRX values than 2621.44s. On the other hand, all other companies do not see any technical issue in supporting up to 10485.76 s eDRX value, which is already supported by CN.  Hence it is proposed to recommend supporting eDRX value up to 10485.76 s in the TR.  Pros/Cons can be summarized as follows based on companies’ inputs:  Pros   * The upper limit of the H-SFN (10bit) already is 10485.76s * The CN already supports eDRX values up to 10485.76s * It is future-proof * No reason to artificially limit without technical concern   Cons:   * There are no REDCAP use cases that require eDRX cycles beyond 2621.44s * Little power saving gain beyond 2621.44s. Simulation results show that the gain is saturated at around 40mins.   **Proposal 3: Capture in the TR that it is recommended to support eDRX value up to 10485.76 s.**  **Proposal 4: Capture in the TR the related pros/cons aspects listed above.** |

Then, during the online discussion, it could only be agreed to capture the pros/cons (above proposal #4). One specific concern was raised by vivo regarding the issue of the RRM relaxation in this case [4]. More precisely, in legacy eDRX in LTE, there is no RRM requirement outside the PTW [TS 36.331 Clauses 4.2.2.1/4.2.2.3]. It means that, RRM on serving cell is required to be performed only in the PTW. In this way, there is RRM relaxation on the serving cell in eDRX case (more specifically, outside PTW). So vivo’s concern is whether for such large eDRX values, the assumption still is that there is such RRM relaxation for serving cell (i.e. no RRM measurement requirement outside PTW) in NR as well.

From rapporteur’s perspective, this issue should rather be discussed in the RRM email discussion and there seems anyways to be not much difference, from RRM measurement perspective, between 2621.44s and 10485.76s. In other words, whatever RRM solution is eventually agreed in NR outside PTW (same or different than LTE, if/how early UE needs to wake-up to re-sync before PTW, …) for 2621.44s should likely also apply to 10485.76s.

Thus we would like to progress this issue, aiming at agreeing on a recommendation. So we propose to check with other companies the potential impact of serving cell RRM measurements on the selection of 10485.76s as upper bound eDRX value.

**Q3: Do you think the solution and requirements for serving cell RRM measurements in Idle outside PTW which will be selected in NR have an impact on the choice of the upper bound of eDRX cycle (2621.44s extended to 10485.76s)?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Apple | No | We think RRM relaxation is not connected to the eDRX based serving cell measurement. We agree that the UE serving cell measurement might be spread far across (only during PTW), but that should be ok, and the UE is not required to measure serving cell between PTW (spec doesn’t prevent the UE from doing so). |
| Vivo |  | We are not intending to link RRM relaxation with eDRX.  But if there is no RRM relaxation for serving cell outside PTW, there is marginal power saving benefit for eDRX. In this way, there is no motivation to support longer eDRX values, e.g. 2621.44s or 10485.76s. Thus, before clarifying the RRM requirement for eDRX (i.e. whether there is RRM relaxation for serving cell outside PTW), we cannot accept the longer eDRX values here.  If all companies agreed that there is no RRM requirement outside PTW in eDRX, we could at least conclude that RRM relaxation for serving cell is feasible. But actually, in another email discussion on RRM relaxation, some companies (e.g. even same companies supporting eDRX) mentioned that the RRM relaxation for serving cell has some unacceptable performance degrading, so it is proposed that serving cell RRM relaxation for Redcap UEs is not considered in Rel-17.  We just want to make this clarification on technique, i.e. what is the true understanding from proponent point of view. We think we should at least correctly capture the potential technique issues in the TR in SI phase. |
| Qualcomm | No |  |
| Lenovo | Yes |  |
| OPPO | No | The upper bound of eDRX cycle and RRM relax should be discussed separately. |
| Sharp | No | Agree with the rapporteur, whether LTE eDRX measurement rule is reused for NR can be discussed in RRM discussion. |
| CATT | No | Assuming the LTE behavior as baseline for RRM (no requirement outside PTW), there is clear benefit in increasing the eDRX cycle. But even if different behavior is concluded for NR, RRM is not the only source of power consumption, POs monitoring also is, so there will still be some gain. And as mentioned repeatedly, no technical concerns have been raised, so such proposal is harmless while still promising in terms of gains. |
| Xiaomi | No | We need to first clarify “there is no RRM relaxation for serving cell outside PTW” is a RAN4 “RRM requirement for eDRX” or “RRM relaxation” , e.g., perform serving cell measurement every four paging cycle .In our understanding , “there is no RRM relaxation for serving cell outside PTW” is more of a RAN4 “RRM requirement for eDRX”.  We agree with the rapporteur’s view whatever RRM solution is eventually agreed in NR outside PTW for 2621.44s should likely also apply to 10485.76s. |
| Huawei | No | We have similar view as Apple. A UE is configured with eDRX only if it is delay tolerant. Hence, stopping serving cell RRM measurements for some time will be ok. However, for those UEs with DRX or short eDRX, serving cell RRM measurement relaxation may have impact on UE’s performance. |
| MediaTek | No | RRM requirements for eDRX will be defined by RAN4. This will follow the same principle regardless of the upper bound for the eDRX cycle being 2621.44s or 10485.76s. |
| Convida | No | The upper bound of eDRX cycle and RRM relax should be discussed separately. |
| Futurewei | No |  |

**Companies who do not agree with the above proposal 3 are invited to express their concerns.**

|  |  |
| --- | --- |
| Company | Argument(s) |
| Apple | Pls see our comments above. |
| vivo | Pls see our comments above. |
| Huawei | Pls see our comments above. |
| MediaTek | Pls see our comments above. |
| Convida | Pls see our comments above. |
|  |  |

**Text proposal:**

We propose to capture proposals #3-4 in the updated TR [7] as follows:

Section 8.3.1:

|  |
| --- |
| From RAN2 perspective, extended DRX can be specified and configured for RedCap UEs so that eDRX cycles can be used in RRC\_IDLE and in RRC\_INACTIVE states. |

Section 8.3.1.1:

|  |
| --- |
| For the upper bound, the eDRX cycle should support up to 10485.76s, since the upper limit of the H-SFN (10bit) already is 10485.76s, and CN already supports eDRX values up to 10485.76s. Although no REDCAP use cases that require eDRX cycles beyond 2621.44s have been identified yet and little power saving gain has been observed beyond 2621.44s (simulation results show that the gain is saturated at around 40mins), there is no reason to artificially limit without technical concern. |

**Q4: Do companies agree with above text proposals?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Apple | We are ok with it, but | The SI has requirement to support battery life for multiple years! And long eDRX is needed in such a case. The industrial sensors can have use cases where only periodic measurments of the application and reporting during even longer periods (if a condition satisifies) can mean that there is technical justification to have large eDRX cycle (atleast in IDLE). |
| vivo |  | Before clarifying the RRM requirement for eDRX (i.e. whether there is RRM relaxation for serving cell outside PTW), we cannot accept the longer eDRX values and corresponding TP here, since there may be no power saving gain for eDRX. In this way, there is no motivation to introduce longer eDRX values. |
| Fraunhofer | Yes, with comments | Agree with Apple. The use case for IWSN (battery powered industrial sensors) clearly benefits from longer eDRX cycles. We would like to point out the difference between DL reachability (paging) and UL latency (wake up+transmission) within the RedCap use cases. Industrial sensors (unlike LPWAN) may require a short latency but on the other hand do not need to be “pulled” for information or have information sent to them. So we do not agree to the statement, that no use cases have been identified. We agree with the conclusion, that there is no technical reason to not have 10485.76s. |
| Qualcomm | Yes |  |
| Lenovo | Yes |  |
| OPPO | Yes | The TP is fine to us. |
| Sharp | Yes |  |
| CATT | Yes | And regarding Apple and Fraunhofer’s comments, we would be OK to remove “no REDCAP use cases that require eDRX cycles beyond 2621.44s have been identified yet and”. |
| Xiaomi | - | We are hesitating to accept this as little power saving gain can be seen beyond 2621.44s |
| Huawei | Yes |  |
| MediaTek | Yes, but | Agree with Apple and Fraunhofer that uplink-centric IWSN use cases can clearly benefit from long eDRX cycles. There is significant scope to improve power saving gain during eDRX sleep by implementation (as seen in NB-IoT).  We therefore agree with CATTs suggestion to remove the statement “no REDCAP use cases that require eDRX cycles beyond 2621.44s have been identified”. |
| Convida | Yes but | The use case for IWSN (battery powered industrial sensors) clearly benefits from longer eDRX cycles. |
| Futurewei | Yes |  |

**Summary:**

TBC

# eDRX in inactive

### On the need for eDRX cycle > 10.24s in inactive

Whether to support eDRX cycle in RRC\_INACTIVE beyond 10.24s for REDCAP UEs was discussed in the email discussion #154 to RAN2#113-e [3], resulting in the following summary:

|  |
| --- |
| **Summary from email disc #154:**  22 companies provided inputs to this question.  A majority of companies (15/22) see a benefit in extending the eDRX cycle in RRC\_INACTIVE beyond 10.24s for REDCAP UEs, 4/21 (Sharp/Qualcomm/Intel/Sequans) are neutral and 2 companies (MediaTek/vivo) see no benefit.  Hence it is proposed to capture that RAN2 sees a benefit and recommends extending the eDRX cycle in RRC\_INACTIVE beyond 10.24s for REDCAP UEs in the TR.  The benefits can be summarized as follows based on companies’ inputs:  Benefits   * It is very beneficial to have >10.24 sec in RRC\_INACTIVE to effectively support the usage of SDT (small data transfer) for e.g. use cases with periodic uplink data with periodicity > 10.24 s. TS 22.104 provides such usecases, e.g. some industrial wireless sensors need to transfer small packets while they are not very sensitive to DL traffic delay, but they have strict battery lifetime requirement. * Based on the results in the Appendix of the TR, there is a clear power saving gain vs eDRX in RRC\_IDLE at least for eDRX cycles of 10.24 s – couple of minutes, where the UE in eDRX in RRC\_INACTIVE additionally benefits from less signaling. Based on these results, lifetime of several years would not be achievable in some cases (e.g. 1 minute IAT) if only RRC\_IDLE can be used, because of the signaling overhead. * Signaling reduction is an additional benefit from network point of view – there is need for less RRC signaling   Issues: no new issues were brought up on top of those already listed by Rapporteur in the introduction of this section (and which are addressed in the following sections), so we replicate them below:   * Impact on NAS retransmission, SA2/CT1 must be involved * Potential handling of different eDRX cycles > 10.24s and/or PTWs, one for IDLE the other for INACTIVE * Need to study which Node decides the eDRX cycle for RRC\_INACTIVE   **Proposal 5 (15/22): Capture in the TR that RAN2 sees a benefit and recommends extending the eDRX cycle in RRC\_INACTIVE beyond 10.24s for REDCAP UEs.**  **Proposal 6: Capture in the TR the justifying benefits listed above and associated issues to solve.** |

Given the vast majority of companies supporting proposal #5, and considering the agreement that we will consult SA2/CT1 about it (see Section 3), we propose to adopt it along with the associated proposal #6 capturing the related pros/cons.

**Companies who do not agree with the above proposals 5-6 are invited to express their concerns.**

|  |  |  |
| --- | --- | --- |
| Company | Proposal(s) | Argument(s) |
| Apple | Agree to 5 and 6. |  |
| Vivo | No | We donot see strong need to support eDRX >10.24 in inactive mode. If UEs want to save power for a long period, idle mode could be a better choice.  Could proponent provide what kind of RedCap UEs or use case will stay in RRC inactive but configured with eDRX>10.24s? |
| Fraunhofer | Agree | The benefit of RRC\_INACTIVE is the reduced latency for the transition from INCACTIVE to CONNECTED. Compared to LPWAN use cases, IWSN use cases have usually more strict requirements regarding latency while on the other hand still have periodic small data transmission or even event-based data transmissions (alarm messages). Thus we support the proposal. |
| Huawei | Agree to P5 and P6 |  |
|  |  |  |
|  |  |  |

**Text proposal:**

We propose to capture proposals #5-6 in the updated TR [7] as follows (Section 8.3.1):

|  |
| --- |
| 8.3.1.2 eDRX in RRC\_INACTIVE RAN2 sees a benefit extending the eDRX cycle in RRC\_INACTIVE beyond 10.24s for REDCAP UEs for the following reasons:   * It is very beneficial to have >10.24 sec in RRC\_INACTIVE to effectively support the usage of SDT (small data transfer) for e.g. use cases with periodic uplink data with periodicity > 10.24 s. TS 22.104 provides such usecases, e.g. some industrial wireless sensors need to transfer small packets while they are not very sensitive to DL traffic delay, but they have strict battery lifetime requirement * Based on the results in the Appendix, there is a clear power saving gain vs eDRX in RRC\_IDLE at least for eDRX cycles of 10.24 s – couple of minutes, where the UE in eDRX in RRC\_INACTIVE additionally benefits from less signaling. Based on these results, lifetime of several years would not be achievable in some cases (e.g. 1 minute IAT) if only RRC\_IDLE can be used, because of the signaling overhead * Signaling reduction is an additional benefit from network point of view – there is need for less RRC signaling   The resulting issues are:   * Impact on NAS retransmission, SA2/CT1 must be involved * Potential handling of different eDRX cycles > 10.24s and/or PTWs, one for IDLE the other for INACTIVE * It needs to be studied which Node decides the eDRX cycle for RRC\_INACTIVE |

**Q5: Do companies agree with above text proposal added to Section 8.3.1?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Apple | Yes |  |
| vivo |  | See above. |
| Fraunhofer | Yes |  |
| Qualcomm | No | The way that the second paragraph is worded implies that RAN2 have agreed to extend eDRX cycle beyond 10.24s and we only need some help from SA2/CT1 to resolved the described issues. We think SA2/CT1 play a more deciding role in this discussion, i.e. the final decision on whether eDRX cycles beyond 10.24s should be adopted or not should be made by SA2/CT1.  We’d suggest to add a sentence after the second paragraph in the above TP as follows:  The final decision on whether to adopt eDRX cycles longer than 10.24s in RRC Inactive will be made by SA2/CT1. |
| Lenovo | Yes |  |
| OPPO | Yes |  |
| Sharp | Yes |  |
| CATT | Yes | @Qualcomm. OK with the comment. How about: “SA2/CT1 must be consulted on the feasibility”? |
| Xiaomi | Yes |  |
| Huawei | Yes |  |
| MediaTek | Yes, but | Agree with the addition from Qualcomm, we are okay with CATT’s suggestion modified as below:  SA2/CT1 must be consulted on the feasibility prior to the introduction of eDRX cycles longer than 10.24s in RRC Inactive. |
| Convida | Yes | We are ok to consult feasibility from SA2/CT1 |
| Futurewei | Yes |  |

**Summary:**

TBC

### Addressing the impacts of eDRC cycle >10.24s in inactive

### Handling of two PTWs and PHs

Whether to support a common PTW and eDRX cycle configuration for RRC\_IDLE and RRC\_INACTIVE as one of the possible solutions to consider during the WI phase was discussed in the email discussion #154 to RAN2#113-e [3], resulting in the following summary:

|  |
| --- |
| **Summary:**  20 companies provided inputs to this question.  A majority of companies (17/20) support a solution based on a common PTW and eDRX cycle configuration for RRC\_IDLE and RRC\_INACTIVE. 4 companies (OPPO/Sharp/ZTE/Convida) are OK with a common PTW for RRC\_IDLE and RRC\_INACTIVE but would prefer to have the flexibility to support a shorter eDRX cycle in RRC\_INACTIVE than in RRC\_IDLE. ZTE also think it is too early to decide and the practical feasibility from CN perspective needs to be checked. Two companies (Huawei/Sequans) would also like to study more flexible solutions.  **Proposal 7 (17/20): Capture in the TR that RAN2 will consider as a starting point a common PTW and eDRX cycle configuration for RRC\_IDLE and RRC\_INACTIVE, justified by its simplicity. More flexible solutions can be considered if shown beneficial.** |

Given the vast majority of companies supporting proposal #7, we propose to adopt it.

**Companies who do not agree with the above proposal #7 are invited to express their concerns.**

|  |  |
| --- | --- |
| Company | Argument(s) |
| Apple | We agree. |
| vivo | Agree if eDRX cycle >10.24s in inactive mode was agreed. |
| Qualcomm | We’d like to change our previous position and think UE should have the flexibility to negotiate different eDRX configurations for RRC Idle and RRC Inactive. For example, it is more efficient for UE to enter RRC Inactive instead of RRC Idle when it expects new data in not-so-distant future but still see opportunity to sleep before the data arrive. In this case, which we believe is one of the motivating scenario for RRC Inactive, it is important for UE to have a different eDRX configuration than the one for its RRC Idle.  We’d propose not to capture any conclusion on this topic and study the issue in more details in the WI phase. |
| OPPO | We prefer to support separate eDRX cycle configuration for CN paging and RAN paging, which could provide more flexible configuration.  We propose to capture both options in the TR rather than considering common PTW and eDRX cycle configuration as a starting point. |
| Sharp | Both common PTW and eDRX cycle configuration and some simple flexible method have been proposed can be included. |
| Huawei | We agree but with some comments.  The common PTW and eDRX cycle could be the simplest way but not necessarily the most efficient, as the requirements in RRC\_IDLE and RRC\_INACTIVE may be different in terms of latency or power consumption. Besides, Proposal 7 is related to the options in Proposal 8. A common PTW and eDRX cycle configuration is more likely to be decided by the CN. To address the possible solutions on handling of two PTWs and PHs, we suggest to add the following options in the TR for future discussion:   * A common PTW but with different eDRX cycle * A common eDRX cycle but with different PTW length * Different eDRX cycle and different PTW length |
| Convida | Agree with Huawei to capture all options on the table. |

**Text proposal:**

We propose to capture proposals #7 in the updated TR [7] as follows (Section 8.3.1.2):

|  |
| --- |
| As a starting point a common PTW and eDRX cycle configuration for RRC\_IDLE and RRC\_INACTIVE, should be considered, justified by its simplicity. More flexible solutions can be considered if shown beneficial. |

**Q6: Do companies agree with above text proposal added to Section 8.3.1.2?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Apple | Yes | agree |
| vivo |  | See above. |
| Fraunhofer | Yes |  |
| Qualcomm | No | See our comments above |
| Lenovo | Yes |  |
| OPPO | No | See our comments to P7. |
| CATT | Yes | @Qualcomm: the TR is a picture of the progress at the time of SI closure and we haven’t seen yet a contribution describing your solution. But that’s OK, we think nothing is closed at the moment and the 2nd sentence is precisely there to leave the door open to other solutions, if sufficient motivation is shown in the WI phase.  @OPPO: similar comment. |
| Xiaomi | Yes |  |
| Huawei | Yes with comment | Please see our comments on P7. |
| MediaTek | Yes |  |
| Convida | No with comments | All options should be captured. |
| Futurewei | Yes |  |

**Summary:**

TBC

### Which node is responsible for configuring the eDRX cycle in inactive?

In the email discussion #154 to RAN2#113-e [3], it is proposed to capture the following options in the TR to be considered for the deciding node for the eDRX configuration for inactive:

* Option 1: CN decides the eDRX parameters for RRC\_INACTIVE
* Option 2: RAN decides the eDRX parameters for RRC\_INACTIVE

Companies’ inputs resulted in the following summary:

|  |
| --- |
| **Summary:**  20 companies provided inputs to this question.  All companies support capturing both options in the TR and performing the down-selection during the WI phase. 5 companies (CATT/Apple/Ericsson/Qualcomm/LGE) would prefer Option 1 and 3 companies (Sharp/Huawei/Convida) would prefer Option 2. 2 companies (Sharp/Convida) comment that for R16 eMTC connected to 5GC, these options were also discussed in SA2 and in the end it is NG-RAN that choses and configures the final eDRX cycle for RRC\_INACTIVE, based on idle mode eDRX cycle as provided by the AMF. So, in any case, SA2/CT1 should be consulted on this.  The arguments in favour of each option can be summarized as follows based on companies’ inputs:  Option 1: CN decides the eDRX parameters for RRC\_INACTIVE   * CN has better insight on UE traffic profile * Better for addressing the NAS retransmission timer issue * CN is responsible for eDRX in RRC\_IDLE (and UE needs to monitor for CN paging also in RRC\_INACTIVE)   Option 2: RAN decides the eDRX parameters for RRC\_INACTIVE   * It provides more flexibility to the RAN node in the configuration of the eDRX parameters * It allows RAN to configure different eDRX cycle for RRC INACTIVE * In R16 eMTC connected to 5GC, it is already NR-RAN that choses and configures the final eDRX cycle for RRC\_INACTIVE, based on idle mode eDRX cycle as provided by the AMF   **Proposal 8: Capture in the TR the two options for the deciding node for the eDRX configuration for RRC INACTIVE: RAN or CN.**  **Proposal 9: Capture in the TR the above arguments in favour of each option.** |

Given all companies supported proposal #8, we propose to adopt it along with the associated proposal #9 capturing the related arguments for each.

**Companies who do not agree with the above proposals 8-9 are invited to express their concerns.**

|  |  |  |
| --- | --- | --- |
| Company | Proposal(s) | Argument(s) |
| Apple | Agree to 8 and 9 | We can decide in WI phase which among RAN/CN can configure. |
| vivo |  | Agree with P8 and P9 if eDRX cycle >10.24s in inactive mode was agreed. |
| Huawei | Agree to P8 and P9 |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Text proposal:**

We propose to capture proposals #8-9 in the updated TR [7] as follows (Section 8.3.1.2):

|  |
| --- |
| Two options should be considered for the deciding node for the eDRX configuration for inactive:  Option 1: CN decides the eDRX parameters for RRC\_INACTIVE   * CN has better insight on UE traffic profile * Better for addressing the NAS retransmission timer issue * CN is responsible for eDRX in RRC\_IDLE (and UE needs to monitor for CN paging also in RRC\_INACTIVE)   Option 2: RAN decides the eDRX parameters for RRC\_INACTIVE   * It provides more flexibility to the RAN node in the configuration of the eDRX parameters * It allows RAN to configure different eDRX cycle for RRC INACTIVE * In R16 eMTC connected to 5GC, it is already NR-RAN that choses and configures the final eDRX cycle for RRC\_INACTIVE, based on idle mode eDRX cycle as provided by the AMF |

**Q7: Do companies agree with above text proposal added to Section 8.3.1.2?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Apple | Yes | Ok with the content |
| Vivo |  | See above. |
| Fraunhofer | Yes | Agree. |
| Qualcomm | Yes |  |
| Lenovo | Yes |  |
| OPPO | Yes |  |
| Sharp | Yes |  |
| CATT | Yes |  |
| Xiaomi | Yes |  |
| Huawei | Yes |  |
| MediaTek | Yes |  |
| Convida | Yes |  |
| Futurewei | Yes |  |

**Summary:**

TBC

# Conclusion

TBD

# Reference

1. R2-2008193 Summary of offline 111 - DRX aspects; CATT
2. R2-2008216 Summary of offline 111 - DRX aspects - second round; CATT
3. R2-2101242 Summary of email discussion 154 - eDRX cycles CATT
4. RAN2-113-e - R16 eMIMO-CLI-PRN-RACS - R17 NTN-REDCAP (Sergio)\_2021\_01\_27\_445
5. R2-2009364 Summary of email discussion 915 - UE power saving features; CATT
6. R2-2101460 2.56 sec non-eDRX operation for RedCap, Apple Inc, MediaTek Inc, Facebook Inc
7. R2-2100984 RAN2 update to TR38875, Ericsson
8. R2-2007346 Discussion on eDRX for RRC\_INACTIVE and RRC\_IDLE; Huawei, HiSilicon
9. R2-2006748 Use cases target to extend paging DRX cycle and relax measurements for stationary devices; Intel Corporation
10. R2-2009116 Further considerations for eDRX; MediaTek Inc.
11. R2-2009247 Discussion on eDRX for Redcap UE; ZTE Corporation, Sanechips
12. R2-2009363 On eDRX for NR RRC Inactive and Idle; CATT
13. R2-2009532 Support of 2.56 eDRX cycle and emergency broadcast reception for RedCap UEs; Apple, Facebook
14. R2-2009620 RedCap power saving enhancements; Ericsson