3GPP TSG-RAN WG2 #114-e draftR2-2106530

Electronic meeting, 19th – 27th May, 2021

Agenda Item: 8.12.3.1

Source: Ericsson

Title: Summary of [AT114-e][110][REDCAP] eDRX aspects (Ericsson)

Document for: Discussion, Decision

# Introduction

The document summarizes the following offline discussion:

* [AT114-e][110][RedCap] eDRX aspects (Ericsson)

Initial scope: Discuss PTW length + starting point and min eDRX cycle value

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 2021-05-25 08:00 UTC

Initial deadline (for rapporteur's summary in R2-2106530): Tuesday 2021-05-25 12:00 UTC

Proposals marked "for agreement" in R2-2106530 not challenged until Tuesday 2021-05-25 22:00 UTC will be declared as agreed via email by the session chair.

For the rest the discussion will continue online in the Wednesday CB session.

# Minimum eDRX cycle length

Based on the tdocs submitted to RAN2#114-e, two different minimum lengths have been proposed for eDRX in Rel-17:

* 2.56 seconds, proposed in [3], [5], [9] and [13]
* 5.12 seconds, proposed in [1], [2], [7], [8], [10], [12] and [14]

**Discussion point 1: What should be the lower bound for extended DRX cycle in RRC\_IDLE and RRC\_INACTIVE?**

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| **Company** | **Lower bound for eDRX?** | **Comments / arguments** |
| Ericsson | 5.12 s | We think we can keep the existing lower bound from LTE. The use cases of shorter (=2.56 s) eDRX are not clear to us, remembering UE should request eDRX only when the MT traffic is delay tolerant. |
| Apple | 2.56s | We do not agree with Ericsson’s statement on the applicability of delay tolerance for eDRX. This was before RedCap was discussed.  eDRX is also used for power-savings. It is already agreed that wearables are part of RedCap and eDRX here is for power-savings. We should assess the eDRX bounds from this perspective as well.  If 2.56s is not agreed, **then a wearable UE has to choose either 1.28sec (the current behavior with NO power-saving) or the next avalible 5.12sec** which impacts the user-interaction aspect of wearables, while we have a **large gap between 1.28sec and 5.12sec!!**  We request companies to also consider wearables and their requirements as RedCap instead of purely looking at industrial sensors etc. which are on other side of RedCap spectrum.  **We also request companies to provide technical reasons on why 2.56sec is a bad choice**. The NWs would anyway have to deal with 5.12sec RedCap devices, in terms of handling paging from CN (buffering the page until the paging occasion) and the interface from CN on the DRX config is already present. If the NW can handle 5.12sec, we do not see why 2.56s cannot be handled (which is even shorter).  Regarding the emergency message reception, the NW anyway would broadcast the SI change page multiple times, and per spec, 2.56sec RAN paging cycle is already present as an option (if the argument is on the 4sec requirement of EM broadcast), **and we are not adding anything new here**.  From wearable perspective, a DRX cycle of 2.56 over 1.28sec (which is the practical deployment for legacy NR) is twice in terms of power-saving, or atleast 80% additional savings, when the UE wake-up time is twice as longer. |
| Qualcomm | 2.56s | We think the wearable use case explained by Apple is a real issue that needs to be addressed. We understand that there are alternative solutions (e.g. through network configuration). But from UE’s perspective, eDRX is the most desirable solution among them, because it allows UE to request and then use the exact paging cycle it wants, if default or RAN paging cycle is not configured to the desired value (e.g. 1.28s). |
| OPPO | 5.12s | An ETWS or CMAS capable Redcap UE should not be expected to be configured with eDRX, i.e., the minimum value of eDRX cycle is kept as 5.12s as LTE and for an ETWS or CMAS capable UE, it may be configured with DRX but should not be configured with eDRX. In this way, no specification impact is needed. |
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# Paging transmission window

The configuration details of PTW have been discussed in previous meetings, e.g. during RAN2#113bis-e in Offline 101. However, no consensus has been sreached e.g. on whether the PTW for RRC\_INACTIVE can be of different length compared to PTW for RRC\_IDLE, and whether the starting location of PTW for RRC\_INACTIVE and RRC\_IDLE, i.e. for RAN paging and CN paging, respectively, should be the same.

The following related agreements were made in RAN2#113bis-e:

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| * RAN decides and configures eDRX via RRC for RRC\_INACTIVE (FFS on the need and details of coordination with the CN) * At least for eDRX cycle, the configurations of the eDRX for RRC\_IDLE and RRC\_INACTIVE can be different (FFS for PTW, e.g. length and starting point, when eDRX cycles are longer than 10.24s) |

Assuming that RAN paging cycle is always equal or shorter compared to CN paging cycle, it is possible there are paging frames where either RAN or CN paging may occur, or paging frames where only RAN paging may occur.

Illustration from [3] is copied below to clarify the existing LTE eDRX configuration, where A denotes start of a PH and B denotes the start of a PTW in the PH (i.e. the starting location PTW\_start in TS 36.304):



Figure 1. LTE eDRX according to [3].

On PTW length, the following have been proposed in the tdocs submitted to RAN2#114-e:

* Common PTW length is used for RRC\_IDLE and RRC\_INACTIVE, proposed in [1], [4], [6], [8], [10], [14]
* The PTW length can be configured to be different for RRC\_IDLE and RRC\_INACTIVE, proposed in [2], [3], [7], [9], [11], [12], [13]

The assumption is that common length, if agreed, would be configured for the CN paging, i.e. by AMF.

**Discussion point 2: Should it be possible for RAN to configure different PTW length for RAN paging compared to PTW length configured for CN paging?**

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| **Company** | **Yes / No** | **Comments / arguments** |
| Ericsson | Yes, shorter | In particular we think RAN should be able to configure a shorter PTW compared to the CN PTW when CN PTW is relatively long. This will benefit of UE power consumption as it doesn’t need to monitor for long CN PTW for RAN paging.  Whether RAN uses the same PTW or a different one should be up to RAN to decide.  We provided the following example in [R2-2105236](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_114-e/Docs//R2-2105236.zip):  *Let’s consider another example where the RAN paging cycle is 61.44 s and the CN paging cycle is 122.88 s. The CN has configured a PTW of 20.48 s. We expect that the PTW for RAN paging does not always need to be configured to the same length as the PTW for CN paging – and in such case it would benefit the UE power consumption to allow the possibility to configure different PTW lengths for RAN and CN paging. Thus, in the example, RAN should be able to configure a shorter PTW than 20.48 s, let’s say 10.24 s PTW is enough. In this case the UE can save power compared to always using 20.48 s PTW.*  We don’t see a reason why RAN should not be able to configure different length for RAN paging. |
| Apple | Should be possible | While we would have preferred to have same config between RAN/CN, our main aim now is to ensure that UE is able to receive CN page while in INACTIVE, if there is a problem where NW assumes the UE is in IDLE. As long as the UE can receive the CN page, we are ok with diff PTW config. |
| Qualcomm | Yes | We think that as long as PTWs configured for RRC Idle and RRC Inactive have some overlapping POs, UE in RRC Inactive can still receive CN paging. Hence it is OK for their PTWs to have different lengths.  Being able to configure different PTWs when two RRC states have different eDRX cycles can save UE power. For example, NW may configure the length of PTW in proportion to eDRX cycle, e.g. to ensure it has enough number of POs to reach a UE if that UE is highly mobile. In that case, if UE is configured with a long eDRX cycle for RRC Idle but much shorter eDRX cycle for RRC Inactive, forcing a common PTW length would cost UE extra power when UE operates in RRC Inactive. |
| OPPO | No | In our understanding, the intention of PTW is to improve the paging robustness for UE configured with eDRX, regardless of whether the UE is in RRC IDLE and RRC INACTIVE. So we think for UE in RRC INACTIVE configured with eDRX, RAN should also follow the CN configured PTW length to page the UE.  Following the same PTW length with CN eDRX has another benefit of saving signaling overhead of RAN eDRX configuration. |
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On PTW starting location, the following have been proposed in the tdocs submitted to RAN2#114-e:

* Common PTW starting locations are used, proposed in [1], [4], [6], [8], [10], [14]
* Leave configuration up to network implementation, or that starting point can be same or different, proposed in [2], [3], [9], [12]
* Use the LTE baseline, and update if needed resulting in overlapping PTWs, proposed in [7]
* Consider either configurable locations, which can be different, or fixed locations in the specification resulting in the same starting locations for RAN and CN PTWs [11]

As the eDRX cycles can be different for RAN and CN paging, the same PTW starting location discussion is relevant for the case where both RAN and CN paging would occur in the same PH (i.e. the PTWs would start in the same PH), see Figure 1.

**Discussion point 3: When RAN paging and CN paging coincide in the same paging hyperframe (PH), should both PTWs start at the same time?**

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| **Company** | **Yes / No** | **Comments** |
| Ericsson | Maybe | It would be possible to specify same starting location for PTW in case paging coincide in the same PH, as proposed in some of the submitted Tdocs.  But it is also possible to leave this configuration up to NW e.g. so that it has possibility to distribute PTWs of different UEs when needed.  We don’t have a strong view. |
| Apple | Yes | Helps with UE power saving. |
| Qualcomm | Yes | It helps ensure there would be some overlapping between the PTWs of two RRC states, as well as saves UE power. |
| OPPO | Yes | Using a common PTW starting point for both CN paging and RAN paging would be beneficial for UE power saving.  For simplicity, we propose to use CN eDRX cycle to derive the PTW starting point based on the legacy calculation formula in LTE for all the PHs. |
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Depending on the outcome of DP2 and DP3, one remaining question e.g. in the case RAN configures a shorter PTW length is which PTW the UE should follow in the case when the PTWs fully overlap. As the UE is required to follow CN paging e.g. for possible state mismatch, it seems reasonable that the UE would in this case follow the CN configured PTW.

**Discussion point 4: Do you agree that when RAN paging and CN paging coincide in the same paging hyperframe and the PTWs overlap each other, UE should follow the CN PTW for paging monitoring?**

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| **Company** | **Yes / No** | **Comments** |
| Ericsson | Yes | In case it is agreed the starting locations are same and e.g. RAN PTW can be shorter then yes the UE should monitor according to CN PTW as the UE is in any case required to monitor for CN paging.  We can discuss later once the set of allowed eDRX cycles is agreed what to do e.g. for cases PTWs started in different PHs overlap (i.e. whether this is allowed or left up to NW to configure in a way it doesn’t happen). |
| Apple | Needs clarification | It is our assumption that UE in INACTIVE only monitors RAN paging and the CN paging should coincide (other wise the UE does not receive the CN page for resolving error cases). We are not sure about UE following the CN PTW/PH config while in INACTIVE.  In IDLE, from UE perspective, it’s the CN paging cycle, and the RAN should configure the default paging cycle to align with RAN paging cycle (like in legacy). |
| Qualcomm | No | If we understand the proposal correctly, our preference is no. Our assumption on UE’s monitoring behavior is the following: when UE is in RRC Inactive, it follows the PTW configured for RRC Inactive; when UE is in RRC Idle, it follows the PTW configured for RRC Idle. Within a PTW, UE follows the legacy “T” to monitor paging, i.e. when UE is in RRC Idle, it monitors only CN paging; when UE is in RRC Inactive, it monitors both RAN and CN paging.  Otherwise (i.e. as suggested in the proposal by the rapporteur), we lose the whole purpose of being able to have different PTW lengths for RRC Idle and RRC Inactive. |
| OPPO | Yes, for RAN eDRX and CN eDRX using the same PTW length | As comment to Q2, we see no need for RAN to configure a separate PTW length for UE in RRC INACTIVE, we think RAN paging should always following the CN configured PTW. |
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# Summary

TBD

# References

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# Delegate contact information

|  |  |
| --- | --- |
| Company | Delegate contact |
| COMPANY\_NAME | NAME ([email@address.com](mailto:email@address.com)) |
| Ericsson | tuomas.tirronen@ericsson.com |
| OPPO | Haitao Li (lihaitao@oppo.com) |
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