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.  **[Apple] Pls note that the LTE eDRX is brought to RedCap with power-savings as the main goal to address. But the LTE devices that use eDRX and NR RedCap devices do not always have the same requirements. RedCap has wearables and so the LTE eDRX can (needs to) be adapted to the RedCap needs. We hope that specification impact should not be dictating the decisions made in RAN2.** |
| Lenovo | Either is ok | The network could configure the UE with short DRX cycle other than eDRX cycle. The eDRX cycle with 5.12s is aligned to the legacy one in LTE, and no significant impact to other group will be introduced.  [**Apple] If by network, Lenovo’s assumption is the gNB, then we are concerned about the cases where the gNB does not configure the RedCap UEs with 2.56sec (the short DRX other than eDRX). Then the wearbale UE needs to monitor at 1.28s while all other RedCap UEs are NOT dependant on the gNB configuration for DRX cycles!**  **While wearables are also RedCap devices, we are concerned that wearables are at the mercy of gNB DRX config, but every other RedCap UE can negotiate with CN on the eDRX cycle and just use** **that DRX cycle without being dependant on the gNB config. We think power-saving is important for wearable type RedCap as well, and request response on how to remove the gNB DRX config dependency for wearables, even when the wearables are configured with NAS 2.56DRX cycle.**  **Is it ok for Lenovo if we agree that eDRX starts at 5.12s, but any RedCap UE with NAS configured 2.56 DRX cycle only follows this 2.56s DRX cycle irrespective of the RAN default paging cycle?**  **[Lenovo\_2]**  Considering the 2.56s could be helpful to save UE power from the view of SI updating and UE specific traffic model, we are fine to either the 5.12s or the 2.56s. |
| Xiaomi | 2.56s | We also want to reuse the LTE way for simplicity. But(see below):  **[Apple] eDRX operation is mostly in RAN (gNB and eNB). Is it ok for Xiaomi if we agree that eDRX starts at 5.12s, but any RedCap UE with NAS configured 2.56 DRX cycle only follows this 2.56s DRX cycle irrespective of the RAN default paging cycle? gNB has to make changes for RedCap anyway, so we can keep the change to within gNB. CN anway provides the UE capabilities and paging capabilities for each of the CN pages to RAN (no change needed for 2.56s here).**  **Add Xiaomi’ comment:**  UE specific DRX cycle=2.56s to follow the behavior of 5.12s, i.e., irrespective of the default Paging Cycle can give UE some benefit of UE power saving while fulfill the 4sec requirement of EM broadcast.  Regarding to the possible SI update missing, we think a reasonable modification period would start from at least rf256 which can ensure at least one chance of receiving page. A reasonable NW implementation can solve this.  So we are ok to this. |
| Nokia, Nokia Shanghai Bell | 2.56s | We are OK to define this value to have more flexibility on the lower end values for eDRX. |
| CATT | 5.12s | We agree the eDRX should be applied for latency tolerant service, so the use case that needs emergency service shouldn’t be configured with eDRX. And currently it supports of 2.56s for legacy DRX cycle configuration, so it doesn’t need to introduce 2.56s for eDRX cycle, furthermore, the motivation of the eDRX is power saving, the shorter of the eDRX cycle, the less benefit the UE can gain on power saving. As for the argument that wearables are expected to closely interact with human, hence need EM reception, in our view such wearables are typically used with a “hub” device e.g. a smart watch or a smartphone with less power-critical requirements and which can handle the EM reception.  [**Apple] Is it ok for CATT if we agree that eDRX starts at 5.12s, but any RedCap UE with NAS configured 2.56 DRX cycle only follows this 2.56s DRX cycle irrespective of the RAN default paging cycle? This way, the wearable type of RedCap UE benefits from power-saving like other RedCap UEs. Otherwise, somehow wearable type RedCap UE is getting penalized for choosing 2.56sec!! It’s as if RAN2 decided that power-saving starts only from 5.12sec! Pls note, between 1.28 and 2.56sec there is atleast 80% more power-saving which is substantial!**  **The emergency broadcast reception should not be impacted, as 2.56 is already part of legacy DRX allowed values for RAN default paging cycle which is used for SI change for EM reception.** |
| Huawei, HiSilicon | 5.12s | We think to benefit from both eDRX power saving and supporting emergency broadcast services, RedCap UE can request an eDRX configuration while still monitoring for ETWS and CMAS in between the paging occasions. The lower bound of eDRX cycle can be kept to baseline 5.12s as in LTE.  [**Apple] We do not understand fully. If the RedCap wearable requests 5.12s eDRX, it will not be able to get a page for voice call (for eg.) in between the 5.12sec cycle. Some NAS timers or even legacy technology timers may time-out from such long delay. Is the assumption that wearable type RedCap UE does not use voice with legacy technologies (like PSTN)?** |
| MediaTek | 2.56s | Agree with Apple and Qualcomm. 2.56s eDRX cycle will enable wearables to be individually configured with 2.56s when the default paging cycle in the network is 1.28s (which is common in current deployments). |
| ZTE | 2.56s | 2.56s is acceptable to us if majority prefer it. |
| Futurewei | 5.12s | Agree with Huawei.  [**Apple] We do not understand fully. If the RedCap wearable requests 5.12s eDRX, it will not be able to get a page for voice call (for eg.) in between the 5.12sec cycle. Some NAS timers or even legacy technology timers may time-out from such long delay. Is the assumption that wearable type RedCap UE does not use voice with legacy technologies (like PSTN)?** |
| Facebook | 2.56s | We share the same thoughts with Apple and QCOM. Battery life, arguable, the biggest pain point in wearables due to the compact form factors and the requirement on light weight. Hence, power saving is particularly critical. As discussed in many papers, eDRX=2.56s provides a very unique sweet spot that allows the simultaneous support of some real time applications while enabling the utilization of the power saving features. |
| Intel | 2.56s | We think that there might be normal category of UEs used for services that do not require prompted response (e.g. on wearables) and may benefit of using 2.56sec from power saving point of views. However, default DRX cycle is usually set by the network to accommodate any kind of UE and therefore it is unlikely that network would set this to 2.56sec. Therefore, we are ok on considering 2.56sec as the minimum eDRX value possible if it can be enabled with the same behaviour as other eDRX cycles ≤ 10.24sec with none or minimal additional specification impact.  If companies have concerns that those UEs may not be able to support lager eDRX values, a new UE capability could be defined specific for UEs supporting only eDRX cycles of 2.56sec. |
| Sequans | 2.56s | It can bring some power saving to e.g. wearables and also don’t see a good reason to oppose this. |
| Convida | Either is ok | We think that it is fine to re-use the existing LTE lower bound (5.12s) cycle length as previously proposed as baseline, but also see some benefit for 2.56s. An issue with re-using 5.12s is meeting the delay requirements for emergency alert paging (e.g., PWS, CMAS). Missing SI update pages may also be an issue. Some, but not all REDCAP UEs, will have both the requirement to receive emergency alert broadcasts whilst still benefitting from power saving with eDRX.  There are a few solutions for this. We could simply identify the REDCAP UEs (type) that require emergency alert broadcast reception and those that do not. For example, a RedCap UE that must receive emergency broadcast services does not request to be configured with eDRX (or could request a shorter 2.56s if that is the majority view), or alternatively, a UE could request or the NW could configure a dynamic eDRX cycle depending on the delay tolerance for mobile terminated data. |
| Samsung | 2.56s | We have sympathized the use case of the wearable. Thus, we have assumed that the wearable device hoping the emergency reception can request UE specific DRX cycle of 2.56s. |
| CMCC | 2.56s | We share same view with Apple. 2.56s would be suitable for wearable use case. |
| Google | 2.56s | We agree with Apple on the wearable use case. 2.56s should be supported to mitigate the gap between 1.28s and 5.12s. |
| Sharp | 2.56s | We are ok with 2.56s if it is the majority’s preference. |
| LGE | 5.12s | If short monitoring is expected (e.g. for ETWS/CMAS), eDRX should be configured. |
| SoftBank | 2.56s | Considering the wearable device use-cases, it would be used as a standalone, so it is important to meet ETWS/CMAS requirements by itself. |
| NEC | 2.56s | We can under the intention to support 2.56s. Regarding the default paging cycle, we tend to agree with Intel that 2.56s is less likely to be configured as default cycle. |
| Thales | 2.56s | Giving the wearables use case explained by Apple we agree that the lower bound should be 2.56s. |
| vivo | Either is OK | Firstly, we think UEs capable of ETWS or CMAS are not expected to be configured with eDRX. Besides, we would like to keep the lower bound of eDRX same with LTE.  But as mentioned by Apple and other companies, lower eDRX cycle could have more power saving gain especially for wearable devices. In this way, we could also accept 2.56s.  In summary, we are ok with 2.56 along with 5.12. |
| DENSO | 2.56s | For wearables and automotive scenarios, it is important to meet the requirement of emergency notification (e.g. 4 sec), and achieve as much power saving as possible while a UE is in the idle or inactive state. |
| Sony | 2.56 | Agree with others regarding the power saving for wearable and other redcap devices. |

Summary: 27 replies to the question have been provided. Out of these, 17 prefer 2.56 s minimum eDRX cycle, 7 companies prefer 5.12 s cycle and 3 are fine with either value.

Most proponents think 2.56 s should be supported to provide possibility to optimize power consumption for the wearable use case. The companies who prefer 5.12 s bring up ETWS/CMAS and mention that even if configured with 5.12 s eDRX cycle, a UE could monitor for the necessary indications. However no technical issues which would make 2.56 s eDRX problematic are brought up.

As the eDRX functionality has an impact on SA2 and CT1 specifications, it is proposed to agree the minimum cycle length of 2.56 s from RAN2 perspective conditional on checking with SA2 and CT1 that it is OK from their point of view.

1. Lower bound for eDRX configuration in RRC\_IDLE and RRC\_INACTIVE is 2.56 seconds. This RAN2 preference needs to be confirmed with SA2/CT1.

# 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:

|  |
| --- |
| * 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. |
| Lenovo | Yes | Considering that network may perform the CN paging if the RAN paging is failed, so the PTW length is better to be longer for CN paging than the one for RAN paging, then the UE could have more paging occasions in CN paging to avoid paging failure for UE.  The PTW length for RRC\_IDLE and RRC\_INACTIVE is suggested to be different from the view of flexibility of eDRX configuration and the possible case with a following CN paging for UE in inactive mode. |
| Xiaomi | No | Not necessary.  We need to know that the PTW is introduced in R13 to improve paging reliability for mobile Ues thus only loose H-SFN synchronization between cells may be required.  Currently for CN paging the PTW provided by CN is set according to the factors such as SFN misalignment among gNBs, latency of N2 interface, gNB scheduling and so on. For RAN paging, these same factors may apply. Since the CN is expected to have the overall knowledge of the synchronization performances in both the UE and the gNB, it seems feasible that the CN configures the PTW for both CN and RAN paging. We do not see a need for RAN to configure a shorter PTW length. The synchronization between cells does not need to differentiate RRC status.  If we do, we need to consider which PTW length for UE to monitoring, to use the max{CN PTW length, RAN PTW length } when the PH based on eDRX cycle for RRC\_IDLE overlaps with a PH based on eDRX cycle for RRC\_INACTIVE?  A lot of details need to consider.  Also, we think the e-DRX cycle contributes more than the PTW to the power consumption gain. So it is not worthwhile to spend so much time on this. |
| Nokia, Nokia Shanghai Bell | Yes | Agree with Ericsson and QC. |
| CATT | No | Firstly, if UE is configured with different length of the PTW for idle and inactive, the UE behavior will be complex considering both the overlapped PTW and separate PTW for idle or inactive. Secondly, the PTW is used to avoid UE missing the paging, it seems not reasonable to configure different PTW length for idle and inactive, unless there exists other consideration that UE in idle could miss the paging with higher probability than UE in inactive so that longer PTW length is needed. |
| Huawei, HiSilicon | Yes | We agree with Ericsson. Especially in non-overlapping PH, a shorter PTW length would be beneficial for power saving. |
| MediaTek | Yes | This can be left to the network implementation. The coordination between RAN and CN can be used to ensure that CN paging occasions for Idle are covered by the RAN paging occasions for Inactive, if necessary. In our understanding this RAN-CN coordination already exists in the current specifications. There is no strong motivation to define restrictions for PTW lengths for RAN and CN paging in the specifications. |
| ZTE | No | The intention of introducing PTW is to improve paging robustness. When eDRX cycle for the two RRC states are longer than 10.24s, we think the robustness requirements are the same no matter the UE is in IDLE or INACTIVE. And from standard point of view, common PTW is simpler for defining UE ehavior. |
| Futurewei | Yes | Agree with Ericsson. |
| Facebook | Yes | We are fine with the different PTW lengths |
| Intel | Yes | We understand that if common LTE-based PTW config. (as proposed by some companies) but different TeDRX values are used for IDLE and INACTIVE, this may break the way that LTE eDRX mechanism spread the UE’s PTW which is calculated based on T eDRX,H (i.e. eDRX cycle of the UE in Hyper-frames) for the PH and PTW\_start. Note that UE-specific PTW depends on PH, PTW\_start and PTW\_end.  Therefore, it can be left up to network implementation the decision on how to configure properly PTW for Ues in IDLE and PTW for Ues in INACTIVE. I.e. it is up to network how to configure PTW to guarantee that legacy requirements for a UE in RRC\_INACTIVE are met (i.e. UE in RRC\_INACTIVE can be paged via both RAN and CN).  If RAN2 TS provide some guidance, this can indicate that PTW for eDRX in IDLE should partially overlaps with PTW for eDRX in INACTIVE to guarantee that a UE in INACTIVE could be paged by CN when required. |
| Sequans | Yes | As long as some Pos overlap, it is beneficial for power saving as described by Ericsson and QC |
| Convida | Yes | For various latency/power savings requirements and flexibility we think that the PTW for RAN paging vs CN paging may vary, suggesting a flexible configuration. Although we think it may be beneficial to have a common/overlapping PTW, we do not see a compelling reason to allow for different eDRX cycles, but require a common PTW. AMF and RAN implementations can configure a common PTW where/when appropriate. |
| Samsung | Yes | We have assumed that PTW could be different, as in eDRX cycle. However, PTW length should be shared/coordinated between CN and RAN, in order to maximize power saving efficiency. |
| Google | Yes | Agree with Ericsson. |
| Sharp | Yes with comments | The main gain of different PTW length is from different PH. In the same PH, common PTW length and start point are simpler. We are fine to follow the majority’s view. |
| LGE | No strong view | We slightly prefer to have the same PTW configuration for simplicity. However, different configurations between Inactive and Idle is also considerable as long as there is common PTW. |
| NEC | Yes | Although it is up to network how to configure PTW for each UE, we see some benefits for having this flexibility. |
| Thales | Yes | Agree with Ericsson and QC. |
| Vivo | Yes | It can be observed that the length of PTW should make sure that UE can receive paging while not consume too much power. If eDRX cycle is large, the UE may move across several cells during the eDRX cycle, then it may need more time to receive SIB and synchronizes with the cell before receiving paging. Hence it is reasonable that Network takes into account the eDRX cycle when configuring the length of PTW. While the eDRX cycles can be different in idle and inactive, we are not expected to configure same PTW length for RAN paging and CN paging. |
| DENSO | Yes | As commented by Ericsson, suppose that the eDRX cycle for the inactive state is short than the idle state, the shorter PTW enables the UE to sleep outside the PTW as much as possible. Even though the UE misses the paging message, the UE can try to receive at the next PH that comer in a short time due to the short eDRX cycle. In this case, there seems a motivation to support different PTW length. |
| Sony | Yes | Reasonable to adjust PTW related to eDRX length, but upto network implement |

Summary: Total 25 replies have been provided. Out of these, 20 replies think PTW length can be different, 4 think it should be the same between CN and RAN paging and 1 reply doesn’t indicate strong preference.

The proponents bring up e.g. following points:

* UE power consumption gain with possible shorter RAN PTW.
* No motivation to restrict different configuration of PTW length, should be left up to NW configuration.

The companies who are against bring up following issues:

* PTW is for paging robustness, there should be no difference between RRC states and CN should know best what is proper configuration.
* Different PTW adds additional complexity.

Couple of replies additionally indicate they prefer common PTW in cases where PH for RAN and CN paging overlap. This is discussed in later questions.

As there is a clear majority for supporting different PTW length configuration, the following is proposed:

1. It is up to RAN to configure the length for PTW for RAN paging, the RAN PTW length can be different from the CN PTW length.

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?**

|  |  |  |
| --- | --- | --- |
| **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. |
| Lenovo | No | It may have some restriction to the network configuration to the PTW and eDRX cycle. We think it could be left to network implementation to configure out the overlapped PTW. |
| Xiaomi | Yes | Separate PTW\_start is not power efficient for the UE.  And it is better to solve the RRC state mismatch problem, i.e., if UE has separate PTW start point in different RRC states, when state mismatch happens and UE will not be able to get page from network to recover(UE is monitoring in PTW for RRC Inactive while the network is paging UE in PTW for RRC idle).  Ues in different RRC states share the same set of Pos is better to solve the RRC state mismatch problem. |
| Nokia, Nokia Shanghai Bell | No strong view | We think network can handle this by configuration. |
| CATT | Yes | Helps with UE power saving |
| Huawei, HiSilicon | Yes | It ensures the overlap of the PTWs for RAN paging and CN paging, which benefits power saving.  Moreover, we think a common PTW can be achieved via specifying that only one of the two PTWs is used, i.e. the IDLE PTW, in overlapping PHs. |
| MediaTek | No | Agree with Ericsson and Lenovo that this can be left to the network implementation. |
| ZTE | Yes | We think overlapped PTWs and same PTW starts can save UE’s power.  Note that according to current spec (i.e. LTE-M eDRX as copied below), different eDRX cycles will result in different PTW start point, so unless new rule is defined, it is hard for network to ensure the PTW starts are always the same.  *PTW\_start denotes the first radio frame of the PH that is part of the PTW and has SFN satisfying the following equation:*  *SFN = 256\* ieDRX, where*  *- ieDRX = floor(UE\_ID\_H /TeDRX,H) mod 4* |
| Futurewei | Yes | As it helps with UE power saving. |
| Facebook | Yes | For UE power saving |
| Intel | Maybe (see comment) | We understand that this is possible but it would depend on which configuration is provided by the network to the UE (assuming that LTE PTW definition is reused in NR as explained in previous discussion point 2). |
| Sequans | Maybe | Since we assume RAN PTW is <= CN’s , as long as it is contained within the CN PTW and some Pos overlap we see no issue |
| Convida | Yes, but | If RAN paging and CN paging coincide in the same PH and both PTWs start at the same time, this will improve power saving. However, this may also be left to NW implementation. |
| Samsung | Yes | It is beneficial for UE power saving |
| CMCC | Yes |  |
| Google | Maybe | This can be left to the network implementation. |
| Sharp | Yes | However if the LTE formula is reused, the start times may be not the same always. |
| LGE | Yes |  |
| NEC | Yes |  |
| Thales | Yes | Should be beneficial for power saving. |
| Vivo | See comments | If we follow the LTE PTW\_start calculation, there may be a problem that no overlap between idle PTW and inactive PTW since the PTW\_start calculation is relation to eDRX cycles which may be different in idle and inactive. In this case, the RRC\_INACTIVE Ues may miss CN paging. Therefore, if RAN2 agrees to use the LTE baseline, the same PTW starts are needed when RAN paging and CN paging coincide in the same paging hyperframe.  But we think network could ensure such restriction that the PTW for inactive mode is covered by PTW for idle mode. |
| DENSO | Yes | We can benefit from power saving by overlapping PTW. Matching the start position of PTW is one of the effective methods, and it should be executed when the NW side judges that it is effective. |
| Sony | Yes | Beneficial for UE power save |

Summary: 26 replies have been provided. 18 replies are in favor of using the same starting location for both PTWs, 2 replies are not and 6 replies do not have strong view.

The proponents bring up UE power saving benefit when the PTW are started at the same time. Opponents and those companies who didn’t indicate strong preference think this could be left up to NW to configure.

A technical issue related to the existing framework is brought up in several replies: If the LTE baseline is adopted, the window starting location would be different depending on the eDRX cycle used, that is, it could be different if the RAN and CN paging cycles are different. Related issues are being discussed for NR paging, eLTE paging and eMTC paging and eDRX at the moment.

1. When RAN and CN paging coincide in the same PH, the PTW starting location is the same. FFS how to calculate the PTW starting location so that it is the same for RAN and CN PTW.

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?**

|  |  |  |
| --- | --- | --- |
| **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.  [Rapp: UE needs to monitor for CN paging in RRC\_INACTIVE, see further comments below]  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.  [Rapp: The benefit comes when RAN paging cycle is shorter compared to CN paging cycle – then there is no CN paging opportunities always during the RAN PTW, which can be shorter in that case] |
| 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. |
| Lenovo | May be Yes | Positive to the view from Ericsson, but the issue from apple should be clarified. |
| Xiaomi | yes | If the answer is yes for this question to use the CN PTW for paging monitoring for possible state mismatch, people can be more convinced to use a common PTW for Q2. |
| Nokia, Nokia Shanghai Bell | Yes | Agree with Ericsson. |
| CATT | Yes | Considering the possible state mismatch, UE in inactive should also monitor the paging from CN, so from this point, UE should follow the longer PTW to avoid missing paging. But this will reduce the benefit UE can get on power saving. If UE is in idle, the UE should follow the PTW from CN.  [Rapp: Share the same view] |
| Huawei, HiSilicon | Yes | In RRC\_INACTIVE, UE monitors paging for both CN paging and RAN paging to cover the state mismatch between UE and RAN/NW. If it is agreed that the PTW in RRC\_INACTIVE can be shorter, then, in overlapping PH, the UE should monitor the longer of the two, i.e. the RRC\_IDLE PTW.  [Rapp: Share the same view] |
| MediaTek | No | We share Qualcomm’s assumptions about UE’s monitoring behavior in Idle and Inactive modes: When the UE is in Idle mode, it follows eDRX configuration for Idle (configured by Registration Accept message). When the UE is in Inactive mode, it follows the eDRX configuration for Inactive (configured by RRCRelease message).  We prefer that the coordination between CN and RAN paging occasions is handled by the network, and the UE just applies the relevant configuration (either Idle or Inactive) depending on its current mode. This would greatly simplify the UE operation. |
| ZTE | No | We understand for RRC inactive state, the UE monitors RAN paging within RAN PTW, and UE monitors CN paging within CN PTW.  If different PTW lengths for idle and inactive is supported, and the PTWs are partial overlapped, then our understanding is that, UE monitors both CN and RAN paging on overlapped occasions; and only CN paging for non-overlapped occasions (if the length of idle PTW is longer than the PTW for inactive).  Below figure shows an example of our understanding:  图片2  [Rapp: Share the same view.] |
| Futurewei | Yes | Agree with Huawei. |
| Facebook | No | Agree with QCOM |
| Intel | No | We share the view explained by Qualcomm. Moreover, we want to further clarify that when UE monitors paging during the PTW, UE follows legacy operation (i.e. during idle PTW, UE follows legacy idle paging operation, and during inactive PTW, UE follow legacy inactive paging operation).  [Rapp: Monitoring during PTW is so far assumed to be similar as in LTE baseline but further details need to be agreed for NR/RedCap] |
| Sequans | No | Agree with QC, MediaTek |
| Convida | Maybe | The is dependent upon a few things. 1) agreement that the PH coincides for both RAN/CN paging and the PTW start at the same time. If so, then, the UE should follow the PTW for CN paging. 2.) Also, per previous agreements, this is also dependent upon which state (IDLE or INACTIVE) of the UE, e.g., RAN decides and configures eDRX via RRC for RRC\_INACTIVE and the CN decides and configures eDRX for RRC\_IDLE. |
| Samsung | Yes, but need clarification | In LTE eDRX, both eDRX cycle and PTW are provided to UE, via NAS. Similarly, in NR eDRX, CN eDRX cycle and CN PTW could be provided to UE, via NAS in response of the UE request.  And, RAN eDRX cycle and RAN PTW (after any coordination with CN) could be provided to UE, via RRC.  Under the assumption above, our answer is ‘Yes’.  On the other hand, we have now identified that RAN2 needs to discuss an overall procedure on how to decide eDRX.  [Rapp: Have similar view] |
| Google | No | We share the same view as Qualcomm. |
| Sharp | Yes | The UE will monitor paging during CN PTW length. But its monitoring behavior may be different in the overlapped PTW and CN PTW only. |
| LGE | No | Same view as Qualcomm |
| NEC | No | agree with Qualcomm, also MediaTek |
| Thales | No | Agree with QC and MediaTek. |
| Vivo | See comments | If the RAN PTW is a subset of CN PTW, i.e. the case that RAN PTW\_start is not ahead of CN PTW\_start and the RAN PTW length is not longer than CN PTW length, there is no doubt that the UE should follow CN PTW for paging monitoring in the overlapped PH (when RAN paging and CN paging coincide in the same paging hyperframe).  [Rapp: similar view]  Besides, when UE in RRC\_INACTIVE and RAN eDRX cycle is shorter than CN eDRX cycle, it’s possible that only RAN paging occur in some PHs, and in these non-overlapped PHs, we are not sure whether UE also should follow CN PTW. Since if UE follow CN PTW same as the overlapped PH, it’s not power efficient. Otherwise, the UE in inactive should judge whether the PH is overlap with idle state firstly.  Therefore, we agree that before we discuss this point, we should discuss the PTW\_start and PTW length issue firstly and discuss whether UE in RRC\_INACTIVE should follow different PTW in the overlap PH and non-overlap PH.  [Rapp: yes, this is dependent on the other discussion] |
| DENSO | No | We have the same opinion as Qualcomm. We think it is better to have the flexibility that each PTW can be set individually or unified to CN PTW according to the selection on the NW side. |
| Sony | Yes | We think this can be postponed once details are more clear. |

Summary: 25 replies have been provided to this discussion point. 10 replies indicate they prefer UE following CN PTW when both RAN and CN paging occur in same PH, 11 replies do not prefer this and 4 replies indicate the discussion point should be clarified further.

It seems there is no common understanding how the monitoring should work with two PTWs—one understanding is that UE in RRC\_IDLE should monitor only CN PTW and in RRC\_INACTIVE only RAN PTW and the other understanding is that UE should always monitor CN PTW (when it occurs) as CN paging needs to be monitored when the UE is in RRC\_INACTIVE.Rapporteur would like to note that in the LTE baseline (eMTC), while the UE is in RRC\_INACTIVE, it will monitor for CN PTW and outside of PTW it will monitor according to RAN paging cycle (there is no PTW for RAN paging). The reason is that both CN and RAN paging need to be monitored and similar principle should be kept for NR/RedCap eDRX.

1. Continue discussion on how UE is expected to monitor RAN and CN PTW, e.g. whether UE in RRC\_INACTIVE monitors for only RAN PTW or both CN and RAN PTW when they overlap.

# Summary

Based on the discussion in the previous sections we propose the following:

For agreement:

[Proposal 1 Lower bound for eDRX configuration in RRC\_IDLE and RRC\_INACTIVE is 2.56 seconds. This RAN2 preference needs to be confirmed with SA2/CT1.](#_Toc72846279)

[Proposal 2 It is up to RAN to configure the length for PTW for RAN paging, the RAN PTW length can be different from the CN PTW length.](#_Toc72846280)

[Proposal 3 When RAN and CN paging coincide in the same PH, the PTW starting location is the same. FFS how to calculate the PTW starting location so that it is the same for RAN and CN PTW.](#_Toc72846281)

For further discussion:

[Proposal 4 Continue discussion on how UE is expected to monitor RAN and CN PTW, e.g. whether UE in RRC\_INACTIVE monitors for only RAN PTW or both CN and RAN PTW when they overlap.](#_Toc72846282)

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