**3GPP TSG-RAN WG2 Meeting #111-eDRAFT R2-2008193**

**Online, 17–28 August 2020**

**Agenda item:** 8.12.3

**Source:** CATT

**Title: Draft** Summary of Offline 111 - DRX Aspects (CATT)‎

**Document for:** Discussion and Agreement

# 1 Introduction

This is to report the result of the following offline discusion as per the draft session report [1]

* [AT111e][111][REDCAP] DRX aspects (CATT)

Scope: Discuss the proposals in [R2-2007013](file:///C:/Data/3GPP/RAN2/Docs/R2-2007013.zip), [R2-2007346](file:///C:/Data/3GPP/RAN2/Docs/R2-2007346.zip), [R2-2007494](file:///C:/Data/3GPP/RAN2/Docs/R2-2007494.zip) as well as proposals 1 to 4 in [R2-2006748](file:///C:/Data/3GPP/RAN2/Docs/R2-2006748.zip). The intention is to identify design alternatives, collect company views and, whenever possible, also narrow down the proposals.

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

* + - List of agreeable proposals (if any)
    - List of proposals that require online discussions

Initial deadline (for companies' feedback): Monday 2020-08-24 22:00 UTC

Initial deadline (for rapporteur's summary in R2-2008193): Tuesday 2020-08-25 02:00 UTC

The remainder of this document is organized as the following. In Section 2 we provide discussions based on company contribution [2-5]. In Section 3 the discussions are summarized with list of proposals.

# 2 Discussion

As per the scope, proposals from company contribution [2-5] are listed in the Appendix. In section 2.1-2.4, these proposals will be discussed in a few aspects.

All participants to this discussion are encouraged to leave their name/contact in section 5.

## 2.1 Support of eDRX in for RRC Inactive and/or Idle ‎

A first aspect in contribution [2-5] is on the support of eDRX in different NR RRC states, i.e., Inactive and/or Idle ‎state. In [2,3,5] there are explicit proposals/observations to study eDRX mechanims for both states, while in [4] evaluations show positive performance gain towards the same direction. Therefore, the following should be agreeable based on the summarized contributions.

**Proposal A RAN2 study eDRX mechanism for both RRC\_IDLE and RRC\_INACTIVE in this SI. ‎**

Please insert your views and comments to Proposal A in the table below.

Table 1

|  |  |  |
| --- | --- | --- |
| **Company name** | **Agree/Disagree** | **Comments if any** |
| Qualcomm | Agree |  |
| Nokia | Agree |  |
| OPPO | Agree | Given that both industrial wireless sensors and wearables have long battery lifetime requirement, eDRX for both RRC idle mode and RRC inactive mode would be beneficial for UE power saving for these use cases. |
| Lenovo | Agree |  |
| Ericsson | Agree |  |
| Convida | Agree |  |
| Apple | Agree |  |
| Sequans | Agree |  |
| Samsung | Agree |  |
| CATT | Agree |  |
| Xiaomi | Agree |  |
|  |  |  |

## 2.2 Baseline of NR eDRX mechanism

In [2-5] the discussions are on different detailed level regarding how eDRX should work for NR. There seems to be some commonality from the view point of high level principles.

* More specifically, [2] suggests to reuse LTE eDRX mechanism with possible consideration of NR system charicteristics, e.g., multiple beam.
* In [3] the procedures of eDRX mechanism for RRC\_IDLE UE and RRC\_INACTIVE in LTE are summarized and suggested to serve as baseline of NR eDRX mechanism‎.
* Similarly in [5] it is suggested that the feature (eDRX for NR) can follow similar approach as it was done for LTE I-eDRX.
* In [4]‎, it is suggested that eDRX mechanisms in LTE/NB-IoT such as PTW and HFN are used as the baseline for ‎introducing eDRX in RedCap‎.

All these seem along the line of using LTE as baseline. Therefore, it is possible to first agree on high level guidence for further eDRX mechianim studies as the following proposal. One motivation to first have such a guideline is to faciliate the discussions in the following sections, e.g., companies could then have a rough idea of the potential machanism on the table, as well as their complexities/impacts based on LTE work.

**Proposal B In further study of NR eDRX, the LTE ‎eDRX mechanism is used as baseline.**

Please insert your views and comments to proposal B in the table below.

Table 2

|  |  |  |
| --- | --- | --- |
| **Company name** | **Agree/Disagree** | **Comments if any** |
| Qualcomm | Agree | We can support using the eDRX signaling framework as baseline. |
| Nokia | Agree |  |
| OPPO | Disagree | Before we decide to reuse LTE eDRX as baseline, we think RAN2 should first discuss whether to extend DRX cycle above 10.24s, since LTE eDRX covers eDRX cycle cycle above 10.24s and below 10.24s. |
| Lenovo | Agree | We are postivie to use LTE eDRX as baselie. |
| Ericsson | Agree |  |
| Convida | Agree | Use LTE eDRX Hyper system frame, Paging Hyper frame and Paging Time Window as baseline. |
| Apple | Agree |  |
| Sequans | Agree |  |
| Samsung | Agree |  |
| CATT | Agree |  |
| Xiaomi | Agree |  |
| Huawei | Agree | LTE eDRX mechanism makes sense in NR |

## 2.3 eDRX cycle range

The group can further discuss to what extend/which components of the LTE eDRX mechanism will be studied/adopted for NR. It seems obvious such discussions depend on the eDRX cycle range. There seem to be different views from the company contributions on the possible eDRX cycle range.

For example, in [3] the following proposals were made

|  |
| --- |
| *Proposal 3: Consider the maximum value of 2621.44s (almost 44 min) eDRX period for RRC\_IDLE state as a starting point.*  *Proposal 4: Study the possibility of introducing longer eDRX period for RRC\_INACTIVE state (exceeding 10.24s****).*** |

In [5] the following were proposed

|  |
| --- |
| *Proposal 1.‎ NR paging cycle is extended up to 10.24 sec for UEs in RRC\_INACTIVE/RRC\_IDLE.‎*  *Proposal 3.‎ For UEs in RRC\_INACITVE, paging DRX cycle is not extended above 10.24 sec.‎*  *Proposal 4.‎ For UEs in RRC\_IDLE, to discuss whether to enable paging DRX cycles above 10.24 ‎sec similarly as it is done for LTE eDRX feature (including new Hyper-SFN, paging time window (PTW), ‎or paging hyper-frame (PH) concepts/mechanism).‎* |

In [4] there seems to be no explicit proposal regarding the value range.

There seems to be common understanding regarding the pros and cons of these possible ranges. A breif summary is as the following.

* It seems generally agreeable that longer eDRX cycle allows more power saving [3][4].
* For inactive case, an eDRX cycle range up to 10.24s has less impact to RAN, as otherwise RAN may need to discuss and introduce for inactive state some mechanims simliar as Hyper-SFN, paging time window (PTW), or paging hyper-frame (PH) that has been used for LTE. Besides, there is potential impact due to the NAS retransmission time limitation (For E-UTRA connected to 5GC, extending DRX cycle above 10.24 sec was not desirable for UEs in RRC\_INACTIVE ‎due to the foreseen CN impact. See some discussions in [5] which refers to CT1 situation).

Considering the potential performance gain vs compleixty (including RAN/CN impact), to extend the cycle range up to 10.24s seems to be a possible baseline for RRC\_INACTIVE. As there seems to be concern of going beyond this, it can be a point of further study. This is reflected in the following proposal.

**Proposal C For RRC\_INACTIVE, the DRX cycle is extended to 10.24s as baseline. FFS on the performance and complexity of further extension.**

Please insert your views and comments to Proposal C in the table below.

Table 3

|  |  |  |
| --- | --- | --- |
| **Company name** | **Agree/Disagree** | **Comments if any** |
| Qualcomm | Agree | In addition to concern on the possible impacts on RAN/CN by longer DRX cycles (>10.24s), we don’t see any of the three target RedCap use cases can have extra long eDRX cycles. |
| Nokia | Agree | Impacts of going beyond the 10.24s should be studied in case these values are supported also for RRC\_IDLE mode. |
| OPPO | Agree | Since eDRX cycle has not been extended above 10.24s for eMTC UE connected to 5GC, we think there is less motivation to introduce it for RedCap UEs. We don’t think RedCap UEs have more power saving requirements than eMTC UEs. |
| Lenovo | Agree | For RRC\_INACTIVE, the impact of DRX cycle longer than 10.24s could be further discussed if the DRX cycle of UE in RRC\_IDLE is extened out of 10.24s. |
| Ericsson | Agree | We support studying longer DRX cycles in RRC\_INACTIVE in addition to RRC\_IDLE. The IWSN use case explicitly mentions lifetime of several years. For example results on possible gain see our contribution in [R2-2006913](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2006913.zip).  From RAN2 perspective we see it beneficial to combine the signaling saving in RRC\_INACTIVE with power saving potential of eDRX – for example consider the combination with R17 Small data (which is only addressing RRC\_INACTIVE).  Otherwise, the only real power saving state is RRC\_IDLE, which in our view is not a good long-term solution. From RAN2 point of view there should be no technical barriers to extend cycles > 10.24 s also in RRC\_INACTIVE. On CN side there are impacts as brough up in some contributions. |
| Convida | Agree | We believe in similar motivations as captured by Ericsson above. |
| Apple | Agree | Similar views as Ericsson |
| Sequans | Agree | Cycles > 10.24s for Inactive have NAS impact, which is not part of the SI; RAN2 POV can be explored in the SI but as lower priority, only if time allows. |
| Samsung | Agree | It’s currently agreeable to extend up to 10.24 sec as baseline.  Since power saving in NR is more crucial than in LTE, we have preferred to allow NW to configure extended cycle lengths even in RRC\_INACTIVE. |
| CATT | Agree | OK extended to 10.24s as baseline‎. And, we are postive to consider a value range beyong 10.24s for better power saving. We are open to discuss if there is any concern e.g., on use case or complexity. |
| Xiaomi | Agree | Back to the history of LTE e-DRX, RAN2#82 discussed analytical results (R2-131793) on e-DRX and concluded that the DRX cycle less than 10.24s cannot achieve the considerable gain of power saving. So we think RAN2 should consider supporting extended paging DRX cycle beyond 10.24s to maximizing the battery lifetime of Redcap UEs.  As it was mentioned above, there is potential impact due to the NAS retransmission time limitation,we think the upper boundary can be further studied.  Note that the 5G NAS timer values has been extended beyond 30s (R2-1903003\_C1-191389). |
| Huawei | Agree | We can consider 10.24s as a starting point because it has no additional SA/CT impact.  However, RRC\_INACTIVE state could help UE to reduce CP latency and improve the small data transmission efficiency after Rel-17 small data is available. If only eDRX period up to 10.24 s is supported for RRC\_INACTIVE, the UE cannot benefit at the same time of long eDRX period power consumption gain and small data transmission efficiency gain.  Thus we think it is worth studying the possibility of introducing longer eDRX period for RRC\_INACTIVE state (exceeding 10.24s). |

For the case of idle, companies seem more willing to study even further extension of the cycle range (e.g., see P3 in [3], and P4 in [5], etc.). It seems possible to collect companies’ views on the following proposal.

**Proposal D For RRC\_IDLE, the DRX cycle is extended to 2621.44s as baseline.**

Please insert your views and comments to Proposal D in the table below.

Table 4

|  |  |  |
| --- | --- | --- |
| **Company name** | **Agree/Disagree** | **Comments if any** |
| Qualcomm | Disagree | We don’t see any of the three target RedCap use cases can have extra long eDRX cycles. |
| Nokia | Agree | This can be the baseline. |
| OPPO | Disagree | We prefer to have a unified solution for both RRC\_IDLE and RRC\_INACTIVE RedCap UEs, i.e. to extend DRX cycle up to 10.24s as baseline. This can minimize the spec impact. |
| Lenovo | Agree | For UE in IDLE mode, it is power saving if the DRX cycle is extended to 2621.44s, and we cann’t exclud the case that RedCap UE in IDLE mode could have a DRX cycle longer than 10.24s. |
| Ericsson | Agree | Can be the baseline – needs to be discussed further whether there are any technical constraints which should be considered. |
| Convida | Agree | This can be the baseline. |
| Apple | Agree | There could be redcap UE types which do not need INACTIVE mode of operation as much, but require higher power savings. |
| Sequans | Disagree | Prefer to have 10.24s as baseline, but higher values should be explored in the SI |
| Samsung | Agree | We have assumed that the power saving performance achieved in RedCap has to be at least on a par with LTE eDRX. If not, NR RedCap would be insufficiently competitive, e.g. against LTE.  We have already possessed LTE eDRX solutions to support such long cycles, and we can easily borrow them for RedCap, possibly with minor updates. |
| CATT | Agree | We are postive to extend for idle case the drx cycle to 2621.44s. In current 5GC spec, extended DRX parameters have already been ‎introduced in Registration procedure.‎ |
| Xiaomi | Disagree | As it was mentioned above, there is potential impact due to the NAS retransmission time limitation,we think it can be further studied. |
| Huawei | Agree | For some industry sensors, they have mainly mobile originated traffic and have low latency sensitivity for the downlink traffic. A long eDRX period is beneficial to UE’s power saving. In addition, 5GC has supported eMTC with 2621.44s eDRX period, so there is no additional work for CN to support this value. |

Whether the eDRX cycle needs to go even beyond ‎2621.44s ‎depends on the interested use case.

* In [3], it is observed to the requirement of the power saving and battery lifetime enhancement is from industrial ‎wireless sensors and wearables‎.
* In [5], the targeted use cases from the SID ‎[1]‎ RP-201386‎ are cited, and it is observed that WB-E-UTRAN connected to 5GC, extending DRX cycle feature is supported for UEs in RRC\_IDLE (with or ‎without suspend indication) up to 44 min, and for UEs in RRC\_INACTIVE up to 10.24 sec.‎
* In [4] there seems to be no explicit preference regarding the interested use cases.

In order to potentially narrow down the propoals, it seems useful to collect companies’ views regarding the following question.

**Question E Do you think DRX cycle range beyond 2621.44s should be considered in further studies of this SI?**

Please insert your views on Question E in the table below.

Table 5

|  |  |  |
| --- | --- | --- |
| **Company name** | **Yes/No** | **Comments if any** |
| Qualcomm | No | No use case for R17 RedCap would call for such a long cycle. |
| Nokia | No |  |
| OPPO | No | See our reply to Proposal D. |
| Lenovo | No |  |
| Ericsson | No | Likely not needed for RedCap. However, if eDRX is to be considered as a long-term solution in long-term for possible future device types, we should not impose technical constraints if not needed – keeping the design goal of forward compatibility in mind. |
| Convida | No |  |
| Apple | No | We think RANP guidelines suggest RedCap UEs are no worse than LWA? In that sense, we do not need to go even further. |
| Sequans | No |  |
| Samsung | No |  |
| CATT | No |  |
| Xiaomi | No |  |
| Huawei | No | 2621.44s may be enough to statisfy the battery life requirement of industrial sensors. |

## 2.4 Further discussions

Besides the previously mentioned aspects there are other proposals from the summarized contributions.

* In [2], there are proposals regarding the configuration of eDRX and the interaction between RAN and CN.
* In [3], further proposals were made regarding SI acquisition aspect, as well as the possible involvement of R4 for performance requirements during WI phase. ‎
* In [4], it is suggested to send an LS to SA2 to indicate our progress.

These proposals are either from only one company or more into later stage discussions. That being said, it seems the group can disucss on the need of sending an LS to SA2 or other potential WGs in SA or CT, to inform RAN2’s progress on the topic. This is reflected in the following.

**Question F Do you see a need that RAN2 inform its conclusions (all or some of them, if agreed) on the topic to SA2 or other SA/CT WGs?**

Please insert your views and comments to Question F in the table below.

Table 6

|  |  |  |
| --- | --- | --- |
| **Company name** | **Yes/No** | **Comments if any** |
| Qualcomm | Depends | It would depend on whether the agreements we make have any impact on SA2 or other WGs. |
| Nokia | FFS | Depends on the RAN2 agreements. |
| OPPO | No | Currently for NR, the largest UE DRX cycle supported in NAS spec is 2.56s. If we decide to extend DRX, we need to inform CT1 to support that. |
| Lenovo | FFS | It depends on the RAN2 agreements. |
| Ericsson | - | Likely needed if eDRX in any form is specified – but RAN2 should progress the work first. Can be addressed later. |
| Convida |  | To early to decide but likely needed depending on the agreement. For example, if we decide to extend the DRX cycle to 2621.44s and then decide to re-use LTE eDRX concepts such as PTW, then we have to inform SA2 or other SA/CT WGs. |
| Apple |  | Can be discussed online towards the end of the meeting. |
| Sequans | FFS | Depends on actual RAN2 agreements, but likely yes later |
| Samsung | FFS | Depends on the RAN2 agreements. |
| CATT | See comments | This depends on what we agree in R2. If we make some progress that may impact SA2 or other SA/CT WGs it would be useful to inform them. |
| Xiaomi | FFS |  |
| Huawei | Yes | eDRX mechanism has impact on SA2 and CT1, especially about the maximum eDRX period of RRC\_INACTIVE. Hence, it is needed to inform them our progress. |

And, companies can input if any on the following questsion.

**Question G Do you see any other issues (as per scope of this offline disc) that have not been covered by previous discussions?**

Please insert your views on Question G in the table below.

Table 7

|  |  |
| --- | --- |
| **Company name** | **Issues and comments if any** |
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|  |  |

# 3 Conclusion

This contribution is on the topic of eDRX in NR, under the R17 RedCap study item. For the topic, proposals from [2-5] were reviewed, and companies’ views have been collected. Based on the discussions the following set of proposals can be put to further checking in online session.

List of pontentially agreeable proposals

TBD

List of proposals for further discussions

TBD

# 4 References

[1] Draft report, RAN2-111e - R16 eMIMO-CLI-PRN-RACS - R17 NTN-REDCAP

[2] R2-2007013 eDRX for NR RRC Inactive and Idle States CATT

[3] R2-2007346 Discussion on eDRX for RRC\_INACTIVE and RRC\_IDLE‎ Huawei, HiSilicon

[4] R2-2007494 eDRX for reduced capability UEs MediaTek Inc.‎

[5] R2-2006748 Use cases target to extend paging DRX cycle and relax measurements for stationary devices Intel Corporation

# 5 Participants

|  |  |
| --- | --- |
| **Company Name** | **Participant name/contact** |
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# Appendix List of Company proposals

Proposals from [2]

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| --- |
| Proposal 1: The LTE eDRX mechanism for idle mode should be reused for NR with the ‎consideration of multi-beam i.e. define eDRX cycle and paging time window.‎  Proposal 2: The eDRX mechanism should apply for both NR RRC inactive and idle state.‎  Proposal 3: Only one eDRX parameters can be configured for UE which apply for UE no matter ‎it is in RRC inactive or idle.‎  Proposal 4: eDRX parameters should be exchanged between CN and RAN to support UE ‎monitor paging according to eDRX in RRC inactive if eDRX parameters are configured to the UE.‎  Proposal 5: The eDRX parameters should be decided by CN. ‎  Proposal 6: RAN 2 should discuss how to configure the eDRX parameters to UE:‎  -‎Option 1: via NAS signaling by CN, and the CN send the eDRX parameters to RAN.‎  ‎-‎Option 2: via RRS signaling by RAN, the RAN acquires the eDRX parameters from CN. ‎ |

Proposals from [3]

|  |
| --- |
| Observation 1: the requirement of the power saving and battery lifetime enhancement is from industrial wireless sensors and wearables.  Observation 2: the larger DRX period has large positive impact on UE power consumption in Non-RRC\_CONNECTED.  Proposal 1: Study eDRX mechanism for both RRC\_IDLE and RRC\_INACTIVE.  Proposal 2: the procedure of eDRX mechanism in LTE could be used as baseline of NR eDRX mechanism.   * Idle mode eDRX parameter is negotiated by UE and AMF; * gNB decides UE’s inactive eDRX parameters based on the negotiated eDRX parameters * Include idle eDRX parameters and inactive eDRX parameters in CN PAGING MESSAGE and RNA PAGING MESSAGE respectively.   Proposal 3: Consider the maximum value of 2621.44s (almost 44 min) eDRX period for RRC\_IDLE state as a starting point.  Proposal 4: Study the possibility of introducing longer eDRX period for RRC\_INACTIVE state (exceeding 10.24s).  Proposal 5: Reuse existing DRX mechanism (based or PH and PTW) for RRC\_IDLE in NR if it is agreed to support eDRX cycle larger than 10.24.  Proposal 6: Study whether to introduce PTW mechanism or not for RRC\_INACTIVE if it is agreed to introduce eDRX period exceeding 10.24s for RRC\_INACTIVE.  Proposal 7: Study SI acquisition enhancement mechanism in NR after eDRX mechanism is introduced.  Proposal 8: Involve RAN4 in the WID after REDCAP study item finishes and eDRX is agreed to be specified. |

Proposals from [4]

|  |
| --- |
| Observation 1: Introducing eDRX UEs can be beneficial for industrial wireless sensors and wearables use cases in RedCap.  Proposal 1: eDRX mechanisms in LTE/NB-IoT such as PTW and HFN are used as the baseline for introducing eDRX in RedCap. The exact formulas and impact on other procedures can be discussed during the work item phase.  Proposal 2: RAN2 to send an LS to SA2 with recommendation to introduce eDRX, to check if there are any potential issues for RedCap from 5GC perspective. |

Proposals from [5]

|  |
| --- |
| Observation 1.‎ Extending DRX cycle for NR UEs in RRC\_IDLE and RRC\_INACTIVE above 2.56sec ‎is needed in order to reach the battery lifetime of the target use cases (from years to days and weeks) ‎similarly as it was done in LTE Rel-13 extended DRX feature.‎  Observation 2.‎ For WB-E-UTRAN connected to 5GC, extending DRX cycle feature is supported for ‎UEs in RRC\_IDLE (with or without suspend indication) up to 44 min. and for UEs in RRC\_INACTIVE up ‎to 10.24 sec.‎  Observation 3.‎ During Rel-16 Power Saving SI phase, RAN2 captured in the conclusion of TR 38.840 ‎that it was desirable to define rules for UE specific DRX cycles extended up to 10.24 sec.‎  Observation 4.‎ For E-UTRA connected to 5GC, extending DRX cycle above 10.24 sec was not ‎desirable for UEs in RRC\_INACTIVE due to the foreseen CN impact to the mobility management ‎procedures due to the smallest value of the NAS retransmission timer and the actual number of NAS ‎retransmission done).‎  …(omitted)  The proposals captured are the following:‎  Proposal 1.‎ NR paging cycle is extended up to 10.24 sec for UEs in RRC\_INACTIVE/RRC\_IDLE.‎  Proposal 2.‎ If Proposal 1 is agreed, this feature can follow similar approach as it was done for LTE ‎I-eDRX feature i.e. (1) upper layers configure eDRX, (2) when configured, eDRX value is used (instead of ‎the smallest), and (3) legacy NR PF/PO mechanism described in 38.304 applies.‎  Proposal 3.‎ For UEs in RRC\_INACITVE, paging DRX cycle is not extended above 10.24 sec.‎  Proposal 4.‎ For UEs in RRC\_IDLE, to discuss whether to enable paging DRX cycles above 10.24 ‎sec similarly as it is done for LTE eDRX feature (including new Hyper-SFN, paging time window (PTW), ‎or paging hyper-frame (PH) concepts/mechanism).‎  …(omitted) |