**3GPP TSG-RAN WG2 Meeting #119bis-e draft R2-22xxxxx
Online, 10 - 19 Oct, 2022**

**Source:** Huawei/Apple

**Title:** Report of [AT119bis][303][NES] TP on NW DTX/DRX (Huawei/Apple)

**Agenda Item:** 8.3.2

**WID/SID:** FS\_Netw\_Energy\_NR– Release 18

**Document for:** Discussion and decision

# 1 Introduction

This document is the report of the following discussion:

* [AT119bis][303][NES] TP on NW DTX/DRX (Huawei/Apple)

- Review TP for NW DTX/DRX. Aim to capture some details on how DTX/DRX.

- Identify remaining questions/details that are required to be discussed for next meeting.

Deadline: Friday, Oct. 21th

Please provide your comments before Thursday 2022-10-20 10:00 UTC. Thanks!

# 2 Draft TR

Based on below agreements RAN2 made online, we provide a draft TR on NW DTX/DRX in the [folder](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119bis-e/Inbox/Drafts/%5BOffline-303%5D%5BNES%5D%20TP%20on%20NW%20DTX%EF%BC%8FDRX%20%28Huawei%EF%BC%8FApple%29).

=> Let’s start with understanding solution in the context of connected

• Example 1: gNB is expected to turn off all transmission and reception for data traffic and reference signal during Cell DTX / DRX OFF duration.

• Example 2: gNB is expected to turn off its transmission / reception only for data traffic during Cell DTX / DRX OFF duration (i.e. gNB will still transmit / receive reference signals).

• Example 3: gNB is expected to turn off its dynamic transmission / reception during Cell DTX / DRX OFF duration (i.e. gNB is expected to still perform periodic transmission / reception, including SPS, CG-PUSCH, SR, RACH, and SRS).

• Example 4: gNB is expected to only transmit reference signals (e.g. CSI-RS for measurement).

**=> RAN2 assumes that the options above are possible for gNB DTX/DRX behavior and discuss UE RAN2 behavior/impact during the DTX/DRX.**

**=> For the purpose of our discussion we will focus on a single UE behavior at any point in time. FFS if we allow multiple configuration of NW DRX/DTX behaviors.**

=> Periodic DTX is assumed as a baseline. The gNB provides indication to UE about NW DTX mode/configuration via dedicated dynamic L1/L2 signaling.

=> Dynamic L1/L2 group signalling from NW to provide NW DTX mode/configuration is also considered in RAN2

=> It is beneficial to align UE DRX with network DTX and DRX alignment among multiple UEs. Details are FFS, including UE transmission/reception behavior during DTX. RAN2 to study the alignment.

Rapporteur first has a quick question on terminology alignment: in above agreement, both "NW DTX/DRX" and "Cell DTX/DRX" are used, but they seem to refer to the same thing. To avoid potential misunderstanding, Rapporteur would like to quickly check companies’ views on whether the terminology can be aligned in the TR.

**Q1: do you agree to align the following terminology in TR? If yes, which one do you prefer?**

1. **NW DTX/DRX**
2. **Cell DTX/DRX**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Yes / No (to align terminology)** | **If Yes, which option do you prefer** | **Detailed Comments if any** |
| Apple | Yes | b) or gNB DTX/DRX | We used "NW DTX/DRX" because some companies were not sure whether it is cell level or not before. During RAN2 online discussion, it seems a consensus that the configuration is cell specific. Meanwhile, RAN1 discussion also used the wording "cell specific DTX/DRX cycle". So, it seems consensus in both RAN1 and RAN2 that it is cell level or gNB level.  |
| Nokia |  |  | For SI phase TR, probably either one is fine. For stage 3 specifications, we will likely need to refer to cells since the UE only sees cells. |
| Samsung | Yes | NW DTX/DRX | NW DTX/DRX could be other-level, i.e. multiple cells could be aligned or it could be BWP-level. |
| vivo | Yes | b | We think DTX/DRX is configured at per cell level. |

Next, companies are invited to share their detailed comments on the draft TR in below Table. **Please do not insert / make comments in the TR document, which will be hard for Rapporteur to track and respond your comments.**

**Q2: Companies are invited to share their detailed comments on the draft TR in the table below.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Detailed comments** | **Rapporteur response** |
| Apple | We are overall fine with current version with Rapporteur's trackable changes (i.e. removing "via RRC signaling" and "one-shot"..). However, we want to clarify two different understandings on related agreements ("Periodic DTX is assumed as a baseline. The gNB provides indication to UE about NW DTX mode/configuration via dedicated dynamic L1/L2 signaling"):1) Alt-1: we agreed both periodic pattern, and one-shot pattern (as implied by "via dedicated dynamic L1/L2 signaling").2) Alt-2: we agreed semi-persistent pattern (i.e. RRC configures a periodic pattern and L1/L2 signaling to activate it).Our original version is with understanding Alt-1, while the current version (i.e. after Rapporteur removing "on-shot") seems to be with understanding Alt-2. We are OK if company prefer to clarify it in next meeting. |  |
| Nokia | Even though “The study will focus on a single UE behavior at any point in time.” was captured in the agreement, not clear what it meant. The online discussion seemed to e related to NW behaviour (Proposal 7: RAN2 discuss whether to allow multiple expected gNB DTX and DRX behaviors during NW DRX / DTX OFF duration which are associated with different NES states.) It can be left out for now and to be added later with more concrete descriptions? |  |
| vivo | 1. cell DTX/DRX may be also applied to RRC\_IDLE UE. We suggest to add a note: ‘FFS if NW DTX/DRX configuration is indicated to UEs in IDLE/INACTIVE state, which is beneficial for UEs to skip some DL/UL channels/signals transmissions/receptions.’2. The NW DTX mode / configuration can also be indicated by RRC signalling, we don’t understand why we have to put an emphasis on ‘via L1/L2 signalling’ and suggest to remove it as:The NW DTX mode / configuration can be indicated to the UE ~~via dynamic L1/L2 signalling. The dynamic L1/L2 signalling at least supports UE dedicated indication.~~3. We are generally fine with the rapporteur removing ‘the one shot pattern’ as we observe quite limited NES gain from enabling it. |  |
|  |  |  |

# 3 Remaining issues

According to the discussion during this RAN2 meeting, the agreements and FFSes are captured as below:

• Example 1: gNB is expected to turn off all transmission and reception for data traffic and reference signal during Cell DTX / DRX OFF duration.

• Example 2: gNB is expected to turn off its transmission / reception only for data traffic during Cell DTX / DRX OFF duration (i.e. gNB will still transmit / receive reference signals).

• Example 3: gNB is expected to turn off its dynamic transmission / reception during Cell DTX / DRX OFF duration (i.e. gNB is expected to still perform periodic transmission / reception, including SPS, CG-PUSCH, SR, RACH, and SRS).

* Example 4: gNB is expected to only transmit reference signals (e.g. CSI-RS for measurement).

**=> RAN2 assumes that the options above are possible for gNB DTX/DRX behavior and discuss UE RAN2 behavior/impact during the DTX/DRX.**

**=> For the purpose of our discussion we will focus on a single UE behavior at any point in time. FFS if we allow multiple configuration of NW DRX/DTX behaviors.**

=> Periodic DTX is assumed as a baseline. The gNB provides indication to UE about NW DTX mode/configuration via dedicated dynamic L1/L2 signaling.

=> Dynamic L1/L2 group signalling from NW to provide NW DTX mode/configuration is also considered in RAN2

=> It is beneficial to align UE DRX with network DTX and DRX alignment among multiple UEs. Details are FFS, including UE transmission/reception behavior during DTX. RAN2 to study the alignment.

Rapporteur identifies the following issues to be further addressed at next RAN2 meeting accordingly:

### #1 Configuration and signalling

The aspects need to be addressed are summarized as below, assuming a single UE behaviour at a time:

1. The detailed information to be configured, e.g. DTX/DRX pattern etc.
2. The signalling design, including but not limited to:
* Configuration by RRC signalling or lower layer signalling?
* Notification procedure and signalling of DTX/DRX mode?
* How group signalling applies to the configuration or mode notification?

**Q3: Do companies agree with the above observation?**

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| --- | --- | --- |
| **Company** | **Yes / No** | **Comments** |
| Apple | Yes with comments | We basically agree with Rapporteur. However, we have two comments / suggestions:1) For signaling design, we think 1st point "Configuration by RRC signalling or lower layer signalling " seems to be unnecessary. Because we have agreed periodic pattern, it is our understanding that RRC signaling is must (it doesn't make sense that lower layer signaling alone can configure a periodic pattern).2) As we mentioned in Q2, our understanding is that RAN2 agreed both periodic pattern and one-shot pattern. If so, the signaling design should be separately discussed for periodic pattern and one-shot pattern. But it depends on whether companies have consensus in Q2. Thus, we suggest to modify it to: - Clarify whether support one-shot DTX/DRX pattern and/or semi-persistent pattern* Configuration procedure and signalling ~~by~~ (e.g.RRC signalling and/or lower layer signalling)?
 |
| Nokia | Yes  | Whether there is a need to introduce “NES Mode” could be decided later after the functionalities are clear. |
| Samsung | Yes |  |
| vivo | Yes |  |

In addition to this, there is one FFS on whether to support multiple configurations. It is also worthwhile to address this at next RAN2 meeting. From rapporteur’s observation, the below needs to be addressed:

1. Whether multiple configurations refer to separate configuration between DTX and DRX, or refer to different sets of configurations for DTX, and different sets of configurations for DRX respectively?
2. Whether this brings benefits compared with the assumption of one configuration at a time?
3. The potential signalling impacts.

**Q4: Do companies agree the above aspects need to be addressed for multiple configuration of DRX/DTX?**

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| --- | --- | --- |
| **Company** | **Yes / No** | **Comments** |
| Apple | Disagree 1) and 2) | For 1), we think there are two issues mixed which makes 1) look confusing. Our understanding is:a. Joint or separate configuration of DTX and DRX mode/operation? b. Whether multiple sets of DTX/DRX configurations (joint or separate depends on conclusion of a) are allowed.Please note that we use the same RAN1 discussion wording for a).For 2), our agreement is "a single UE **behavior** at any point in time" rather than "a single **configuration** at a time". We think the intention is that RRC can configure multiple sets of DTX and/or DRX modes, but gNB only notify UE with one mode via L1/L2 signaling. Thus, we suggest below changes:1. ~~Whether multiple configurations refer to separate configuration between DTX and DRX, or refer to different sets of configurations for DTX, and different sets of configurations for DRX respectively?~~ Joint or separate configuration of DTX and DRX mode/operation?
2. Whether multiple sets of DTX/DRX configurations/modes are allowed~~? this~~ to brings benefits compared with ~~the assumption of~~ only one configuration at a time?
 |
| Nokia | Yes |  |
| Samsung | No | NES gain will be maximized when the gNB turns off the functionalities as much as possible. Then, multiple configurations or separate DTX&DRX seems not necessary. NW may have multiple NES options, but one configuration is sufficient at a time for a UE. |
| vivo | Yes | 1) we think it refers to different sets of configurations for DTX/DRX.2) We assume the question here is not about whether enabling multiple configurations brings more or less NES gain. Rather, without clear definition of cell DTX, we are not sure whether one set of configuration is enough to implement cell DTX without affecting much UE performance. one UE may be submissive to several cell DTX configurations, since the original C-DRX pattern may be downgraded to cell DTX pattern. For example, the cell may configure different groups of UE with different DTX patterns. If UE-A is originally configured with 10ms DRX cycle, UE-B with 20ms, UE-C with 40ms…and if DTX for (UE-A, B, C) is configured with 40ms DTX cycle, UE-A may need to apply several DTX patterns at the same time to compensate its original DRX cycle loss. If the original C-DRX pattern can already be aligned with direct NW implementation, we do not see there is any need on spec change. |

According to the papers from [R2-2210253](file:///C%3A%5CUsers%5Cmtk65284%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2_RL2%5CTSGR2_119bis-e%5CDocs%5CR2-2210253.zip) and [R2-2210595](file:///C%3A%5CUsers%5Cpanidx%5COneDrive%20-%20InterDigital%20Communications%2C%20Inc%5CDocuments%5C3GPP%20RAN%5CTSGR2_119bis-e%5CDocs%5CR2-2210595.zip) (although not discussed online), there is one open question on whether this DRX/DTX applies per serving cell or per UE. The scenario needs to be understood first: in which cases, when gNB is already in energy saving mode, it still needs to support multiple serving cells as CA. Therefore this aspect may need further discussion on which scenarios are supported.

**Q5: Do companies agree to discuss the scenarios where DTX/DRX is already configured and the gNB still needs to configure multiple serving cells as CA (i.e., DTX/DRX configured together with CA)?**

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| --- | --- | --- |
| **Company** | **Yes / No** | **Comments** |
| Apple | Yes with comments | We think below change seems to be more aligned with Rapporteur text:**discuss whether there are valid ~~the~~ scenarios where DTX/DRX is already configured and the gNB still needs to configure multiple serving cells as CA (i.e., DTX/DRX configured together with CA)?** |
| Nokia | - | Not clear what the issue is about. Cell specific configurations are per serving cell with or without CA. |
| Samsung | Yes | RAN2 is also considering other NES options for CA. We do not need to exclude CA scenario for DTX/DRX. |
| vivo | Yes |  |

### #2 UE behaviour and gNB behavior

There are 4 examples agreed for DTX/DRX. It would be good that for each example, the detailed UE and gNB behaviour can be analysed. This is also important to assess the benefits of each direction. For each example, it is suggested to analyse the below aspects:

1. From gNB side, which information needs to be transmitted and potential benefits for energy saving
2. from UE side, the behaviour like which information needs to be received, monitoring etc., performance impact compared with normal access, impact on legacy UEs if any

**Q6: Do companies agree with the above observation?**

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| --- | --- | --- |
| **Company** | **Yes / No** | **Comments** |
| Apple |  | We think maybe some high level gNB/UE behavior can be discussed for next meeting, but detailed behaviors should be discussed in normative phase. We tend to think current part of TR (i.e. providing 4 possible examples) is sufficient to conclude SI.  |
| Nokia | Yes with comment for 2) | Legacy UEs wouldn’t see the new command so it will follow legacy procedure. Not clear what impact on legacy UEs is referring to. |
| Samsung | Yes |  |
| vivo | Yes |  |

### #3 Alignment

According to the discussion, there will be at least two aspects for discussion:

1. Whether/how to align UE DRX with network DTX, including UE transmission/reception behavior during DTX
2. Whether/how to align DRX alignment among multiple UEs

**Q7: Do companies agree with the above observation?**

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| --- | --- | --- |
| **Company** | **Yes / No** | **Comments** |
| Apple | Yes |  |
| Nokia | Yes for 1)No for 2) | How to align DRX configuration for multiple UEs is up to NW implementation. Nothing can be done from UE side for multiple UEs. |
| Samsung | Yes |  |
| vivo | Yes for 1)No for 2) | As commented in Q4, we think 2) is up to NW implementation without spec change. |

In addition to the above, there were also a couple of papers discussing UE assistant information. However from rapporteur’s observation, this can be done in a later stage, e.g. normative work directly. As if the above aspects are made clear and feasible, there would be no big problem to re-use existing UE assistance information or enhance whenever needed. So it is better to focus on the above aspects which are more fundamental for the DTX/DRX mechanism.

# 4 Conclusion

To be completed