**3GPP TSG RAN WG1 Meeting #112bis-e R1-2304015**

**e-Meeting, April 17th – 26th, 2023**

**Source: Moderator (Intel Corporation)**

**Title: Discussion summary #3 of issues for enhancements on cell DTX/DRX mechanism**

**Agenda item: 9.7.2**

**Document for: Discussion**

# Introduction

In this contribution, moderator summarizes issues identified by the submitted technical contributions for RAN1 #112bis-e agenda 9.7.2 Enhancements on cell DTX/DRX mechanism.

# Summary of issues

## 2.1 General cell DRX/DTX operation

* [1] Futurewei
  + Observation 5: Instead of completely turning off the whole cell, it is more likely that in real deployments that a subset or subsets of the gNB operations are deactivated or muted.
  + Observation 6: RAN2 should support in their specifications Cell DTX/DRX operations that includes more granular deactivation or muting for energy savings purposes such as inter-node beam or spatial configurations activation.
* [2] Huaewi/HiSilicon
  + Proposal 1: Cell DTX/DRX should be applied in a serving cell level.
* [3] Panasonic
  + Proposal 1: Cell DTX design can be more prioritized than Cell DRX, as gNB DL transmission dominates the total energy consumption. The exact UE behaviour impacted by the Cell DRX should be carefully justified for better tradeoff among network energy saving, UE power saving and system stability.
  + Proposal 9: For better network energy saving gain, the cell DTX/DRX patterns/parameters can be considered to be aligned with I-DRX.
* [4] Nokia/NSB
  + Proposal 1: Wait for RAN2 agreements on Cell DTX/DRX configuration/ activation/ deactivation.
  + Proposal 13: Enhancement on cell DTX/DRX mechanism can be jointly considered with adaptation of spatial and power domain techniques.
* [5] vivo
  + Proposal 6: Support the following UE behavior when cell DTX and UE C-DRX are both configured in the following.
    - Cell DTX UE DRX UE behavior
    - active active Normal
    - active Non-active Follow behavior for non-active period of UE C-DRX
    - Non-active active Follow behavior for active period of UE C-DRX on PDCCH monitoring
    - Non-active Non-active Follow behavior for non-active period of cell DTX in 2.2.1
* [6] OPPO
  + Proposal 3: gNB and UE behaviors during non-active periods should be defined when only cell DTX cycle, only cell DRX cycle, or cell DTX/DRX cycle is configured.
  + Proposal 4: gNB is not expected to turn off transmission and reception for common channels/signals during non-active periods when only cell DTX cycle, only cell DRX cycle, or cell DTX/DRX cycle is configured.
* [7] Spreadtrum
  + Observation 1: For low to medium traffic load, gNB can enter micro sleep or light sleep for energy saving in RRC CONNECTED state.
  + Observation 2: It is better that gNB can inform the UEs to skip some activities for a time interval, when gNB enters micro sleep or light sleep.
* [8] CATT
  + Proposal 6: The cell DTX and cell DRX can be configured and operated separately by higher layer signaling to adapt to the individual characteristics of DL and UL operations.
  + Proposal 7: The potential configuration methods related to the cell DTX/DRX can be considered as following:
    - Option 1: The cell DTX/DRX parameters including the DTX/DRX cycle, the starting offset of the DTX/DRX active time and the DTX/DRX active time duration, are semi-static configured.
    - Option 2: The cell DTX/DRX configuration only including the DTX/DRX cycle and the starting offset of the DTX/DRX active time, the end point of cell DTX/DRX active time may be related the UE’s C-DRX active time.
  + Proposal 14: The cell DTX/DRX could be applied for the different serving cells in CA scenario, in which the cell DTX/DRX can be activated or deactivated via the UE-specific RRC signalling or L1/L2 signaling for expediting the transition between cell DTX/DRX active time and non-active time.
* [9] NEC
  + Observation 1: Cell DTX/DRX can be configured either via gNB implementation or cell DTX and DRX patterns can be configured and operated independently.
  + Proposal 3: Support configuration of cell DTX/DRX cycle around SSB transmission.
  + Proposal 4: Support mapping of cell DTX/DRX patterns/configurations to SSB transmission characteristics.
  + Proposal 5: For the cell DTX/DRX configuration in CA scenario, support both the common DTX/DRX configuration and independent DTX/DRX configurations for different cells.
* [10] Intel
  + Proposal 3: Whether to drop or continue with the occasions of the impacted signals/channels outside cell DTX/DRX active time is configurable by the network.
  + Proposal 4: Consider different modes of cell DTX/DRX where each mode may consider impact to a subset of signals/channels outside cell DTX/DRX active time.
  + Proposal 7: Consider specification of application delay following the activation of a cell DTX/DRX pattern.
* [11] Fujitsu
  + Observation 1. The assumption on the length of the cell DTX/DRX non-active period should be discussed first to guarantee an efficient further discussion on which signal can be postponed during Cell DTX/DRX non-active time in RAN1.
  + Proposal 1: In discussion on which signal can be postponed during Cell DTX/DRX non-active time, it assumes that the Cell DTX/DRX non-active time at most lasts for X ms.
    - RAN1 discusses and decides the value of X.
* [12] ZTE/Sanechips
  + Observation: L1 behaviors of CSI-RS and SRS transmission during cell DTX/DRX non-active periods should be configurable by signaling to minimize the impact on link management and beam management.
  + Observation: A semi-static configuration of cell DTX/DRX pattern may not be suitable for various traffic models and not beneficial for the network energy savings when UE is suffered from time-intensive traffic.
* [13] Xiaomi
  + Proposal 6: The impacts of cell DTX/DRX on CSI measurements and reports should be considered.
* [14] Interdigital
  + Observation 3: Utilizing a cell DTX can yield significant energy savings gain, with marginal negative impact on user level QoS (throughput).
  + Observation 4: Utilizing Cell DRX with dynamic activation/deactivation can yield significant energy savings gain, while ensuring marginal negative impact on user level QoS (throughput).
* [15] China Telecom
  + Proposal 1:
    - The mechanism of cell DTX and cell DRX should be discussed separately.
    - At least the alignment with C-DRX should be considered separately.
  + Proposal 4:
    - The activate of cell DTX/DRX should be decided by the network.
    - The assistant information from UE and neighbor cells can reported to the cell for making the decision.
  + Proposal 5:
    - The WUS from UE can be considered for gNB to trigger the de-activating of cell DTX/DRX.
    - The low layer signals, i.e. MAC CE or UCI, should be used as the WUS signal.
    - The assistant information of neighbor cells can also be used for gNB to judge the network condition and de-activate the cell DTX/DRX.
* [16] Google
  + Proposal 1: Study the impact of RLM/BFD procedure during non-active periods of cell DTX.
  + Proposal 2: During non-active periods of cell DTX, UE does not receive the periodic/semi-persistent CSI-RS.
  + Proposal 3: Introduce a multi-burst based aperiodic TRS for fast time and frequency offset tracking after the non-active periods of cell DTX.
  + Proposal 5: The impact of RACH and SR procedure from non-active periods of cell DRX should be studied by RAN2.
  + Proposal 6: Study the impact of BFR procedure from non-active periods of cell DRX.
* [17] Samsung
  + Observation 1: Determining SSB symbols as active durations of cell DTX is beneficial for reducing gNB transmission durations as well as user plane latency.
  + Proposal 1: The SSB transmission symbols are considered as active for the determination of the active durations of cell DTX.
  + Observation 3: Dynamic adaptation of cell DTX/DRX is beneficial for UE power saving.
  + Observation 4: Multiple configurations for cell DTX/DRX is beneficial for network energy saving.
  + Proposal 8: Define the UE behaviour to support the joint operation of cell DTX/DRX and other collision handling.
  + Proposal 9: Support BFR procedure enhancement for the impact of cell DTX/DRX operation.
* [18] ETRI
  + Proposal 8: Support multiple cell DTX/DRX modes to allow UE to adapt transmission/reception behaviours during cell DTX/DRX non-active time.
  + Proposal 9: Each cell DTX(/DRX) mode is associated with a set of DL(/UL) signals UE receives(/transmits) (or, equivalently does not receive(/transmit)).
  + Proposal 10: Deactivation DCI can indicate one of the cell DTX(/DRX) modes to apply during the next cell DTX(/DRX) non-active time.
* [19] CMCC
  + Proposal 2: In case of L1 signalling based cell DTX/DRX activation/deactivation is supported, PDCCH monitoring for the activation/deactivation should be allowed during cell non-active periods.
* [20] CEWiT
  + Proposal 1: Multiple Cell DTX/DRX configurations with different time granularity for starting time, periodicity and durations is supported.
  + Observation 2: Skipping of scheduled operation overlapping with non-active period of cell DTX/DRX causes performance loss at UE
  + Observation 3: gNB rescheduling the skipped operation during active period of DTX/DRX results in signaling overhead
  + Proposal 5: Study enhancements in rescheduling operations skipped during non-active period of Cell DTX/DRX
* [21] Mediatek
  + Observation 3: In [4] and [5], alignment and aggregation of cell and UE active periods can achieve significant network energy saving (NES) gain, particularly for light load scenario. However, there can still be a large amount of active UEs in light load scenario, e.g., as VoIP service.
  + Proposal 3: Efficient cell-wise signaling design is developed for alignment and aggregation of cell and UE activities so as to avoid excess UE-specific signaling overhead due to a large amount of active UEs (e.g., in VoIP service).
  + Proposal 4: Analogous mechanism to Rel-17 TRS for idle/inactive, i.e., SIB for configuration broadcast and paging indications for activation/adaptation of candidate configuration(s), is specified.
    - FFS: Application delay and alignment of UE DRX and Cell DTX/DRX after receiving the indication.
* [22] Transsion Holdings
  + Proposal 2: Some constraints on active/non-active time between cell DTX and cell DRX should be discussed.
* [23] LG Electronics
  + Proposal #2: For network energy saving, a signal/channel to be turned off from the Cell DTX/DRX non-active period can be configured for each signal/channel.
* [25] Lenovo
  + The list of candidate signals/channels that are impacted by inactive periods of cell DTX/DRX are updated based on further input from RAN WG2
  + SSB transmission is independent of cell DTX, i.e., SSB transmission is allowed during cell DTX inactive periods
  + RAN WG1 should only consider UE-common cell DTX/DRX configuration per cell for further discussion on candidate signals/channels, in which the UE may be expected to not receive or transmit specific signals/channels during inactive periods of cell DTX/DRX, respectively
* [26] Qualcomm
  + Observation 1: Cell DTX/DRX mechanism might be achieved by C-DRX operation with proper C-DRX configurations across connected mode UEs in the cell.
  + Observation 2: The UE may need to transmit or receive one or more channels outside its C-DRX active time, which may reduce opportunity for the cell to go into deeper sleep modes.
  + Observation 3: Cell DRX/DTX mechanism can be enhanced by restricting UE transmission and reception of channels within the non-active time of cell DTX/DRX.
  + Observation 4: Restricting UE transmission/reception of channels within the non-active time of cell DTX/DRX should not impact performance of the UEs.
  + Observation 5: Broadcast and multicast should be also considered in addition to unicast when discussing transmission/reception restriction for RRC connected state UEs.
  + Observation 6: Dynamic cell DTX/DRX activation/deactivation mechanism should be performed for a single cell DTX/DRX configuration.
    - Benefit of dynamically switching between multiple DTX/DRX configurations is unclear.
* [27] Rakuten
  + Proposal 4: Dropped channel/signals can be dynamically configured for NES UEs when it is necessary to use to satisfy their QoS, if necessary.
  + Observation 3: The parameter ranges, granularity of DRX related operations for NES can be same as legacy UEs to avoid any impact.
  + Proposal 5: Configurable range of the enhanced DTX/DRX parameters should be within the range of legacy DTX/DRX parameters in Rel-17.
  + Proposal 6: NES applicable UE can be configured for enhanced DRX mode, by defining new DRX Group.
  + Proposal 7: Multiple DRX groups can be configured to satisfy different QoS requirements.
  + Proposal 8: At this moment, there is no significant necessity to define additional functionality relevant to RAN1 to coordinate between cell DTX/DRX and UE C-DRX.
* [29] Ericsson
  + Proposal: Support at least a cell DTX/DRX mechanism that does not disrupt an ongoing packet delivery including packet transmissions/retransmissions.
    - FFS. The detail of such a mechanism, e.g., L1 based cell DTX/DRX active period extension, inactivity timer, etc.
* [30] ITRI
  + Observation: Concentrated Transmission is beneficial for network energy saving
* [31] Fraunhofer
  + Observation 1: Alignment of UE C-DRX can be a main mechanism to enable cell-DTX efficiently.
  + Observation 2: Even with serving a few UEs, the ability of a cell to be inactive as per cell DTX is severely impacted due the need for HARQ retransmissions.
  + Proposal 1: RAN1 to discuss mechanisms to reduce the impact of HARQ retransmissions on cell DTX.

#### Summary of Issues

There were several inputs received from different companies regarding the configuration and operation of cell DTX/DRX for energy savings in the RRC CONNECTED state. Some companies suggested that cell DTX/DRX operations should include more granular deactivation or muting of signals and channels for energy savings, including support of dynamic adaptation of cell DTX/DRX.

#### Suggestions for further Discussions

Many of the cell DTX/DRX operations from moderator understanding relies on RAN2 agreement/conclusion. Therefore, it might be better for RAN1 to focus on areas that are purely focused on RAN1 aspects or have relatively small reliance on RAN2 agreement.

#### [CLOSED-1st Round of Discussions]

Companies are asked to provide comments and proposals on general cell DTX/DRX operations that may be agreeable in RAN1. Moderator suggests focusing on aspects that do not require RAN2 input, or aspects that RAN2 may input from RAN1’s opinion.

Moderator will take the inputs and suggestions and create a formal proposal (with proposal #) for conclusion and/or agreement.

###### Proposal #1-1

Suggested moderator guidance for further RAN1 discussion in #112-bis-e:

* RAN1 will discuss and provide recommendation of signals and channels (and its potential L1 behavior changes, if agreeable and available) that may be impacted from cell DTX/DRX operation to RAN2. The focus of the discussion will be (for the time being) on the following signals and channels:
  + Reference signals (e.g. CSI-RS, SRS)
  + Channels primarily related to L1 procedures (e.g. PDCCH monitoring, HARQ-ACK feedback, CSI reporting)
* RAN1 will discuss L1 procedures that may be impacted from cell DTX/DRX, e.g., PUCCH deferral, HARQ-ACK codebook generation, etc.

###### Proposal #1-1A

Suggested moderator guidance for further RAN1 discussion in #112-bis-e:

* RAN1 will discuss and provide recommendation of signals and channels (and its potential L1 behavior changes, if agreeable and available) that may be impacted from cell DTX/DRX operation to RAN2. The focus of the discussion will be (for the time being) on the following signals and channels:
  + Reference signals (e.g. CSI-RS, SRS)
  + Channels primarily related to L1 procedures (e.g. PDCCH monitoring, HARQ-ACK feedback, CSI reporting)
* RAN1 will discuss L1 procedures that may be impacted from cell DTX/DRX, e.g., PUCCH deferral, HARQ-ACK codebook generation, etc.
* Other RAN1 aspects are not precluded from discussions.

|  |  |
| --- | --- |
| Company | Comments |
| CMCC | We think the impacted signals and channels that agreed during last RAN1 meeting can be discussed. Then when RAN2 makes conclusion, they can also refer to RAN1’s opinions.  Besides impacted channels and signals, the dynamic activation and deactivation of cell DTX/DRX can also be discussed, including the alignment of cell DTX/DRX with C-DRX.  For the activation/deactivation, the outcome of RAN2 post 121 email discussion made the following proposal, so RAN1 should discuss this.  **Proposal 5:** Cell level common L1 signalling for Cell DTX/DRX activation/deactivation is beneficial from RAN2 perspective, send an LS to RAN1 with our preference and ask about feasibility and design details. (17/28)  For the alignment, if cell DTX/DRX is activated and deactivated dynamically, the alignment should also be done in a dynamic way, otherwise the energy saving of dynamic activation/deactivation will be limited due to distributed UE active period. |
| Xiaomi | 1, support dynamic cell DTX/DRX mechanism, such as indicating DTX/DRX-off by DCI or MAC CE, which can be operated independently from or simultaneously with semi-static cell DTX/DRX mechanism.  2, dynamic adaptation of cell DTX/DRX can be supported to make semi-static cell DTX/DRX more flexible. |
| Spreadtrum | RS can be discussed in RAN1. |
| Fujitsu | The channels/signals are expected to be not transmitted/received by the gNB, especially reference signals, can be discussed in RAN1. |
| Lenovo | 1. Identify RSs/signals/channels that are dropped/muted in periods of non-active cell DTX/DRX  2. Whether/How dynamic (L1-triggered) cell DTX/DRX is activated/deactivated |
| MTK | RAN1 can particularly focus on:   * RS aspect(s), including the related L1 procedure(s), can be discussed * Potential L1 indication for the activation/deactivation/change of cell DTX/DRX configuration. Regarding the “cell-wise” nature of cell DTX/DRX for base-station energy saving, cell-wise L1 indication can be investigated. |
| Futurewei | RAN1 should focus, at this time, on issues that have no parallel discussions in RAN2. For example, channels allowed during non-active time are currently being discussed in RAN2 and RAN1 should wait for RAN2’s decision and then decide what is left for RAN1 to consider. For now, in our view, RAN1 should only focus on RS and its associated procedure. |
| Fraunhofer | RAN1 can discuss the following aspects without waiting for input from RAN2:  1. Behavior of RSs during Cell DTX/DRX  2. L1 group signaling (DCI) to support dynamic activation, de-activation or switching to a different cell DTX/DRX configuration  3. Mitigation of HARQ reduction of energy savings, e.g. operating at lower BLER when Cell DTX/DRX activated. |
| Intel | We think the signals/channels that can be impacted in outside cell DTX/DRX active time can definitely be discussed in RAN1. Also, whether there can be different modes of cell DTX/DRX possible, such as based on what set of signals/channels are impacted, whether this feature can be configurable or fixed by specifications, etc. |
| Moderator | Please continue to provide comments on this issue.  Moderator has put together Proposal #1-1 based on feedback received. However, moderator thinks there is no need for formal agreement on Proposal #1-1. The proposal if generally agreeable can simply be a guidance from moderator to focus the discussion for RAN1 #112-bis-e, but does not need to be strictly binding. |
| Samsung | In addition to Proposal#1-1, the following should also be considered in RAN1   * L1 signalling for cell DTX/DRX adaptation and related issues * Whether PHY layer related channels/signals are impacted by cell DTX/DRX * Joint operation of cell DTX/DRX and existing/ongoing PHY features * Latency related issues as agreed in the agreement in the last meeting.  |  | | --- | | **Agreement**   * RAN1 continues discussion on the at least following physical layer related aspects of cell DTX/DRX aspects   + physical layer signals/channels and procedures expected to be impacted during non-active periods of cell DTX/DRX     - consider impact to at least KPIs from the SI when physical layers/signals/channels are impacted by cell DTX/DRX * Further discussions on other aspects are not precluded | |
| Moderator | Added text to state that other discussion are not precluded.  Please note, moderator has no intention of formally agreeing to Proposal 1-1A. The proposal just serves some unofficial guidance for discussion for this meeting. Nothing more.  If companies would like to bring specific discussion, please provide a proposal that I can capture explicitly so that we can get discussion and feedback on. |
| Samsung2 | We suggest to discuss the following proposal, we have clarified in our contribution [17] that determining SSB symbols as active durations of cell DTX is beneficial for reducing gNB transmission durations as well as user plane latency. Reducing gNB transmission durations could be beneficial for network energy saving.  **Proposal**: The SSB transmission symbols are considered as active for the determination of the active durations of cell DTX. |
| Panasonic | We are supportive of the first bullet. |
| Huawei, HiSilicon | From RAN1’s perspective, we can discuss:   1. Signals/channels that cell DTX/DRX can impact, especially for reference signals 2. The design of L1 signaling for (de)activation   3 UE behavior when cell DTX/DRX and C-DRX are both configured or activated |
| CATT | RAN1 should discuss the physical layer procedure and Rel-18 UE behaviors as well as the Legacy UE behaviors when some of the physical channels/signals are not transmitted during gNB DTX inactive time. All the other aspects, such as dynamic activation/deactivation, should be discussed after the UE behaviors are clearly defined. |
| China Telecom | The following aspects can be further discussed in RAN1:   * Which and how the signals/channels will be impacted by cell DTX/DRX, the RS should be concentrated first.   The L1 signals for indication the activation/de-activation of cell DTX/DRX. |
| LG Electronics | We share the same vie with Huawei and at least the design of L1 signaling for (de)activation can be discussed in RAN1. |
| Spreadtrum2 | Fine |

#### == Summary of 1st Round of Discussions ==

Before summary of 1st round of discussions are made, moderator would like to inform companies about latest RAN2 agreements on cell DTX/DRX.

**RAN2 Agreements**

1. A periodic cell DTX/DRX configuration is explicitly signalled to the UEs.

2. A periodic cell DTX/DRX pattern is configured by UE specific RRC signalling.

3. The Cell DTX/DRX configuration contains at least: periodicity, start slot/offset, on duration.

4. As a baseline Cell DTX/DRX is activated/deactivated implicitly by RRC signalling, i.e. activated immediately once configured by RRC and deactivated once the RRC configuration is released.

5. From RAN2 point of view, majority companies see a benefit with L1 signalling for Cell DTX/DRX activation/deactivation, send a LS to RAN1 (email 308) with our preference and ask about feasibility and design details. Ask about feasibility and reliability of using L1 signaling. Clarify that the question is about activation/deactivation copy the agreement from last meeting that we are focusing on single configuration. Extract a few key benefits of dynamic signaling from email discussion and online discussions.

6. As baseline, UE doesn’t monitor SPS occasions during Cell DTX non-active period. As baseline, gNB is assumed to be not transmitting PDSCH to that UE on such SPS occasions during the Cell DTX non-active period

7. As baseline, UE does not transmit on CG occasions during Cell DRX non-active periods

Several companies commented that RAN1 should further discuss about L1 signaling aspects for cell DTX/DRX. Given that RAN2 has agreed to benefits of supporting L1 signaling, and is asking RAN1 to look further into this, moderator thinks this should be further discussed.

Samsung has suggested a proposal for agreement regarding SSB transmissions. While moderator thinks no specific agreements are needed for signals/channels that will persist as per current specification, moderator will put the proposal forward for discussion.

#### [OPEN-3rd Round of Discussions]

Companies are asked to provide further comments on Proposal #1-2 from Samsung.

###### Proposal #1-2

* The SSB transmission symbols are considered as active for the determination of the active durations of cell DTX.

Beyond Proposal #1-2, moderator asks companies to provide further comments on any other proposal regarding general cell DTX/DRX operation that they would like to discuss and agree to.

|  |  |
| --- | --- |
| Company | Comments |
| Intel | We have agreed that SSB transmissions will not be impacted due to cell DTX/DRX, and hence SSB transmissions can be made outside active period of cell DTX as well as within active period. Hence, we do not think rendering SSB symbols to be active in a generic manner is needed. |
| Xiaomi | Similar view as Intel. |
| Samsung | @Intel, Xiaomi  As we have clarified in our contribution, the proposal can help reducing gNB transmission durations as well as user plane latency and thus is beneficial for network energy saving.  An example is given below for illustration. The assumption is that the PDCCH is assumed not to be monitored by a UE during non-active durations. The baseline is that the active/non-active durations are determined based on periodicity, start slot/offset, and on duration of a cell DTX/DRX configuration. Consider a case where a DL traffic arrives before the SSB transmission. If the proposal is not supported, UE will not monitor the PDCCH#1, if gNB would transmit the DL grant, gNB needs to defer the PDCCH #1 to a later PDCCH MO on the active symbols, e.g., PDCCH#2. On the contrary, if the proposal is supported, the SSB symbols are considered as active durations and the UE monitors the PDCCH on the SSB symbols, in this case, gNB can schedule PDCCH#1 and thus the increased latency can be avoided. In addition, if there is no other DL transmission in the 2nd cycle, gNB does not need to transmit any PDCCH and thus can go to sleep for the active durations, the network energy saving gain can be thus increased by reducing the active RF durations. |
| Fraunhofer | Our baseline assumption is that in most implementations the gNB will actually align the on-duration to include SSBs and Cell DTX/DRX periodicity to match SSB period. Perhaps, the proponents can clarify if there would be any benefits on top of such simpler baseline. Or, if the benefit comes only when combining short SSB cycle with a large Cell DTX/DRX cycle? |
| Nokia/NSB | @Samsung: try to check my understanding of your proposal:  Is the question here on whether the UE can expect other transmissions which are frequency-multiplexed with the SSB transmission i.e. shall UE monitor PDCCH? Or you mean something else? If it is the case, we don’t the reason why not utilize the possibility for communication since the gNB is anyway awake. |
| ZTE, Sanechips | Agree with other companies’ view. Cell DTX/DRX doesn’t impact SSB transmissions. The benefits of additional consideration are unclear. |
| Apple | We tend to understand the motivation of utilizing the SSB symbols for transmission of other signals/channels, since gNB anyway needs to wake. However, defining these symbols as active would require UE to monitor PDCCH on these symbols which significantly sacrifices UE power. We do not support the current proposal but are open to discuss what signals/channels can be assumed to be available on symbols with SSB, paging, and SIBs. |
| Huawei, HiSilicon | We agree with ZTE and other companies. It is confirmed in WID that cell DTX/DRX will not affect SSB transmission. Defining the SSB transmission time as active time is not needed because:   1. Through gNB implementation, the transmission occasion of SSB may be covered by the active period of cell DTX. 2. If SSB is still transmits outside the Cell DTX active period, with the definition of active time in SSB transmission, UE may periodically wake up to monitor PDCCH. In fact, UE may not need to wake up and receive SSB in every occasion.   Similar to the UE behavior in C-DRX, SSB can be transmitted within inactive time. |
| CATT | We are OK. However, it is only for “a given cell” configured with cell DTX |
| Qualcomm4 | Agree with views from Intel. |
| CEWiT | Similar view as Intel. |
| InterDigital | Agree with Intel and HW |
| ETRI | The proposal seems a further optimization on top of what we have in the WID. It may not be necessary to achieve our primary goals. |
| China Telecom | Agree with companies that SSB transmission shouldn’t defined as the active time. |
| LG Electronics | We understand the motivation of the Samsung’s proposal, but it can be considered after the discussion in Section 2.4 is agreed. |
| CMCC | We understand the motivation.  If the gNB wants to make full use of the wake up duration, it can configure the the signals which are not affected by non-active period with the same slot or neighboring slot, such as the L1 cell DTX/DRX activation/deactivation signalling or CSI-RS.  But if these slots carrying SSB are treated as active, then gNB may also have to do corresponding data processing, and listen to feedback. Since the HARQ operation is not decided now, if DG scheduling is happened on these slots, and HARQ reception and retransmission are all allowed during the non-active period, so there is a risk that the non-active periods of cell DTX will be fragment into a lot of non-consecutive duration, the power saving of gNB will be reduced. |
| Ericsson2 | We are open to consider this and suggest rewording as follows.   * OFDM symbols containing SSB are considered part of active period for cell DTX. |

## 2.2 Signaling aspects of cell DTX/DRX

* [1] Futurewei
  + Observation 1: The number of channels/signals that would be allowed to be received and transmitted by the Rel-18 NES capable CONNECTED UE(s) should be kept at absolute minimum to maximize network energy saving gains.
  + Observation 2: A common DTX/DRX pattern can be configured through UE RRC signaling and L1/L2 signaling can be used in addition to the existing common DTX/DRX pattern to perform the following functions:
    - Deactivate the configured pattern DTX/DRX completely for a duration of time, or
    - An updated DTX/DRX pattern is configured that overrides the existing DTX/DRX pattern.
  + Observation 3: To provide the gNB flexibility in transmitting and/or receiving critical channels/signals, multiple Cell DTX/DRX configurations should be supported.
* [2] Huawei/HiSilicon
  + Proposal 2: Consider to support dynamic cell DTX/DRX (de)activation by group-common L1 signaling
    - RAN1 to discuss whether the L1 signaling is based on a new DCI format or an existing DCI format.
* [3] Panasonic
  + Proposal 10: Multiple cell DTX/DRX configurations should be considered for better energy saving adaptation. The switching between configurations needs possible L2/L1 signaling enhancement.
* [5] vivo
  + Proposal 13: Support UE DRX alignment via group common L1 signalling.
* [6] OPPO
  + Proposal 1: Support UE being configured with one or more cell DTX/DRX cycles for network energy saving purpose.
  + Proposal 2: The configuration information of cell DTX/DRX should be indicated to UE via UE-specific RRC signaling per cell or per cell group.
* [8] CATT
  + Proposal 8: Multiple cell DTX/DRX configurations would be supported.
  + Proposal 9: The cell DTX/DRX is configured to Rel-18 CONNECTED UEs via RRC signaling, and L1/L2 signaling or RRC signaling is used to activate at least one cell DTX/DRX configuration.
  + Proposal 10: The activation and deactivation of cell DTX/DRX should consider the following aspects:
    - The cell DTX/DRX is a semi-static procedure and is not activated or deactivated frequently.
    - The activation and deactivation of cell DTX/DRX should reduce the impact to the UE power consumption.
  + Proposal 11: The activation and deactivation of cell DTX/DRX can consider the following options:
    - Option 1: The cell DTX/DRX is activated or deactivated by RRC signaling.
    - Option 2: The cell DTX/DRX is activated or deactivated by L1/L2 signaling.
  + Proposal 12: The L1/L2 signaling or RRC signaling for activation and deactivation of cell DTX/DRX should at least contain the following contents:
    - Activation or deactivation indication.
    - Cell DTX identification.
    - Cell DRX identification.
  + Proposal 13: If L1 signaling is used to activate or deactivate the cell DTX/DRX, the confirmation of L1 signaling such as HARQ-ACK feedback or cell DTX/DRX confirmation MAC CE should be supported.
* [9] NEC
  + Observation 2: (Re)Configuration of UL and/or DL channels and signals in a UE specific manner, to configure cell DTX/DRX, may result in large signalling overhead for relatively large number of connected UEs.
  + Proposal 2: Support group specific or cell specific signaling for cell DTX/DRX configuration and operation.
  + Proposal 6: Support dynamic indication of the activation or inactivation of a cell DTX/DRX on-duration, and dynamic indication of extension or termination of a cell DTX/DRX on-duration.
* [10] Intel
  + Proposal 1: A separate cell DTX/DRX configuration/pattern, including at least {periodicity, start slot/offset, on duration}, is provided to the UE via UE specific RRC signaling.
    - UE would switch to this configuration upon activation of the cell DTX/DRX mode.
    - The cell DTX/DRX configuration becomes effective after an application delay.
  + Proposal 5: Consider DCI based indication to activate a cell DTX/DRX pattern.
    - Deactivation can be based on DCI indication or expiry of validity duration
  + Proposal 6: Consider support of multiple configurations of cell DTX/DRX pattern.
  + Proposal 8: Consider DCI based indication to adjust active time of a cell DTX/DRX pattern.
  + Proposal 9: Consider use of a DCI indication (similar to DCI format 2-6) to indicate whether to monitor the next ON duration of cell DTX/DRX cycle.
* [12] ZTE/Sanechips
  + Proposal: L1 signaling is considered for dynamic indication of cell DTX/DRX to adapt to flexible traffic.
  + Proposal: At least activating/deactivating a single cell DTX/DRX pattern should be considered as indication information of L1 signaling.
  + Observation: In order to ensure that the cell DTX/DRX pattern can be flexibly adapted to various traffic models, the flexible indication of cell DTX/DRX pattern by L1 signaling needs to be considered.
  + Proposal: Activating/deactivating the cell DTX/DRX pattern among multiple cell DTX/DRX patterns, e.g. switching cell DTX/DRX pattern, and dynamic enabling/disabling cell DTX/DRX on duration, should be considered as the indication information of L1 signaling.
  + Proposal: Considering signaling overhead, group-common signaling is proposed for the design of L1 signaling for cell DTX/DRX indication information.
  + Proposal: In CA scenario, cell DTX/DRX indication information for multiple cells should be supported by L1 signaling.
* [13] Xiaomi
  + Proposal 7: Whether cell DTX and cell DRX should be configured/indicated jointly or separately should be considered.
* [14] Interdigital
  + Proposal 7: Support dynamic signaling for indicating the activation/deactivation of a cell DTX/DRX configuration
  + Proposal 8: Support group common signaling as baseline for indicating the activation/deactivation of a cell DTX/DRX configuration
  + Proposal 9: DCI is used for group common signaling for indicating the activation/deactivation of a cell DTX/DRX configuration
* [15] China Telecom
  + Proposal 6: The configuration, activation/de-activation of cell DTX/DRX should be done separately.
* [17] Samsung
  + Proposal 3: Support fast cell DTX/DRX activation/deactivation/adaptation mechanism via L1/L2 signaling.
  + Proposal 4: Support a cell/group common or UE-specific DCI format to activate/deactivate/modify the configured cell DTX/DRX, the following options or the combinations of the options can be considered.
    - Option 1: Dynamically indicates whether the onDuration timer is started for one or more cell DTX/DRX cycles on one or more serving cells
    - Option 2: Dynamically indicates which cell DTX/DRX configuration is activated if multiple cell DTX/DRX configurations are provided.
    - Option 3: Dynamically indicates whether slot(s) in a next period are active or non-active.
    - Option 4: Dynamically indicates activation/deactivation/modification of cell DTX/DRX configuration for one or more cells from a set of cells.
    - FFS: Dynamically indicates the cell DTX/DRX timers.
    - FFS: Implicit indication of cell DTX/DRX.
  + Proposal 5: Support the following mechanism through MAC CE command in addition to L1 signalling,
    - Select one activated cell DTX/DRX configurations from the multiple configurations if multiple configurations are supported for cell DTX/DRX.
    - Update the parameters for the set of configurations of cell DTX/DRX.
  + Proposal 6: Support acknowledgement feedback for reception of cell/group common DCI format for activation/deactivation/modification of a configured cell DTX/DRX, e.g., NACK feedback only when it is not correctly received.
    - FFS: The UE behaviour if the DCI format is missed.
* [18] ETRI
  + Proposal 5: Support dynamic deactivation of cell DTX based on DCI. The deactivation DCI
  + indicates UE whether or not to go-to-sleep at the next occurrence of cell DTX off-duration
    - is monitored within DTX active time (before target off-duration)
  + Proposal 6: Support dynamic activation of cell DTX based on DCI. The activation DCI
    - indicates UE whether or not to wake-up at the next occurrence of cell DTX on-duration
    - is monitored outside DTX active time (before target on-duration)
* [19] CMCC
  + Proposal 12: L1 signalling based cell DTX/DRX activation/deactivation is supported to balance gNB power saving and user experience.
  + Proposal 13: PDCCH can be used for dynamic activation and deactivation of cell DTX/DRX, and can be monitored during cell non-active periods.
* [20] CEWiT
  + Proposal 2: Signaling the parameters of cell DTX/DRX (e.g., type of cell DTX/DRX with a particular time granularity, starting time, periodicty and duration) to UE is supported.
  + Observation 1: For dynamically configured signals/channels the priority should be based on type of DTX/DRX
  + Proposal 3: Dynamically configured signals/channels are prioritized over DTX/DRX activation over MAC-CE
  + Proposal 4: In case of dynamic activation of DTX/DRX conflicting with Dynamically configured signals/channels the prioritization is based on recent indication
* [22] Transsion Holdings
  + Proposal 3: It is suggested that RRC signaling plus Group common dynamic L1/L2 signaling can be considered to notify UE cell DTX/DRX configuration.
  + Proposal 4: Configuring different cell DTX/DRX configurations for different power states should be supported.
* [23] LG Electronics
  + Proposal #1: To align DRX active time for different UEs in the cell, the DRX parameters (e.g., start offsets, DRX cycle and length of ON duration) and its application time (during which indicated DRX parameters are applied) can be jointly indicated by L1/L2 signaling (e.g., group-common DCI or MAC-CE).
  + Proposal #2: For network energy saving, a signal/channel to be turned off from the Cell DTX/DRX non-active period can be configured for each signal/channel.
* [26] Qualcomm
  + Observation 7: If the cell DRX is activated by RRC signaling, determination of available slots for CG PUSCH repetitions may depend on cell DRX configuration.
  + Proposal 2: If the cell DRX is activated by L1/L2 signaling and CG PUSCH repetition is dropped in the non-active time of cell DRX, the dropped CG PUSCH repetition is counted in the configured number of repetitions.
* [27] Rakuten
  + Observation 1: Based on the agreement of the study scope in RAN1#112, RAN1 aim is Semi-static RRC + dynamic L1 signaling.
  + Proposal 1: As signaling types to configure cell DTX/DRX, discuss further about combination of static/semi-static signaling via RRC and dynamic signaling via L1 signaling.
  + Proposal 2: In case that dynamic signaling is supported, RRC signaling can be cell-specific or group common.
* [28] NTT Docomo
  + Proposal 2: Configuration and activation/deactivation mechanisms of Cell DTX/DRX should be discussed.
* [29] Ericsson
  + Proposal: Support UE-specific configuration of cell DTX/DRX.
  + Proposal: Support at least a cell DTX/DRX mechanism that does not require explicit L1/L2 signalling for activation/deactivation.
  + Observation: If L1 based signalling for activation/deactivation of cell DTX/DRX is to be considered, then mechanisms that address UE and gNB misalignment issue need to be considered.

#### Summary of Issues

There are various aspects to signaling for cell DTX/DRX identified by companies in the contributions. The signaling issues seem to be mainly focused on (1) UE, and/or cell specific signaling, (2) whether to support signaling support in L1, L2 MAC CE, and/or L2 RRC (if signaling is needed), and (3) whether to support multiple cell DTX/DRX configurations.

#### Suggestions for further Discussions

Many of the issues are being actively discussed in RAN2, since signaling design aspects are expected to be handled by RAN2, RAN1 can either wait for RAN2 to conclude on signaling design issues or RAN1 can conclude on set of recommendations for RAN2 (and send an LS to RAN2 to consider). Many issue have been discussed in post RAN2 meeting discussions using “[POST121][312][NES] DTX/DRX - Configuration/activation/deactivation and alignment” and “[POST121][311][NES] DTX/DRX - gNB and UE behaviours” thread, which are expected to be discussed and potentially concluded on Wednesday RAN2 meeting session.

Moderator suggests waiting for RAN2 to conclude (potentially on Wednesday), and if RAN2 is unable to make agreements, then discuss in RAN1 on whether RAN1 should try to agree to set aspects and provide recommendations to RAN2.

#### [CLOSED-1st Round of Discussions]

Companies are asked to provide comments and proposals on signaling aspects that may be agreeable in RAN1. Moderator suggests focusing on aspects that do not require RAN2 input, or aspects that RAN2 may input from RAN1’s opinion.

Moderator will take the inputs and suggestions and create a formal proposal (with proposal #) for conclusion and/or agreement.

|  |  |
| --- | --- |
| Company | Comments |
| CMCC | As the moderator summarizes, among the three signalling issues, the first one is about configuration of cell DTX/DRX, it is up to RAN2, and according to our understanding, both cell specific and UE specific configuration signalling can be considered.  The second one is about activation and deactivation. The outcome of RAN2 post 121 email discussion made the following proposal, so RAN1 should discuss this.  **Proposal 5:** Cell level common L1 signalling for Cell DTX/DRX activation/deactivation is beneficial from RAN2 perspective, send an LS to RAN1 with our preference and ask about feasibility and design details. (17/28)  The third one is whether multiple DTX/DRX can be configured, to our understanding, it is beneficial for gNB to adapt to different cell DTX/DRX pattern according to traffic. |
| Xiaomi | 1, Cell DTX/ DRX can be indicated or configured independently and also jointly  2, To reduce resource overhead, broadcast or multicast signaling can be used for Cell DTX/ DRX indication or configuration. |
| Spreadtrum | L1 signaling can be considered. |
| Apple | If RAN2 agrees on multiple cell DTX/DRX patterns, RAN1 could further determine the L1/L2 signaling to active/triggering one of the patterns. |
| Fujitsu | L1 signaling for cell DTX/DRX activation/deactivation can be considered. |
| DOCOMO | L1 signaling can be discussed in RAN1. |
| NOKIA/NSB | It is good to wait till RAN2 agreement reached |
| InterDigital | RAN1 can discuss on L1 signaling aspects |
| Lenovo | L1 signaling aspects shall be discussed in RAN1. However we prefer the discussion is deferred to the next meeting until further clarity is available from RAN2, and that the focus on this meeting should be on the RSs/signals/channels that are RSs/signals/channels that are dropped/muted in periods of non-active cell DTX/DRX |
| MTK | The risk of waiting RAN2 decision is insufficient time for developing L1 signaling details if RAN2 make the request late. Alternative way is to have RAN1 discuss and characterize potential L1 signaling for indicating cell DTX/DRX activation/deactivation/change, so that final design can be delivered on time when RAN2 provide their requirement. No need of L1 signaling is also one possible decision, but the point is risk management to ensure WI completion. |
| Futurewei | We should wait for RAN2 decisions or outcome before spending time and effort on this. |
| Fraunhofer | RAN 1 shall discuss L1 group signaling (DCI) to support dynamic activation, de-activation or switching to a different cell DTX/DRX configuration |
| Intel | RAN2 has already agreed that “Pattern configuration for cell DRX/DTX is common for Rel-18 UEs in the cell.” Although RAN2 is yet to endorse/recommend L1 signaling for activation/deactivation, we think RAN1 can discuss on L1 signaling aspects or at least identify preferred L1 signaling option, since only two meetings left. |
| Moderator | Please continue to provide comments on this issue. |
| Samsung | L1 signaling design for activating/deactivating/modifying the configured cell DTX/DRX should be discussed/agreed in RAN1 without the need of waiting for RAN2’s conclusion.  Based on RAN2’s input of the post meeting email discussion, a clear majority of companies see the need of L1 signalling for Cell DTX/DRX activation/deactivation. RAN2 also has the intention to send an LS to RAN1 for checking the feasibility of this L1 signalling. Hence, RAN1 should start the discussion ASAP considering there could be lots of details for the L1 signalling design and we only have three meetings left. |
| CEWiT | |  | | --- | | L1 signaling can be considered. | |
| ETRI | L1 signaling for activation/deactivation of cell DTX/DRX can be discussed without input from RAN2.  If RAN2 decides to support multiple cell DTX/DRX configurations/modes, aspect of dynamic configuration/mode switching can also be included in L1 signaling functionality. |
| Qualcomm | RAN2 agreed “Pattern configuration for cell DRX/DTX is common for Rel-18 UEs in the cell”. It is under discussion on whether the configuration is conveyed to UEs by RRC or SI. In addition, RAN2 “Confirm study item agreement that we can have separate DTX and DRX configuration. We will focus on designing DTX/DRX for at least single configuration”.  Furthermore, L1 signalling may be used to activate/deactivate cell DTX/DRX – under discussion. From our perspectives, RAN1 may start discussing L1 signalling to activate/deactivate cell DTX/DRX for **a single configuration.** In particular, when UE is configured with a single configuration of cell DTX/DRX, how L1 signalling is used to activate cell DTX/DRX operation. In other word, how to use L1 signaling to switch between legacy UE behaviors and new UE behavior with cell DTX/DRX operation. It should be noted that cell DTX/DRX is only beneficial when the load is low or medium only. |
| ZTE, Sanechips | RAN2 has agreed that there will be at least one configuration of cell DTX/DRX. FFS multiple configurations. Therefore, we can at least start to discuss the L1 based activation/de-activation. If RAN2 made more agreements on multiple configurations, we can further discuss how to switch cell DTX/DRX patterns via L1 based signaling. |
| Panasonic | We are supportive to discuss L1 signaling in RAN1. On the other hand, if some conclusions are expected on Wednesday RAN2 meeting session, we are okay to discuss after that. |
| Huawei, HiSilicon | This issue can be divided into 2 parts:   1. Whether the L1 signalling is needed. This issue had already been discussed by RAN2 and achieved some progress. We may leave this issue to RAN2 2. The design of L1 signalling, this is something that needs RAN1 input. We can discuss about this as long as RAN2 have a clear agreement, or we can discuss this simultaneously with RAN2. |
| ITRI | L1 signaling for cell DTX/DRX should be supported. |
| CATT | Semi-static configuration of cell DTX/DRX configuration should be the baseline. The discussion should focus on whether the L1 signaling is needed and how the L1 signaling indication is defined for both CONNECTED and IDLE UEs. |
| China Telecom | L1 signaling for indicating the activation/de-activation of cell DTX/DRX should be discussed and supported. |
| OPPO | L1 signaling to activate/deactivate cell DTX/DRX pattern can be discussed. |
| LG Electronics | At least L1 signaling to activate/deactivate for Cell DTX/DRX can be considered based on RAN2’s input of the post meeting email discussion. |
| Ericsson1 | Whether L1/L2 signaling based activation/deactivation of cell DTX/DRX is needed depends on RAN2 discussion.  RAN1 could still discuss aspects related to L1 aspects such as those related to the KPI aspects discussed in last meeting. For example, in our contribution, we have a proposal to support mechanism that does not disrupt an ongoing packet delivery including packet transmissions/retransmissions. |
| Spreatrum2 | L1 signaling can make RS available for UE as soon as possible. |
|  |  |

#### == Summary of 1st Round of Discussions ==

Before summary of 1st round of discussions are made, moderator would like to inform companies about latest RAN2 agreements on cell DTX/DRX.

**RAN2 Agreements**

1. A periodic cell DTX/DRX configuration is explicitly signalled to the UEs.

2. A periodic cell DTX/DRX pattern is configured by UE specific RRC signalling.

3. The Cell DTX/DRX configuration contains at least: periodicity, start slot/offset, on duration.

4. As a baseline Cell DTX/DRX is activated/deactivated implicitly by RRC signalling, i.e. activated immediately once configured by RRC and deactivated once the RRC configuration is released.

5. From RAN2 point of view, majority companies see a benefit with L1 signalling for Cell DTX/DRX activation/deactivation, send a LS to RAN1 (email 308) with our preference and ask about feasibility and design details. Ask about feasibility and reliability of using L1 signaling. Clarify that the question is about activation/deactivation copy the agreement from last meeting that we are focusing on single configuration. Extract a few key benefits of dynamic signaling from email discussion and online discussions.

6. As baseline, UE doesn’t monitor SPS occasions during Cell DTX non-active period. As baseline, gNB is assumed to be not transmitting PDSCH to that UE on such SPS occasions during the Cell DTX non-active period

7. As baseline, UE does not transmit on CG occasions during Cell DRX non-active periods

Majority of the companies commented that RAN1 should further discuss and consider L1 signaling support for cell DTX/DRX. Given that RAN2 has agreed that there are benefits for supporting L1 signaling for cell DTX/DRX and RAN2 will send a formal LS to RAN1, it seems logical for RAN1 to discuss this issue further.

RAN2 is asking for feasibility/reliability and design details.

#### [OPEN-3rd Round of Discussions]

Moderator suggests discussion further on proposal #2-1 and #2-2.

###### Proposal #2-1

* RAN1 further study feasibility and reliability of using L1 signaling for enabling and disabling cell DTX and cell DRX configurations.

###### Proposal #2-2

* If feasible to support, L1 signalling for Cell DTX/DRX activation/deactivation will have the following characteristics:
  + Transported via PDCCH
    - FFS DCI format, monitored SS
    - FFS DCI content
    - FFS whether L1 signaling is UE specific DCI or group common DCI
  + FFS on detailed UE behavior upon reception of cell DTX/DRX activation/deactivation L1 signaling

|  |  |
| --- | --- |
| Company | Comments |
| Intel | Regarding P 2-1, we don’t think there is any issue with feasibility. Reliability of L1 signaling can be discussed, although we think it is no different than other broadcast DCI signaling in a PDCCH (if PDCCH is used)  Regarding P2-2, We do not think DCI is always needed to deactivate cell DTX/DRX. Moreover, at least for group common DCI signaling, a reference start position need to be specified. We suggest to add following FFSs:  FFS: Timer or validity duration based deactivation of cell DTX/DRX.  FFS: whether to specify a reference time to indicate start of cell DTX/DRX  Few typos: FSS 🡪 FFS |
| Moderator | FFS typo fixed |
| Xiaomi | OK with the two Proposals. |
| Samsung | Regarding P 2-1, we are fine with it. In addition, RAN2 already agreed to ask RAN1 about the feasibility and reliability, RAN1 can directly start to discuss the feasibility and reliability issue without the proposal being agreed.  We do not see any issue the feasibility and reliability of L1 signaling, the reliability can be ensured by UE transmitting ACK to the DCI.  Regarding P 2-2, we think it is straightforward, instead, we should directly start discussing on the details as in the FFS. We also support additional FFS points suggested by Intel, i.e., timer-based deactivation and the need for reference time to activate the cell DTX/DRX. |
| DOCOMO | For Proposal #2-1, we are fine although we have similar view with Samsung that we don’t see any issue on the feasibility and reliability of L1 signaling.  For Proposal #2-2, we support it. |
| vivo | We think we need to discuss these proposals until RAN2 send formal LS to RAN1.  It is clearly from the RAN2 agreement that there is still no consensus that L1 signaling for cell DTX/DTX has benefits and thus needed.  Besides, we think benefit for introduction of L1 signaling of cell DTX/DRX activation/deactivation is not clear from RAN1 perspective as well since there is no any evaluation on this in SI phase. For UE C-DRX, there is no such L1 signaling of activation/deactivation. Why this should be introduced for cell DTX/DRX is questionable. |
| Fraunhofer | We agree with adding the FFSs proposed by Intel to P#2-2. In addition to that we suggest two more:  FFS: Reliability for group common DCI and fallback behavior for failed signaling  FFS: Forward compatibility if multiple Cell DTX/DRX configurations are to be supported on the future. |
| ZTE, Sanechips | For Proposal #2-1, we also agree that there is no feasibility issue.  For Proposal #2-2, we are okay.  For the FFS suggested by Intel, some update is as below to be more generic  FFS: Timer or validity duration based deactivation/activation of cell DTX/DRX.  FFS: whether to specify a timing ~~reference time to indicate start~~ for the deactivation/activation of cell DTX/DRX.  Regarding the reliability issue of L1 signaling,we think it can be guaranteed by flexible AL adaptation. |
| Apple | Agree with other companies that there is no feasibility issue. RAN1 can directly start the study after receiving RAN2 LS. Support P2-2. |
| Huawei, HiSilicon | For proposal #2-1, we are fine on feasibility of L1 signaling since it is indeed more flexible than RRC/MAC CE. For reliability, we are also open to discuss. In some cases, the reliability could be an issue if miss detection happens.  For proposal #2-2, we are fine for further discussion. |
| CATT | We support L1 signaling for activation/deactivation if L1/MAC signaling is supported. |
| Qualcomm4 | Thanks very much FL for sharing RAN2 agreements.  On P2-1, we think it should be updated since RAN2 agreed “Clarify that the question is about activation/deactivation copy the agreement from last meeting that we are **focusing on single configuration**.”   * Our understanding of the current P2-1 wording is to use L1 signalling for switching cell DTX and cell DRX configurations. * However, our understanding of RAN2 agreement is to use L1 signalling for activation and activation of cell DTX/DRX for a single cell DTX/DRX configuration. In particular, UE is first RRC configured with one cell DTX/DRX configuration. Then L1 signaling is used to inform UE when the UE applies new UE behaviors associated with cell DTX/DRX e.g., dropping one or more channels during non-active time of cell DTX/DRX etc. (cell DTX/DRX is activated) and when UE applies legacy UE behaviors (cell DTX/DRX is deactivated)   From reliability perspective, we see it can be an issue. If UE does not receive the L1 signaling and NW does not know it, UE and NW are not aligned in the cell DTX/DRX behavior. Proposal #2-1  * RAN1 further study feasibility and reliability of using L1 signaling for enabling and disabling **new UE behavior associated with** cell DTX and cell DRX for a single cell DTX/DRX configuration**~~s~~**.   Another alternative wording   * RAN1 further study feasibility and reliability of using L1 signaling for ~~enabling and disabling~~ activating and deactivating cell DTX and cell DRX for a single cell DTX/DRX configuration ~~configurations~~.   On P2-2, the first FFS can be made more general to ask question whether enhancing legacy DCI or introducing new DCI should be pursued. The reliability should be guaranteed to avoid misalign between UE and gNB; hence suggesting another FFS – e.g., HARQ-ACK feedback similar to Scell dormancy procedure should be introduced.  Hence, our suggested **update** is below: Proposal #2-2  * If feasible to support, L1 signalling for Cell DTX/DRX activation/deactivation will have the following characteristics:   + Transported via PDCCH     - ~~FFS DCI format, monitored SS~~     - FFS whether enhancing legacy DCI or introducing new DCI     - FFS DCI content     - FFS whether L1 signaling is UE specific DCI or group common DCI   + FFS on detailed UE behavior upon reception of cell DTX/DRX activation/deactivation L1 signaling at least including application timeline   + FFS HARQ-ACK feedback after UE receives L1 signaling |
| CEWiT | we are fine with the proposal and agree to further add the FFSs proposed by Intel in P2-2. |
| InterDigital | We support P #2-1 and P #2-2.  For P #2-1, to be consistent with RAN2 agreement, we suggest the following change: Proposal #2-1  * RAN1 further study feasibility and reliability of using L1 signaling for indicating ~~enabling and disabling~~ activation/deactivation of cell DTX and cell DRX configurations.   As mentioned by companies and confirmed by RAN2 agreement, we also think there is no feasibility issue regarding support for L1 signaling. |
| ETRI | For Proposal 2-1, we think the feasibility and the reliability was sufficiently verified during Rel-16/17 exercises for UE power saving. But we are okay with the proposal as it is.  We support Proposal 2-2. |
| China Telecom | We support both the proposal. And we prefer the version of Proposal #2-1 as InterDigital proposed. |
| LG Electronics | We are fine with Proposal 2-1.  For Proposal 2-2, we have a similar view with Intel. When Cell DTX/DRX (de)activation is indicated by group-common DCI or UE-specific DCI, we also think the information related to actual starting timing can also be indicated by the pre-configured time offset (relative or absolute). |
| CMCC | For proposal#2-1, we agree that it is feasible, the reliability should be discussed. And share similar view as Qualcomm that the discussion should first base on single DTX/DRX configuration. And content can be extended for multiple configurations if they are agreed by RAN2.  For proposal#2-2, whether this L1 signalling can be monitored during cell non-active period needs to be discussed. The benefit of L1 signalling is fast adaption, so we think monitored during non-active period is useful for fast adapting to burst traffic arriving.   * If feasible to support, L1 signalling for Cell DTX/DRX activation/deactivation will have the following characteristics:   + Transported via PDCCH     - FFS DCI format, monitored SS     - FFS DCI content     - FFS whether L1 signaling is UE specific DCI or group common DCI   + FFS on detailed UE behavior upon reception of cell DTX/DRX activation/deactivation L1 signaling   + FFS the monitored behavior during cell non-active periods. |
| Ericsson2 | For 2-1, we suggest below updates to keep description generic at this point – if L1 signaling is being studied to enhance DRX/DTX functionality, it is preferable to not preclude any specific options at this point.  For 2-2, we suggest below updates. Proposal #2-1  * RAN1 further study feasibility, overhead, benefits and reliability of using L1 signaling ~~for enabling and disabling~~ to enhance cell DTX and cell DRX functionality ~~configurations e.g. L1~~ .  Proposal #2-2  * ~~If feasible to support,~~ study L1 signalling for enhancing Cell DTX/DRX functionality ~~activation/deactivation~~ ~~will have~~ with the following characteristics:   + ~~Transported via~~ PDCCH based signaling     - ~~FFS DCI format, monitored SS~~     - FFS DCI content     - FFS whether ~~L1 signaling is~~ UE specific DCI or group common DCI   + FFS on detailed UE behavior ~~upon reception of cell DTX/DRX activation/deactivation L1 signaling~~   + FFS: feedback after UE receives L1 signaling   + FFS: how to ensure reliability and avoid misalignment |

## 2.3 Interaction of cell DTX/DRX with UE DRX

* [1] Futurewei
  + Observation 4: Alignment of the UE DTX with cell DRX can be handled through gNB implementations as part of scheduled UL transmissions that is controlled by the gNB.
* [2] Huawei/HiSilicon
  + Proposal 4: Further discuss the case and UE behavior that cell DTX and UE C-DRX are applied to a same UE simultaneously.
* [3] Panasonic
  + Observation 1: When UE DRX is configured, strict alignment of all UE DRX configurations and cell DTX/DRX may potentially lead to resource congestion.
  + Proposal 11: Multiple UE DRX configurations can be considered for more flexible adaption to achieve alignment with cell DTX/DRX. The switching between configurations needs possible L1/L2 signaling enhancement.
  + Proposal 12: Interaction of Cell DTX/DRX and UE C-DRX needs to be clarified if both are supported and configured.
* [4] Nokia/NSB
  + Observation 1: The Alignment between Cell DTX/DRX and UE C-DRX has no RAN1 impact, and it ups to RAN2 discussions and decision.
* [5] vivo
  + Proposal 12: Support the following UE behavior when cell DRX and UE C-DRX are both configured in following table.

|  |  |  |
| --- | --- | --- |
| **Cell DRX** | **UE DRX** | **UE behavior** |
| active | active | Normal |
| active | Non-active | Follow behavior for non-active period of UE DRX |
| Non-active | active | Follow behavior for non-active period of cell DRX |
| Non-active | Non-active | Follow behavior for non-active period of cell DRX |

* [6] OPPO
  + Proposal 5: The alignment of cell DTX/DRX and UE C-DRX cycles or the alignment of UE C-DRX cycles for different UE can be left to gNB implementation.
  + Proposal 6: gNB and UE behaviors should be defined when both cell DTX/DRX and UE C-DRX cycles are configured.
* [7] Spreadtrum
  + Proposal 1: At least for cell DTX, alignment between cell DTX and UE C-DRX is pursued.
  + Proposal 3: At least for cell DRX, alignment between cell DRX and UE C-DRX is not pursued.
* [8] CATT
  + Proposal 1: The cell DTX/DRX parameters could be configured to ensure the alignment between the cell DTX/DRX and UE C-DRX, i.e. the cell DTX active time should completely capture the DRX-ON of UEs and at least cover the reception window of DCI format 2\_6 in order not to affect the legacy UEs.
  + Proposal 2: If the cell DTX/DRX is applied, the UE behaviors should be specified when the cell DTX active time ends earlier than the UE DRX-ON extended by any of drx-InactivityTimer, drx-RetransmissionTimerDL or drx-RetransmissionTimerUL.
  + Proposal 3: If the cell DTX/DRX is applied, the following options can be considered in order not to impact on the transmission/reception in periodic resources for legacy RRC\_CONNECTED UE:
    - Option 1: The periodic resources outside the C-DRX active time are overlapped with the cell DTX/DRX active time based on gNB implementation.
    - Option 2: Specify that transmission and reception in periodic resources are not affected by cell DTX/DRX.
  + Proposal 4: If the service of Rel-18 RRC\_CONNECTED UE is not periodic or delay-sensitive service such as XR or URLLC, the data should not be transmitted or received in periodic resources outside the C-DRX active time during cell DTX/DRX non-active time.
  + Proposal 5: If the service of Rel-18 RRC\_CONNECTED UE is periodic or delay-sensitive service such as XR or URLLC, the following options can be considered in order not to impact on the transmission/reception in periodic resources outside the C-DRX active time:
    - Option 1: Cell DTX/DRX is not applied.
    - Option 2: The periodic resources outside the C-DRX active time are overlapped with the cell DTX/DRX active time based on gNB implementation.
    - Option 3: Specify that transmission and reception in periodic resources are not affected by cell DTX/DRX.
* [9] NEC
  + Proposal 1: Align C-DRX cycles for different UEs such that ON durations of different UEs are completely contained within cell/gNB active time.
  + Proposal 7: Indicate parameters related to cell DTX/DRX pattern via DTX/DRX activation signalling.
  + Proposal 8: Cell DTX/DRX activation signaling indicates whether cell DTX overrides C-DRX of UEs or not.
* [10] Intel
  + Observation 2: Alignment of on-duration of UE’s C-DRX among UEs to ensure that they are within the Cell DTX on-duration can be achieved by implementation.
  + Proposal 10: Further discuss whether part or all of UE DRX procedures need to be adjusted after cell DTX/DRX pattern is activated.
    - Details can be up to RAN2.
* [12] ZTE/Sanechips
  + During cell DTX/DRX non-active periods that is overlapped with UE CDRX active time, UE can perform CSI-RS reception and CSI report to minimize the impact on link management similar to the mechanism during the timer duration indicated by drx-onDurationTimer in DRX-Config also outside active time.
  + Observations: The alignment of cell DTX on duration and UE CDRX on duration can ensure data scheduling with lower latency and provide a longer cell DTX off duration.
  + Proposal: At least the UE CDRX start offset is proposed to be indicated by L1 signaling to adapt to the dynamic indication of cell DTX/DRX pattern.
* [13] Xiaomi
  + Proposal 5: The interaction between cell DTX and UE C-DRX should be considered. And UE behavior for cell DTX alone should be discussed first as baseline.
* [15] China Telecom
  + Proposal 7: The configuration of cell DTX/DRX should be regarded independently instead of as the enhancement of C-DRX.
  + Proposal 8: The configuration of the longest time for cell DTX/DRX should be introduced to avoid the collision with C-DRX.
* [17] Samsung
  + Proposal 7: When UE is provided with both cell DTX and UE DRX,
    - For the case where the duration is determined as active for cell DTX, UE behaviour is the same as legacy, i.e., cell DTX is not configured.
    - For the case where the duration is determined as non-active for both cell DTX and UE DRX, UE behaviour is the same as the case when cell DTX is configured and UE DRX is not configured or UE follows both cell DTX and UE DRX if there is no collision between cell DTX and UE DRX.
    - For the case where the duration is determined as non-active for cell DTX but active for UE DRX, consider the following two options.
      * Option 1: UE behaviour is the same as non-active time of cell DTX when UE DRX is not configured.
      * Option 2: UE behaviour is the same as non-active time of UE DRX when cell DTX is not configured.
  + Proposal 12: Support cell specific or UE-group specific indication on UE’s DRX cycle to align multiple UE’s ON durations.
* [19] CMCC
  + Proposal 14: Alignment of cell DTX/DRX and UE C-DRX can be triggered dynamically.
  + Proposal 15: Activation of cell DTX/DRX and alignment of cell DTX/DRX and UE DRX can share the same L1 indication signalling.
* [22] Transsion Holdings
  + Proposal 5 How to align the DRX cycles or offsets for different UEs needs to be further studied.
  + Proposal 6 Align UE DRX with cell DTX and DRX between multiple UEs should be studied.
* [23] LG Electronics
  + Proposal #4: It is necessary to discuss UE behaviour when both Cell DTX/DRX and UE C-DRX are configured simultaneously.
* [27] Rakuten
  + Observation 2: Interaction between cell DTX/DRX and UE DRX can be realized based on configuration alignment without any special functionality.
* [28] NTT Docomo
  + Proposal 3: Alignment between Cell DTX and UE DRX should be discussed in accordance with the UE behavior during Cell DTX inactivity periods.

#### Summary of Issues

Some companies commented that UE DRX alignment to work with cell DTX/DRX can be handled through gNB implementation. Some companies commented that some interaction to align the active times for UE DRX might be required.

#### Suggestions for further Discussions

The C-DRX is specified in RAN2, therefore moderator thinks any potential agreements with regards to DRX will need to be sent to RAN2 for recommendation and/or confirmation. Since basic functionality for cell DTX/DRX has not been concluded yet, moderator suggests to first work on the basic cell DTX/DRX functionality before discussing further on interaction between UE DRX and cell DTX/DRX.

#### [CLOSED-1st Round of Discussions]

Companies are asked to provide comments and proposals on C-DRX aspects that may be agreeable in RAN1. Moderator suggests focusing on aspects that do not require RAN2 input, or aspects that RAN2 may input from RAN1’s opinion.

Moderator will take the inputs and suggestions and create a formal proposal (with proposal #) for conclusion and/or agreement.

|  |  |
| --- | --- |
| Company | Comments |
| CMCC | We think the alignment can be discussed in RAN1. This issue is highly related to whether dynamic activation/deactivation is supported. Since if only RRC based activation/deactivation of cell DTX/DRX is introduced, the alignment with C-DRX can also be done based on RRC configuration. However, RRC based configuration can not adapt to the traffic varying flexibly. And RAN2 thinks that Cell level common L1 signalling for Cell DTX/DRX activation/deactivation is beneficial. With L1 based activation/deactivation, when there are much traffic to be served, gNB can deactivate the cell DTX/DRX, and if UE C-DRX active periods are RRC configured to be centralized, the resource for scheduling may be crowed and UPT will be reduced. And on the other hand, if gNB decides to activate the cell DTX/DRX for power saving, while the UE C-DRX active periods are RRC configured to be distributed, the power saving gain will be limited, if cell DTX ON period has to cover all UE’s on duration.  Therefore, we proposed to discuss the dynamic alignment along with the dynamic activation/deactivation of cell DTX/DRX, which RAN2 thinks should be discussed by RAN1. |
| Xiaomi | UE behavior for the four status, (cell DTX-on, C-DRX- on)/ (cell DTX- on, C-DRX-off)/ (cell DTX-off, C-DRX- on)/ (cell DTX-off, C-DRX-off), should be defined. |
| Spreadtrum | UE C-DRX is only about PDCCH monitoring. There is no need of alignment b/w UE C-DRX and Cell DTX, and gNB can handle it. |
| Apple | Agree with FL’s proposal. Focus on UE behavior when only cell DTX/DRX is configured first, and when the behavior becomes clear, we could discuss about the additional behaviors under various misaligned scenarios. |
| Fujitsu | We agree with FL and Apple that the interaction between UE DRX and cell DTX/DRX should be deferred after the basic functionality of cell DTX/DRX is clear. |
| DOCOMO | Support the FL’s suggestion. |
| NOKIA/NSB | To our knowledge, this aspect to be discussed is leading by RAN2, and any RAN1 impact could be identified later if any.  Moreover, the alignment aspect (between cell DTX/DRX and UE’s CDRX) can be handled by NW implementation. |
| InterDigital | We are fine with FL’s proposal. We also think further discussion on interaction between CDRX and cell DRX/DRX can be left to RAN2 at this stage. |
| Lenovo | In our understanding, the discussion on this issue should be led by RAN2 |
| MTK | DRX/DTX is essentially trade-off between QoS impact and UE/BS energy saving. From UE point of view, DRX cycle is the most critical factor related to both average packet latency (OoS impact) and UE energy saving. As long as DRX cycle can be kept with cell DTX/DRX mechanism, we would be fine to leave the alignment design to RAN2. Collection and LS of RAN1 views on this aspect can be useful for cross-WG co-work. |
| Futurewei | Share same view as Nokia. |
| Fraunhofer | As Nokia, Lenovo and Futurewei, we think this should be discussed first in RAN2. RAN1 involvement, if needed can come later. |
| Intel | OK to wait for RAN2 input in this regard. From our perspective, there is no alignment needed by specification. RAN2 has already suggested that “A periodic Cell DTX/DRX (i.e., active and non-active periods) can be configured by gNB via UE-specific RRC signalling per serving cell. ” . Hence, once the configuration is provided, UE follows that. We still need to discuss corresponding UE behaviors in different situations, such as during overlap of active and non-active times of cell DTX/DRX and UE C-DRX. |
| Moderator | Please continue to provide comments on this issue. |
| Samsung | We agree with FL that the alignment issue can be deprioritized for now and we can first focus on UE behavior when only configured with cell DTX/DRX and then we can define UE behaviour for the four cases mentioned by Xiaomi. |
| CEWiT | the applicability of the RRC configured cell DTX depends on dynamic activation/de-activation signalling. This will cause mis alignment betweeen cell DTX and UE DRX oprations and hence needed to be considered. |
| ETRI | We can wait for RAN2 to conclude basic concept of interaction between cell DTX/DRX and UE C-DRX. |
| Qualcomm | This can be discussed later if needed. |
| Panasonic | We are okay to firstly work on the Cell DTX/DRX related UE behaviour and then discuss whether and how to handle alignment with UE DRX. |
| Huawei, HiSilicon | For our perspective, we think this issue to RAN2 discussion especially, since the signals/channels that cell DTX/DRX impact are not decided yet. |
| ITRI | We are fine with FL’s suggestion. |
| CATT | The alignment of C-DRX and cell DTX/DRX is an implementation issue only |
| China Telecom | Agree with FL to discuss the cell DTX/DRX independently first. |
| OPPO | We can wait for RAN2 input. |
| LG Electronics | We agree with FL’s suggestion.  From our perspective, it may be necessary to define the UE behaviours for each time interval (a combination of the active/inactive time of Cell DTX/DRX and the ON/OFF duration of UE-DRX). For example, a UE may perform PDCCH reception only during a time interval in which the active time in a cell DTX/DRX configuration and the ON duration in a UE C-DRX configuration intersect. |
| Ericsson1 | This may be discussed later if needed. |
| Spreadtrum2 | Can be discussed later |

#### == Summary of 1st Round of Discussions ==

Majority of the companies agree with moderator that interaction between UE DRX and cell DTX/DRX can be put on hold until RAN2 has progressed design for cell DTX/DRX further.

#### [ON HOLD-Next Round of Discussions]

Discussion on interaction between UE DRX and cell DTX/DRX are deferred until further notice.

## 2.4 Signals/Channels impacted by cell DTX/DRX

* [2] Huawei/HiSilicon
  + Proposal 3: Support the following signals/channels to be applied with Cell DTX/DRX:
    - UE-specific PDCCH
    - SPS PDSCH and CG PUSCH
    - Periodic/Semi-persistent CSI
    - Periodic/Semi-persistent SRS
    - Periodic/Semi-persistent CSI-RS
    - FFS: SR for SCell BFR, CSI-RS for tracking and CSI-RS for Scell BFR.
* [3] Panasonic
  + Proposal 2: UE is not expected to receive periodic/semi-persistent CSI-RS for CSI measurement/report during non-active periods of cell DTX. However, for TRS configured for beam and radio link monitoring and UE mobility, the availability can be at least configurable.
  + Proposal 3: For Cell DTX/DRX, UE behaviour of receiving PRS does not require specification change and can be up to gNB implementation of configuration.
  + Proposal 4: For Cell DTX/DRX, UE is not expected to receive PDCCH scrambled with UE specific RNTI and PDCCH in Type-3 CSS.
  + Proposal 5: For Cell DTX/DRX, UE behaviour of receiving SPS-PDSCH may follow handling of that in C-DRX as starting point.
  + Proposal 6: For Cell DTX/DRX, UE behaviour relevant to SR can be same with that of C-DRX as a starting point.
  + Proposal 7: For Cell DTX/DRX, UE is not expected to transmit periodic/semi-persistent CSI report and periodic/semi-persistent SRS during non-active period.
  + Proposal 8: For Cell DTX/DRX, UE behaviour of transmitting CG-PUSCH may follow handling of that in C-DRX as starting point.
* [4] Nokia/NSB
  + Proposal 2: We propose the following extended list of DL channels/signals to be used as a baseline for more detailed discussion.
    - Periodic/Semi-persistent CSI-RS for L1/L3-RSRP
    - Periodic/Semi-persistent CSI-RS for Radio Link Management (RLM)/beam Failure detection (BFD)
    - Periodic/Semi-persistent CSI-RS for tracking (TRS)
    - PRS
    - PDCCH scrambled with UE specific RNTI
    - PDCCH in Type-3 CSS
    - SPS-PDSCH
  + Proposal 3: Discuss whether all types of periodic/semi-persistent CSI-RS and PRS transmission shall be dropped during cell DTX non-active period.
    - FFS on the potential solutions to overcome the impact from the dropped transmissions due to cell DTX non-active period.
  + Proposal 4: Wait for RAN2 agreements on the gNB/UE behaviour for PDCCH and SPS-PDSCH (re)-transmission during the Cell DTX non-active period.
    - FFS on potential RAN1 impacts.
  + Proposal 6: We propose the following list of UL channels/signals to be used as a baseline for more detailed discussion.
    - SR
    - Periodic/Semi-persistent CSI report
    - Periodic/Semi-persistent SRS
    - HARQ feedback for SPS/DG-PDSCH
    - CG-PUSCH
  + Proposal 7: Discuss whether periodic/semi-persistent CSI CSI-RS-reports and SRS receptions shall be omitted during cell DRX non-active period.
    - FFS on the potential solutions to overcome the impact from the omitted occasions due to cell DRX non-active period.
  + Proposal 8: Wait for RAN2 agreements on the gNB/UE behaviour for SR and DG/CG-PUSCH reception during the cell DRX non-active period.
    - FFS on potential RAN1 impacts.
  + Proposal 9: Wait for RAN2 progress on HARQ feedback for DG/SPS-PDSCH reception during the cell DTX non-active period.
  + Proposal 11: Discuss the impact of cell DTX non-active periods on existing HARQ-ACK codebook generation (at least considering Type 1 HARQ-ACK codebook).
  + Observation 2: PUCCH deferral operations in legacy consist of (i) deferral for PUCCH repetition operation (from Rel-15), and (ii) SPS HARQ-ACK deferral (from Rel-17).
  + Proposal 12: Discuss the interaction of cell DRX (non-active periods) with the existing PUCCH deferral operations, i.e., PUCCH repetition deferral and Rel-17 SPS HARQ-ACK deferral.
* [5] vivo
  + Proposal 1: UE does not monitor PDCCH scrambled by C-RNTI, CI-RNTI, CS-RNTI, INT-RNTI, SFI-RNTI, SP-CSI-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, TPC-SRS-RNTI, and AI-RNTI in non-active period of cell DTX if UE C-DRX is not configured.
  + Proposal 2: UE doesn’t not expect periodical/semi-persistent CSI-RS resources excluding TRS are available in non-active period of cell DTX if UE C-DRX is not configured.
  + Proposal 3: UE still monitors TRS in non-active period of cell DTX.
  + Proposal 4: UE still monitors PRS in non-active period of cell DTX.
  + Proposal 5: UE doesn’t monitor SPS PDSCH in non-active period of cell DTX if UE C-DRX is not configured.
  + Proposal 7: UE does not need to transmit SR in non-active period of Cell DRX.
  + Proposal 8: UE needs to transmit PUCCH carrying HARQ for transmitted PDSCH in non-active period of Cell DRX.
  + Proposal 9: UE does not need to transmit PUCCH/PUSCH carrying periodical or semi-persistent CSI in non-active period of Cell DRX.
  + Proposal 10: UE does not need to transmit periodical or semi-persistent SRS in non-active period of Cell DRX.
  + Proposal 11: UE doesn’t need to transmit CG PUSCH in non-active period of cell DRX.
* [7] Spreadtrum
  + Observation 3: RAN1 should continue discussion on which PHY signals/channels are impacted during inactive period of cell DTX/DRX.
  + Proposal 2: Whether TRS is not expected not transmit during non-active period of cell DTX should be studied, and UE performance impact should be considered.
* [10] Intel
  + Observation 1: TRS configuration for idle/inactive mode Ues and connected mode Ues can be different by implementation and gNB can control the transmission of TRS for idle/inactive mode Ues via availability indication.
  + Proposal 2: Following signals/channels can impacted outside cell DTX/DRX active time:
    - DL
      * Periodic/Semi-persistent CSI-RS (including TRS)
      * PRS
      * PDCCH scrambled with UE specific RNTI
      * PDCCH in Type-3 CSS
      * SPS-PDSCH
    - UL
      * SR
      * Periodic/Semi-persistent CSI report
      * Periodic/Semi-persistent SRS
      * CG-PUSCH
      * HARQ-ACK for SPS- PDSCH
* [11] Fujitsu
  + Proposal 2: During Cell DTX/DRX non-active time, UE shall expect that at least the following UE-specific channels/signals are not transmitted/received:
    - DL:
      * CSI-RS.
      * UE-specific PDCCH.
      * PRS.
    - UL:
      * PUCCH carrying CSI reports.
      * SRS.
    - Note: For aperiodic CSI-RS/SRS, if it is triggered by PDCCH transmitted during active period, the UE is expected to receive/transmit it.
* [12] ZTE/Sanechips
  + Proposal: In order to save gNBs’ and Ues’ power consumption, at least periodic signals transmission and procedures including periodic CSI-RS, CSI report and SRS should be reduced during cell DTX/DRX non-active periods.
  + Proposal: The following physical signals/channels are proposed to be discussed by RAN2:
    - Dynamic data transmission/reception
    - PDCCH scrambled with UE specific RNTI
    - PDCCH in Type-3 CSS
    - SPS-PDSCH
    - SR
    - CG-PUSCH
* [13] Xiaomi
  + Proposal 1: Dynamically scheduled PDSCH/PUSCH/PUCCH(HARQ-ACK/CSI report)/reference signal, should have higher priority over cell DTX/DRX
  + Proposal 2: Whether and how RLM/BFD/BFR related procedures will be interrupted by cell DTX/DRX should be considered.
  + Proposal 3:
    - DL channels/signals UE expected to not receive during non-active periods of cell DTX
      * Periodic/Semi-persistent reference signals (including CSI-RS/TRS/PT-RS/PRS), but reference signals for BFD/BFR can be separately considered.
      * PDCCH in USS/Type-3 CSS
      * SPS-PDSCH
    - UL channels/signals UE expected to not transmit during non-active periods of cell DTX
      * SR. But SR for BFR can be separately considered.
      * Periodic/Semi-persistent CSI report
      * Periodic/Semi-persistent SRS/PRS
      * CG-PUSCH
  + Proposal 4: Besides semi-static configuration, dynamic indication for cell DTX/DRX should also be considered.
* [14] Interdigital
  + Proposal 1: UE is not expected to measure periodic/semi-persistent CSI-RS (including PTRS, TRS, BFD, and RLM RS) during non-active periods of cell DTX
  + Proposal 2: UE is not expected to measure PRS during non-active periods of cell DTX
  + Observation 1: To maximize network and UE power savings, UE should not monitor PDCCH for dynamic grants/assignments for new transmissions during Cell DTX non-active periods, even if the UE is in C-DRX Active time. Such can be decided by RAN2.
  + Observation 2: To maintain HARQ retransmission timely, UE should monitor PDCCH for dynamic grants/assignments for retransmissions during the UE’s C-DRX Active time per legacy behaviour, even during the Cell DTX non-active period. Such can be decided by RAN2.
  + Proposal 3: UE is not expected to transmit periodic/semi-persistent CSI-RS reports during non-active periods of cell DRX.
  + Proposal 4: UE is not expected to transmit periodic/semi-persistent SRS during non-active periods of cell DRX
  + Proposal 5: UE transmits HARQ feedback for Dynamic PDSCH assignments if the PUCCH resource is provided in DCI (per legacy), even when the PUCCH overlaps with non-active period of cell DRX
  + Proposal 6: UE transmits HARQ feedback for SPS-PDSCH if the PUCCH resource is provided in DCI (per legacy), even when the PUCCH overlaps with non-active period of cell DRX
* [15] China Telecom
  + Proposal 2: Support cell DTX applied to at least the following signals/channels.
    - PDCCH in USS
    - SPS-PDSCH
    - PTRS
    - periodic/semi-persistent CSI-RS/TRS
  + Proposal 3: Support cell DRX applied to at least the following signals/channels.
    - PUCCH with periodic/semi-persistent CSI
    - SR
    - CG-PUSCH
    - Periodicity/semi-periodicity SRS
* [16] Google
  + Proposal 4: During the non-active periods of cell DRX, UE does not transmit the periodic/semi-persistent CSI/beam report.
  + Proposal 5: The impact of RACH and SR procedure from non-active periods of cell DRX should be studied by RAN2.
  + Proposal 6: Study the impact of BFR procedure from non-active periods of cell DRX.
* [17] Samsung
  + Proposal 1: The SSB transmission symbols are considered as active for the determination of the active durations of cell DTX.
  + Observation 2: Allowing the reception/transmission of a PDSCH/PUSCH/PUCCH scheduled by a DCI format during non-active time of cell DTX/DRX is beneficial for network energy saving, UE energy saving and latency reduction.
  + Proposal 2: The following signals/channels are not received/transmitted during non-active periods of cell DTX/DRX and the other signals/channels are not impacted by cell DTX/DRX.
    - DL
      * Periodic/Semi-persistent CSI-RS (excluding TRS)
      * PRS
      * PDCCH scrambled with UE specific RNTI
      * Type3-PDCCH in CSS
      * SPS-PDSCH
    - UL
      * SR
      * Periodic/Semi-persistent CSI report
      * Periodic/Semi-persistent SRS
      * CG-PUSCH
      * FFS: Not receiving/transmitting the above channels/signals can be configured by RRC.
  + Proposal 11: The DCI format indicating activation/deactivation/modification of cell DTX/DRX configuration can also indicate parameter updates per spatial domain (SD) and power domain (PD) adaptations, e.g., a value of powerControlOffset or powerControlOffsetSS or an adjustment values to powerControlOffset or powerControlOffsetSS.
* [18] ETRI
  + Observation 1: For behaviours during cell DTX/DRX non-active time, there is ongoing discussion in RAN2 on SPS/CG, SR, PDCCH, and dynamic PDSCH/PUSCH.
  + Proposal 1: Suspend discussions in RAN1 for SPS/CG, SR, PDCCH, dynamic PDSCH/PUSCH, and HARQ-ACK of dynamic/SPS PDSCH until receiving input from RAN2.
  + Proposal 2: For periodic/semi-persistent CSI-RS, periodic/semi-persistent SRS, and periodic/semi-persistent CSI report, during cell DTX/DRX non-active time, down-select from the following options:
    - Option 1: UE skips those transmissions
    - Option 2: UE can be configured whether or not to receive/transmit those transmissions (FFS: configuration unit)
  + Proposal 3: Skipped CSI-RS occasions during cell DTX/DRX non-active time do not contribute to RRM/RLM, CSI/beam report, and BFR.
  + Proposal 4: For aperiodic CSI-RS, aperiodic SRS, and aperiodic CSI report, UE does not expect to be scheduled with those transmissions during cell DTX/DRX non-active time.
  + Proposal 7: Further study the following aspects for dynamic activation and deactivation of cell DTX/DRX.
    - Whether a new DCI format needs to be introduced (against reusing DCI format 2\_6).
    - Whether/how to support L1-based activation/deactivation for cell DRX.
    - Number of DCI formats for indicating cell DTX activation and deactivation, and potentially cell DRX activation and deactivation.
* [19] CMCC
  + Proposal 1: PDCCH monitoring scrambled by MCS-RNTI is not impacted by cell non-active periods.
  + Proposal 2: In case of L1 signalling based cell DTX/DRX activation/deactivation is supported, PDCCH monitoring for the activation/deactivation should be allowed during cell non-active periods.
  + Proposal 3: SPS-PDSCH is not expected to be received by UE during cell non-active periods.
  + Proposal 4: To reduce performance loss of no CSI-RS measurement during cell DTX/DRX non-active periods, CSI-RS can be transmitted with a larger periodicity during cell non-active periods.
  + Proposal 5: If TRS is used for power saving by idle/inactive Ues, it is not impacted by Cell DTX.
  + Proposal 6: NCD-SSB is not transmitted during non-active periods of Cell DTX.
  + Proposal 7: SR can be transmitted during cell DTX/DRX non-active period.
  + Proposal 8: To provide timely and effective CSI for gNB, periodic/semi-persistent CSI report can be allowed with a larger periodicity during cell non-active periods.
  + Proposal 9: gNB can configure whether to skip periodic/semi-persistent CSI-RS and CSI report or to allow them with a larger periodicity.
  + Proposal 10: gNB can configure UE whether to skip periodic/semi-persistent SRS or to allow SRS transmission with a larger periodicity.
  + Proposal 11: CG-PUSCH is skipped during Cell DRX non-active period.
* [21] Mediatek
  + Observation 1: To comply with the constraint, “The impact to IDLE/INACTIVE Ues due to the above enhancement should be avoided”, signals or channels that can be utilized by idle/inactive (legacy) Ues should not be impacted by non-active periods of cell DTX/DRX.
  + Proposal 1: TRS and PRS should not be impacted by non-active periods of cell DTX/DRX, considering the usage by idle/inactive (legacy) Ues.
  + Observation 2: To avoid excess latency for latency constrained use cases, e.g., VoIP and/or AR, schedule of data retransmissions should be allowed in non-active periods of cell DTX/DRX.
  + Proposal 2: New data of UE specific scheduling and PDSCH/PUSCH is not expected in non-active periods of cell DTX/DRX, while retransmission(s) of scheduled data in active periods of cell DTX/DRX is still allowed.
* [22] Transsion Holdings
  + Proposal 1 PDCCH scrambled with UE-specific RNTI, SPS-PDSCH, and CG PUSCH may be expected to not receive or transmit during non-active periods of cell DTX/DRX.
* [23] LG Electronics
  + Proposal #3: At least following signals/channels for connected mode Ues can be expected to not transmit or receive during non-active periods of cell DTX/DRX.
    - DL
      * Periodic/Semi-persistent CSI-RS
      * PRS
      * PDCCH scrambled with UE specific RNTI
      * SPS-PDSCH
    - UL
      * SR
      * Periodic/Semi-persistent CSI report
      * Periodic/Semi-persistent SRS
      * CG-PUSCH
* [24] Apple
  + Proposal 1: UE does not monitor PDCCH including UE-specific RNTI and Type-3 CSS in cell DTX non-active duration,
    - For DG-PDSCH/PUSCH scheduled by PDCCH received during on duration, up to gNB scheduling.
    - HARQ-ACK still allowed based on gNB scheduling for PDSCH scheduled by PDCCH in ON duration.
  + Observation 1: Because gNB has to wake up for preamble reception in all Ros in non-active duration of Cell DRX, marginal NES loss is expected if the occasions of exceptional CG/SR are configured close to Ros.
  + Observation 2: Because gNB has to wake up for SSB/SIB/paging in non-active duration of Cell DTX, marginal NES loss is expected if the exceptional SPS are configured close to occasions to transmit SSB/SIB/paging.
  + Proposal 2: A list of exceptional SPS-ConfigIndex can be included in Cell DTX configuration. gNB only wakes up to transmit low latency traffic in the SPS occasions indicated by the list during non-active duration of Cell DTX.
  + Proposal 3: A list of exceptional ConfiguredGrantConfigIndex can be included in Cell DRX configuration. gNB wakes up to receive low latency CG-PUSCH in the CG occasions indicated by the list during non-active duration of Cell DRX.
  + Proposal 4: A list of exceptional schedulingRequestID can be included in Cell DRX configuration. gNB wakes up to receive SR associated with low latency traffic in the SR occasions indicated by the list during non-active duration of Cell DRX.
  + Proposal 5: To not impact legacy Ues that do not support NES feature, TRS is still maintained during non-active duration of cell DTX.
  + Observation 3: Allowing P/SP CSI-RS to be stopped during cell DTX/DRX non-active duration may significantly increase UE measurement latency.
  + Proposal 6: Send an LS to RAN4 to study on the how much measurement latency increase is foreseen for P/SP CSI-RS before determining the transmission of CSI-RS in cell DTX/DRX non-active duration.
* [25] Lenovo
  + TRS is excluded from the set of signals that are muted during inactive periods corresponding to cell DTX
  + Use SSB to obtain estimates of time/frequency offset values in DL transmission, if TRS is included in the set of signals that are muted during inactive periods corresponding to cell DTX
  + CSI-RS for BM is excluded from the set of signals that are muted during inactive periods corresponding to cell DTX
  + If CSI-RS is included in the set of signals that are muted during inactive periods corresponding to cell DTX, SSB can be used for BM purposes, assuming that a corresponding SSBRI-based beam reporting is configured
  + CSI-RS for channel measurement is included in the set of signals that are muted during inactive periods corresponding to cell DTX
  + CSI reporting for BM is excluded from the set of signals that are muted during inactive periods corresponding to cell DRX
  + CSI reporting for channel measurement is included in the set of signals that are muted during inactive periods corresponding to cell DRX
  + CSI quantities of a CSI report that is muted during an inactive period of a cell DRX can be included as part of the CSI quantities of a subsequent occasion of CSI reporting during an active period of cell DRX, if the CSI reporting setting parameter associated with time restriction for channel measurements is not configured
  + SRS configured with usage set to beam management is excluded from the set of signals that are muted during inactive periods corresponding to cell DRX
  + SRS configured with usage set to antenna switching, codebook or non-codebook are included in the set of signals that are muted during inactive periods corresponding to cell DRX
  + SPS-PDSCH and CG-PUSCH can be configured with a range of possible periodicities that fall within the active periods of cell DTX/DRX, respectively
  + If the allowed range of periodicities of SPS-PDSCH and CG-PUSCH do not fall within the periodicities of the active periods of the cell DTX/DRX, respectively, the SPS-PDSCH and CG-PUSCH should then be excluded from the set of channels that are muted during cell DTX/DRX, respectively
  + SR is included in the set of signals that are muted during inactive periods corresponding to cell DRX
* [26] Qualcomm
  + Proposal 1: RAN1 adopts the UE transmission/reception restriction in the non-active time of cell DTX/DRX provided in the following Table for RRC connected mode Ues.
  + In the following, yes indicates channel dropping within cell DTX/DRX non-active time
  + Downlink
    - PDCCH in USS set, PDCCH in Type3-PDCCH CSS set Yes
    - DG PDSCH No
    - TRS No
    - CSI-RS for BM, BFD No
    - CSI-RS for RLM Yes
    - CSI-RS for RRM Yes, with some additional spec change consideration
    - CSI-RS for positioning (aka PRS) No
    - SPS left to RAN2
  + Uplink
    - Periodic/Semi-persistent SRS Yes
    - Periodic/Semi-persistent CSI report Yes
    - DG PUSCH No
    - PUCCH for HARQ ACK No
    - CG left to RAN2
    - SR left to RAN2
  + Observation 7: If the cell DRX is activated by RRC signaling, determination of available slots for CG PUSCH repetitions may depend on cell DRX configuration.
  + Proposal 2: If the cell DRX is activated by L1/L2 signaling and CG PUSCH repetition is dropped in the non-active time of cell DRX, the dropped CG PUSCH repetition is counted in the configured number of repetitions.
* [27] Rakuten
  + Proposal 3: At least, SSB, SIB1/2, Paging, RACH should not be dropped to avoid any impact to legacy Ues. These channels should not be considered as the further target of dropped channels.
* [28] NTT Docomo
  + Proposal 1: UE behavior during Cell DTX/DRX inactivity periods should be further discussed. Following table can be starting point.
  + DL
    - Periodic/Semi-persistent CSI-RS (FFS: for tracking): Can be dropped. Regarding CSI-RS for tracking, it needs to review impact on time/freq. synchronization.
    - PRS: Can be dropped
    - PDCCH in Type 3-PDCCH CSS and USS: Can be dropped
    - SPS PDSCH: Can be dropped but no scheduling restriction should be imposed (i.e., gNB does not need to ensure that configuration of SPS PDSCH conflicts Cell inactivity periods)
    - SSB: No impact as noted in WID
    - SIB: No impact as noted in WID
    - Paging PDSCH: No impact as noted in WID
    - PDCCH in Type0-PDCCH CSS, Type0A-PDCCH CSS, Type1-PDCCH CSS, and Type2-PDCCH CSS: No impact as noted in WID
    - Dynamic PDSCH: Can be avoided by gNB implementation
  + UL
    - SR: Can be dropped
    - Periodic/Semi-persistent CSI report: Can be dropped
    - Periodic/Semi-persistent SRS: Can be dropped
    - HARQ-ACK for SPS PDSCH reception: Can be dropped
    - CG PUSCH: Can be dropped
    - PRACH No impact as noted in: WID
    - Dynamic grant PUSCH: Can be avoided by gNB implementation
    - Aperiodic CSI report on PUSCH: Can be avoided by gNB implementation
    - Aperiodic SRS: Can be avoided by gNB implementation
    - HARQ-ACK for dynamic PDSCH reception: Can be avoided by gNB implementation
    - HARQ-ACK for SPS PDSCH activation/deactivation: Can be avoided by gNB implementation
* [29] Ericsson
  + Observation: Since PDCCH (addressed to C-RNTI) is dynamically scheduled, such PDCCH transmissions can be turned off today using legacy mechanism.
  + Observation: Prohibiting PDCCH transmissions (e.g. addressed to UE C-RNTI) during cell DTX/DRX non-active period does not bring any additional gNB energy saving compared to what is possible today while it can lead to increased latency and UE throughput loss.
  + Proposal: Support at least a case with no restriction on UE monitoring of PDCCH (addressed to C-RNTI and in Type 3 CSS) during non-active period of cell DTX/DRX.
  + Observation: Restricting reception of TRS during cell DTX/DRX non-active period can save NW energy (e.g. ~ 10% gain).
  + Proposal: Support selective reception of TRS in indicated TRS occasions during non-active period of cell DTX/DRX. Study further details of indication/occasions, e.g., TRS is received in occasions overlapping with a window before on-duration, before data scheduling, etc.
  + Proposal: UE transmits SR in indicated SR resource/occasions during non-active period of cell DTX/DRX. Study further details of indication
  + Proposal: UE receives periodic CSI-RS/transmits periodic SRS in indicated resources/occasions during non-active period of cell DTX/DRX. Study further details of indication(s)
  + Observation: PRS may be used also by idle/inactive Ues, and it may not be necessary to restrict PRS reception during non-active period of cell DTX/DRX.
* [30] ITRI
  + Proposal 1: For enhancements on cell DTX/DRX mechanism, at least the following signal mechanisms for cell DTX/DRX should be discussed:
    - UE specific DCI
    - Group common DCI
    - Cell-wise indication
  + Proposal 2: For enhancements on cell DTX/DRX mechanism, whether to transmit SSB during non-active periods of cell DTX/DRX should be discussed.
    - FFS: UE behavior for SSB reception during non-active periods of cell DTX/DRX

#### Summary of Issues

While many of the cell DTX/DRX operations require RAN2 inputs, there are specific aspects that RAN1 may be able to agree and even provide inputs to RAN2 for recommendation. These are signals and channels that are mainly specified in RAN1 specifications, such as CSI reporting, physical layer signals (such as CSI-RS and SRS), HARQ feedback, and PDCCH monitoring. For these signals and channels, RAN2 may not be able to conclude the impact from cell DTX/DRX and require RAN1 input and guidance.

The following (RAN1 domain) signals/channels are suggested by companies that may be disabled during cell DTX/DRX.

* DL
  + Periodic/Semi-persistent CSI-RS (for RRM)
  + Periodic/Semi-persistent CSI-RS (for L1-RSRP)
  + Periodic/Semi-persistent CSI-RS (for RLM)
  + Periodic/Semi-persistent CSI-RS (for BM, RFD)
  + Periodic/Semi-persistent CSI-RS (for tracking)
  + PRS
  + PDCCH scrambled by C-RNTI, CI-RNTI, CS-RNTI, INT-RNTI, SFI-RNTI, SP-CSI-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, TPC-SRS-RNTI, and AI-RNTI
  + PDCCH in USS
  + PDCCH in Type-3 CSS
  + SPS PDSCH – (should wait for RAN2 input?)
* UL
  + Periodic/Semi-persistent CSI report
  + Periodic/Semi-persistent SRS
  + HARQ feedback for SPS PDSCH
  + HARQ feedback for DG PDSCH
  + CG PUSCH – (should wait for RAN2 input?)
  + SR – (should wait for RAN2 input?)

Also following issues has been identified by companies:

* Impact to HARQ-ACK codebook generation from cell DRX
* PUCCH deferral operations during cell DRX

#### Suggestions for further Discussions

Moderator suggests discussing the list of potential signals/channels (from RAN1 perspective). The starting point could be the list compiled from summary of company’s views.

Moderator also suggest discussing the issue on HARQ-ACK codebook generation, and PUCCH deferral operation during cell DRX.

One of the most controversial aspects seems to be on impact to TRS during cell DTX periods, which moderator suggest starting the discussions with.

###### Proposal #4-1

The following signals/channels are assumed by RAN1 to be not transmitted by the gNB during cell DTX (if cell DTX information is provided to the UEs). Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.

* Periodic/Semi-persistent CSI-RS (for RRM)
* Periodic/Semi-persistent CSI-RS (for L1-RSRP)
* Periodic/Semi-persistent CSI-RS (for RLM)
* Periodic/Semi-persistent CSI-RS (for BM, RFD)
* Periodic/Semi-persistent CSI-RS (for tracking)
* PRS
* PDCCH in USS
  + C-RNTI, CS-RNTI(s), MCS-C-RNTI
  + SP-CSI-RNTI
  + SL-RNTI, SL-CS-RNTI, V-RNTI
  + AI-RNTI
* PDCCH in Type-3 CSS
  + INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, CI-RNTI
  + C-RNTI, MCS-C-RNTI, CS-RNTI(s), PS-RNTI
  + G-RNTI, G-CS-RNTI
  + MCCH-RNTI
  + AI-RNTI

###### Proposal #4-2

The following signals/channels assumed by RAN1 to be not transmitted by the UE during cell DRX (if cell DRX information is provided to the UEs). Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.

* Periodic/Semi-persistent CSI report
* Periodic/Semi-persistent SRS
* HARQ feedback for SPS PDSCH
* HARQ feedback for DG PDSCH

###### Proposal #4-1A

The following signals/channels are assumed by RAN1 to be not transmitted by the gNB during cell DTX (if cell DTX information is provided to the UEs). Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.

* [Periodic/Semi-persistent CSI-RS (for RRM)]
  + Note: may be revisited depending on impact on measurement requirements
* Periodic/Semi-persistent CSI-RS (for L1-RSRP)
* FFS:
  + Periodic/Semi-persistent CSI-RS (for RLM)
  + Periodic/Semi-persistent CSI-RS (for BM, RFD)
  + Periodic/Semi-persistent CSI-RS (for tracking)
* PRS
* PDCCH in USS, if retransmission timer is not running according to TS 38.321
  + FFS: if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation
  + ~~C-RNTI, CS-RNTI(s), MCS-C-RNTI~~
  + ~~SP-CSI-RNTI~~
  + ~~SL-RNTI, SL-CS-RNTI, V-RNTI~~
  + ~~AI-RNTI~~
* PDCCH in Type-3 CSS, if retransmission timer is not running according to TS 38.321
  + FFS: if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation
  + ~~INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, CI-RNTI~~
  + ~~C-RNTI, MCS-C-RNTI, CS-RNTI(s), PS-RNTI~~
  + ~~G-RNTI, G-CS-RNTI~~
  + ~~MCCH-RNTI~~
  + ~~AI-RNTI~~

###### Proposal #4-2A

The following signals/channels assumed by RAN1 to be not transmitted by the UE during cell DRX (if cell DRX information is provided to the UEs). Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.

* Periodic/Semi-persistent CSI report
* Periodic/Semi-persistent SRS
* HARQ feedback for SPS PDSCH
* FFS:
  + HARQ feedback for DG PDSCH

#### [CLOSED-1st Round of Discussions]

Companies are asked to provide comments and inputs on the Proposal #4-1 and #4-2.

##### Issue #1

|  |  |
| --- | --- |
| Company | Comments |
| CMCC | For Periodic/Semi-persistent CSI-RS / SRS/ CSI report, they are related to transmit quality of PDSCH/PUSCH during active period, if long non-active period can be configured for cell DTX/DRX, out of date CSI may reduce the transmit efficiency of both uplink and downlink. So it can up to gNB to configure whether these RS or report are totally skipped or can be allowed with a larger periodicity. |
| Xiaomi | We have the following modification on P #4-1,  For RLM/BM/BFD, we think at least BM/BFD related CSI-RS should be transmitted, since in scell dormancy, the BM/BFD related RS is also transmitted in dormant during. gNB behaviour should be aligned in those two cases.  For the deleted RNTIs, our think is to not transmit all PDCCH in USS/Type #3 CSS, but we are ok to discuss whether some RNTIS are special and should be transmitted. *Proposal #4-1* *The following signals/channels are assumed by RAN1 to be not transmitted by the gNB during cell DTX (if cell DTX information is provided to the Ues). Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.*   * *Periodic/Semi-persistent CSI-RS (for RRM)* * *Periodic/Semi-persistent CSI-RS (for L1-RSRP)* * *~~Periodic/Semi-persistent CSI-RS (for RLM)~~* * *~~Periodic/Semi-persistent CSI-RS (for BM, RFD)~~* * *Periodic/Semi-persistent CSI-RS (for tracking)* * *PRS* * *PDCCH in USS*   + *~~C-RNTI, CS-RNTI(s), MCS-C-RNTI~~*   + *~~SP-CSI-RNTI~~*   + *~~SL-RNTI, SL-CS-RNTI, V-RNTI~~*   + *~~AI-RNTI~~* * *PDCCH in Type-3 CSS*   + *~~INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, CI-RNTI~~*   + *~~C-RNTI, MCS-C-RNTI, CS-RNTI(s), PS-RNTI~~*   + *~~G-RNTI, G-CS-RNTI~~*   + *~~MCCH-RNTI~~*   + *~~AI-RNTI~~*   For P#5-2, we have the following modification,  For HARQ feedback for DG PDSCH, we think it should be transmitted, because it’s gNB’s intention to dynamically scheduling it *Proposal #4-2* *The following signals/channels assumed by RAN1 to be not transmitted by the UE during cell DRX (if cell DRX information is provided to the Ues). Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.*   * *Periodic/Semi-persistent CSI report* * *Periodic/Semi-persistent SRS* * *HARQ feedback for SPS PDSCH*   *~~HARQ feedback for DG PDSCH~~* |
| Spreadtrum | RAN1 only focuses on RS at this stage. PDCCH/PDSCH and other traffic related can be discussed in RAN2. |
| Vivo | **Comment 1**: Clarification on the case proposal #4-1 and proposal #4-2 apply to.  There are the following two cases when cell DTX/DRX information is provided to UE:  Case 1: only cell DTX/DRX is configured and no UE C-DRX is configured  Case 2: both cell DTX/DRX and UE C-DRX is configured.  In our view, UE behavior for Case 1 should be prioritized for discussion. Current proposal #4-1 and proposal #4-2 should be only applied to Case 1 and FFS Case 2.  Besides, “during cell DTX” is better to be changed to a more precise wording, e.g. “during configured non-active period of cell DTX”.  **Comment 2**: For CSI-RS channel in Proposal#4-1, we support to differentiate CSI-RS type for further discussion. It seems missing one type: CSI-RS for channel measurement. Besides, we prefer to adopt similar behavior applied to non-active period of UE C-DRX. In this sense, we don’t support exclude CSI-RS for tracking since it is important for UE to have time and frequency sync.  **Comment 3**: For PDCCH in Proposal#4-1, there is no need to mention search space type. Cell DTX will control PDCCH monitoring of certain RNTI that is similarly with handling of UE C-DRX in Section 5.7 of TS 38.321. Actually, even in CSS, PDCCH by C-RNTI may also exist. In non-active period of cell DTX, this kind of PDCCH can also be excluded. Besides, we think retransmission of failed PDSCH/PUSCH should be considered for PDCCH monitoring.  **Comment 4:** For HARQ feedback for DG PDSCH, we don’t support it is excluded since it is important for UE performance. For HARQ feedback for SPS PDSCH, it may be FFS when there is more details on activation/deactivation of cell DTX/DRX. |
| Apple | **For TRS,** we consider it important for both CONNECTED Ues and IDLE/INACTIVE Ues for R17 power saving Ues, therefore, TRS is still maintained during non-active duration of cell DTX.  **For P/SP CSI-RS,** we consider it necessary for RAN4 to study the impact on measurement latency if P/SP CSI-RS is to be stopped during the non-active duration, an LS to ask RAN4’s input is needed. The reason is as below:  Currently for UE DRX cycles smaller than 320ms, the measurement is relaxed (1.5×Mout×P) due to reason that the CSI-RS transmission periodicity and the DRX cycle are not well aligned (as shown in the left figure of Fig.1). Ideally, the measurement interval would be a lowest common multiple (LCM) of TCSI-RS and TDRX, however, since the delay may be too large if LCM is used, a compromise of 1.5 times of the original defined value was determined. **This compromise was made under the assumption that CSI-RS is always there even when UE DRX is configured.** However, if it is agreed that CSI-RS during cell DTX non-active duration are not transmitted (as shown in the right figure of Fig.1), there is no way for UE to measure during the non-active duration to meet the requirement. This will lead to additional discussions in RAN4 and will increase UE measurement latency. This cannot be easily compromised to a larger number as in UE DRX case since UE can not find a proper CSI-RS to measure in any non-active duration.  图标  描述已自动生成 图标  描述已自动生成  Fig. 1 UE DRX/Cell DTX not aligned with CSI-RS  **For SPS/CG/SR,** can be up to RAN2 since they are already discussing.  **For PDCCH in USS and Type3 CSS,** UE is not expected to monitor as in C-DRX, but the DG scheduling and HARQ based on PDCCH received in ON duration are still allowed.  **For HARQ,** if PDSCH is scheduled based on PDCCH received in ON duration, HARQ is still allowed. For SPS, depending on RAN2 discussion. |
| Fujitsu | For HARQ feedback for DG PDSCH, if DG PDSCH is transmitted during the non-active period of cell DTX, there is no reason to postpone HARQ feedback to the active period. |
| DOCOMO | **Proposal #4-1:**   * For CSI-RS, we support to differentiate CSI-RS type for further discussion, and we are fine to let CSI-RS for tracking and BM be transmitted during non-active duration of cell DTX. * For PDCCH, we don’t think it is necessary to list up RNTIs. Categorization by search space type should be enough. If special handling for some RNTI is supported, UE power consumption may not be reduced as the UE anyway needs to monitor PDCCH in USS/Type-3 CSS for PDCCH scrambled by the special RNTI.   **Proposal #4-2:**   * For HARQ feedback for DG PDSCH, it could be avoided by gNB implementation. |
| Nokia/Nsb | In general, for both proposals, we should make it clear that it is about cell DTX non-active period  Regarding Proposal #4-1   * It is generally fine for us. * Whether or not TRS and/or PRS can be muted during non-active period is debatable.   Regarding Proposal #4-2   * The last two bullet points on HARQ for SPS/DG PDSCH can be removed. As proposed in our Tdoc, we should wait for RAN2 progress on this issue. |
| ZTE, Sanechips | For proposal #4-1:   1. The CSI for channel measurement is missing in the proposal. 2. Till now, we are not sure about the details design of cell DTX/DRX, like the periodicity, the off period, etc. Therefore, we think it is too early to assume some signals/channels is not transmitted/received by the UE. From our perspective, we think we should provide NW the flexibility to decide whether or not to transmit/receive some signal/channel by proper configuration when needed, for example, during long off period. 3. For the PRS, we think it is the PRS for RRC inactive state UEs. 4. For the PDCCH, we think it should be discussed case by case. Furthermore, similar discussion is on-going in RAN2, duplicated discussion should be avoided.   For proposal #4-2:   1. Similar as proposal#4-1, we should provide NW the flexibility to decide whether or not to receive CSI/SRS by proper configuration when needed, for example, during long off period. 2. For the HARQ-ACK information, we think it is important for re-transmission /scheduling latency reduction, it should be allowed during off period. |
| InterDigital | We are generally ok with Proposal #5-1, although we do not see the need to list the RNTIs PDCCH in USS and PDCCH in Type-3 CSS at this stage of discussion. Furthermore, the reception of PDCCH during cell DTX non-active periods are under discussion in RAN2.  On Proposal #4-2, it can be up to gNB to decide whether HARQ feedback for SPS PDSCH and DG PDSCH are excluded during cell DTX non-active periods, e.g. by configuring or indicating a suitable K1 offset value. As such, we think the 2 bullets on HARQ feedback can be removed from Proposal #4-2. |
| Lenovo | Proposal #4-1:   * We prefer to remove CSI-RS for BM and CSI-RS for tracking, since dropping them can have detrimental impact on PDCCH reception * Agree with vivo to add CSI-RS for channel measurement, i.e., not configured with ‘trs-info’ nor ‘repetition’, which can be added to the list of dropped/muted DL signals during cell DTX inactive period   Proposal #4-2:   * SRS configured with usage set to ‘beammanagement’ should not be dropped, other SRS usage scenarios can be dropped * Agee with DOCOMO that HARQ feedback for DG PDSCH during cell DRX non-active period can be avoided via implementation, and hence if configured by the network, it should not be dropped |
| MTK | On Proposal #4-1:  Since TRS and PRS are subject to potential idle/inactive mode UE usage, they should be transmitted during non-active periods of cell DTX/DRX. On the other hand, since TRP and PRS configurations are typically static, BS also has the flexibility to align them with active periods of cell DTX/DRX.  To avoid excess TB delivering delay due to pending retransmissions, ignoring PDCCH should be subject to the condition **no** ReTX timer is running.  By the above, the following revision is suggested:   * Periodic/Semi-persistent CSI-RS (for RRM) * Periodic/Semi-persistent CSI-RS (for L1-RSRP) * Periodic/Semi-persistent CSI-RS (for RLM) * Periodic/Semi-persistent CSI-RS (for BM, RFD) * ~~Periodic/Semi-persistent CSI-RS (for tracking)~~ * ~~PRS~~ * PDCCH in USS, if retransmission timer is not running according to TS 38.321   + C-RNTI, CS-RNTI(s), MCS-C-RNTI   + SP-CSI-RNTI   + SL-RNTI, SL-CS-RNTI, V-RNTI   + AI-RNTI * PDCCH in Type-3 CSS, if retransmission timer is not running according to TS 38.321   + INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, CI-RNTI   + C-RNTI, MCS-C-RNTI, CS-RNTI(s), PS-RNTI   + G-RNTI, G-CS-RNTI   + MCCH-RNTI   + AI-RNTI   On Proposal #4-2:  To avoid system performance impact (e.g., XR capacity loss due to larger packet latency), it is suggested HARQ feedback for DG PDSCH can still be transmitted by UE. Accordingly the following revision is suggested:   * Periodic/Semi-persistent CSI report * Periodic/Semi-persistent SRS * HARQ feedback for SPS PDSCH * ~~HARQ feedback for DG PDSCH~~ |
| Fraunhofer | There is too much on Proposal#4-1 and Proposal#4-2 at the moment. With such wide scope it will be hard to achieve convergence and not overlap with RAN2 discussion.  Therefore, we agree with Spreadtrum it would be better to focus on RSs only in RAN1 for now. For Proposal#4-2 we would agree with Nokia to remove the last 2 bullets and wait for RAN2 on that. |
| Intel | Ok with Proposal 4-1. For P 4-2, we think HARQ feedback for DG PDSCH can be removed, based on similar argument that DG PDSCH and DG PUSCH are excluded and expected to be handled by gNB implementation via dynamic scheduling.  Regarding arguments on removing *Periodic/Semi-persistent CSI-RS (for tracking)*, please note that in Rel-17 availability indication was specified which can be used to turn on/off TRS intended for idle/inactive mode UEs. Hence, impact to idle/inactive mode UEs can be avoided. We support including TRS in the list of impacted signals/channels. |
| Moderator | Updated the Proposal to #4-1A and #4-2B based on feedback received so far. Moderator suggests taking Proposal #4-1A and #4-1B for further discussion in GTW.  If the proposals are not discussed in GTW, then continue email discussion on them. |
| Samsung | We prefer not to define/assume gNB’s behaviour, instead the proposal should focus on UE’s behaviour.  We suggest to change ‘transmitted by the gNB’ to ‘received by a UE’ for Proposal #4-1A  We think Periodic/Semi-persistent CSI-RS (for tracking) should not be impacted considering it is significant for a UE to have good T/F tracking and it can be received by idle/inactive UEs.  We think ‘PDCCH in Type-3 CSS’ is not a spec wording and suggest to use ‘Type-3 PDCCH in CSS’ instead.  We should first focus on cell DTX/DRX only first, the timer related to UE C-DRX should be removed.  HARQ-ACK should not be impacted by cell DRX. For DG HARQ-ACK, there is no reason for UE not to follow the DCI indication in any case. For HARQ-ACK for SPS PDSCHs, if a UE receives a SPS PDSCH, UE should also transmit the HARQ-ACK for the SPS PDSCH, if gNB does not transmit the SPS PDSCH, gNB can skip the decoding of the HARQ-ACK, restricting not transmitting the HARQ-ACK is not necessary and would put additional restrictions for gNB scheduling if gNB would avoid canceling the HARQ-ACK for SPS PDSCHs. Updated Proposal #4-1A The following signals/channels are assumed by RAN1 to be not ~~transmitted by the gNB~~ received by a UE during cell DTX (if cell DTX information is provided to the UEs). Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.   * [Periodic/Semi-persistent CSI-RS (for RRM)]   + Note: may be revisited depending on impact on measurement requirements * Periodic/Semi-persistent CSI-RS (for L1-RSRP) * FFS:   + Periodic/Semi-persistent CSI-RS (for RLM)   + Periodic/Semi-persistent CSI-RS (for BM, RFD)   + Periodic/Semi-persistent CSI-RS (for tracking) * PRS * PDCCH in USS~~, if retransmission timer is not running according to TS 38.321~~   + FFS: if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation   + ~~C-RNTI, CS-RNTI(s), MCS-C-RNTI~~   + ~~SP-CSI-RNTI~~   + ~~SL-RNTI, SL-CS-RNTI, V-RNTI~~   + ~~AI-RNTI~~ * Type 3-PDCCH in ~~Type-3~~ CSS~~, if retransmission timer is not running according to TS 38.321~~   + FFS: if some specific RNTI ~~scrambled PDCCH in Type-3 CSS~~ will be excluded from cell DTX operation   + ~~INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, CI-RNTI~~   + ~~C-RNTI, MCS-C-RNTI, CS-RNTI(s), PS-RNTI~~   + ~~G-RNTI, G-CS-RNTI~~   + ~~MCCH-RNTI~~   + ~~AI-RNTI~~  Updated Proposal #4-2A The following signals/channels assumed by RAN1 to be not transmitted by the UE during cell DRX (if cell DRX information is provided to the UEs). Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.   * Periodic/Semi-persistent CSI report * Periodic/Semi-persistent SRS * ~~HARQ feedback for SPS PDSCH~~ * ~~FFS:~~   + ~~HARQ feedback for DG PDSCH~~ |
| CATT | We don’t agree with the formula in Proposal #4-1A since the spec does not mention that the configured CSI-RS is used for CSI, L3-RSRP for RRM, L1-RSRP for Beam management, and RLM.  For proposal#4-2A, We should add the presumptions that Rel-18 UEs are configured with the physical channels/signals to be transmitted during the inactive time of cell DTX/DRX. Rel-18 UEs are not expected the configured physical channels/signals to be transmitted during the inactive time of the cell DTX/DRX.  Our suggestion of modification is as follows,  Rel-18 UEs are configured with the physical channels/signals to be transmitted during the inactive time of cell DTX/DRX. Rel-18 UEs are not expected the following configured physical channels/signals to be transmitted during the inactive time of the cell DTX/DRX~~. The following signals/channels are assumed by RAN1 to be not transmitted by the gNB during cell DTX (if cell DTX information is provided to the UEs).~~ Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.   * [Periodic/Semi-persistent CSI-RS ~~(for RRM)]~~   + Note: may be revisited depending on impact on measurement requirements * ~~Periodic/Semi-persistent CSI-RS (for L1-RSRP)~~ * ~~FFS:~~    + ~~Periodic/Semi-persistent CSI-RS (for RLM)~~   + ~~Periodic/Semi-persistent CSI-RS (for BM, RFD)~~   + ~~Periodic/Semi-persistent CSI-RS (for tracking)~~ * PRS * PDCCH in USS, ~~if retransmission timer is not running according to TS 38.321~~   + FFS: if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation   + ~~C-RNTI, CS-RNTI(s), MCS-C-RNTI~~   + ~~SP-CSI-RNTI~~   + ~~SL-RNTI, SL-CS-RNTI, V-RNTI~~   + ~~AI-RNTI~~ * PDCCH in Type-3 CSS~~, if retransmission timer is not running according to TS 38.321~~   + FFS: if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation   + ~~INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, CI-RNTI~~   + ~~C-RNTI, MCS-C-RNTI, CS-RNTI(s), PS-RNTI~~   + ~~G-RNTI, G-CS-RNTI~~   + ~~MCCH-RNTI~~   + ~~AI-RNTI~~ |
| Spreadtrum2 | Support current FL’s version. The signals/channels not transmitted by gNB can be added into the list step by step. |
| Futurewei | As per our comments previously, RAN1 should focus at this only on the first two bullets. |

##### Issue #2

Companies are also asked to provide comments on handling of

* HARQ-ACK codebook generation,
* PUCCH deferral operation during cell DRX

|  |  |
| --- | --- |
| Company | Comments |
| Xiaomi | Can be discussed if time budget allows. |
| Nokia/NSB | The impact of cell DTX and cell DRX on existing operations such as HARQ-ACK codebook generation and PUCCH deferral would need to be discussed. Such discussions could be conducted once the impact of cell DTX and DRX is clarified with respect to PDSCH receptions and PUCCH transmissions. |
| ZTE, Sanechips | It depends on the out come of proposal #4-1, 4-2, RAN2 discussion. |
| Fraunhofer | It is better to postpone this discussion until other aspects are more clear. |
| Moderator | Please continue to provide comments on this issue. |
| Samsung | We think these issues should be discussed.  Besides PUCCH repetition (the deferral issue), the PDSCH/PUSCH repetitions should also be discussed in RAN1. UE behavior is different for PDSCH reception/PUSCH transmission with and without repetitions. For example, a UE does not expect a PDSCH without repetition overlapping with semi-static UL symbols but a PDSCH repetition can be canceled by semi-static symbols.  Collision with other channels in case of cell DTX/DRX should also be discussed. For example, in the case below, if multiplexing is performed first, SR is multiplexed in the CSI PUCCH and cannot be transmitted if PUCCH with CSI is agreed to be canceled during non-active time of cell DRX. On the contrary, if CSI is canceled first the SR can be transmitted. The order of multiplexing and cancelling due to cell DRX should be defined. |
| CATT | These could be discussed once we agreed on the Proposal #4-1A and Proposal #4-2 |

#### [CLOSED-2nd Round of Discussions]

Moderator would like to continue the discussion from what was left off from Monday GTW session. Moderator has updated the Proposal slightly based on discussion from GTW in Proposal #4-1B and #4-2B.

##### Issue #1

Companies are asked to provide comments and inputs on the Proposal #4-1B and #4-2B.

Moderator would like companies to discuss and provide input on how we can resolve the FFS. There is only 2 more meetings left, and RAN1 needs to resolve the FFS soon. Therefore, it is critical to figure out how RAN1 can resolve the FFS.

###### Proposal #4-1B

From RAN1 point of view, Rel-18 UE does not expect to receive and/or process the following signals/channels from the gNB, during inactive periods of cell DTX (if cell DTX information is provided to the UEs) and when the UEs are not configured with DRX. Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.

* PDCCH in USS
  + FFS UE behavior when retransmission timer is running according to TS 38.321
  + FFS: if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation
* PDCCH in Type-3 CSS
  + FFS UE behavior when retransmission timer is running according to TS 38.321
  + FFS: if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation
* Periodic/Semi-persistent CSI-RS (for CSI reporting)
* FFS:
  + PRS
  + Periodic/Semi-persistent CSI-RS (for RRM)
  + Periodic/Semi-persistent CSI-RS (for RLM)
  + Periodic/Semi-persistent CSI-RS (for L1-RSRP, L1-SINR)
  + Periodic/Semi-persistent CSI-RS (for BFD)
  + Periodic/Semi-persistent CSI-RS (for tracking)
* FFS whether different UE behavior will be specified when UE is configured with DRX.
* Note: UE to expecting and/or processing signals/channels may be revisited depending on impact on related RAN4 requirements

###### Proposal #4-2B

From RAN1 point of view, Rel-18 UE is not expected to transmit the following signals/channels to the gNB during inactive periods of cell DRX (if cell DRX information is provided to the UEs). Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.

* Periodic/Semi-persistent CSI report
* Periodic/Semi-persistent SRS
* HARQ feedback for SPS PDSCH
* FFS:
  + HARQ feedback for DG PDSCH

|  |  |
| --- | --- |
| Company | Comments |
| ETRI | For Proposal #4-1B, for PDCCH bullets, we prefer to remove “FFS UE behavior when retransmission timer is running according to TS 38.321” since this proposal is for the case where UE C-DRX is not configured and retransmission timer for cell DTX/DRX is not defined yet.  For Proposal #4-2B, we support the proposal. It may be safer to put FFS to the third bullet as well until receiving input from RAN2 about SPS PDSCH behavior. |
| Samsung | The FFS for the timer should be removed because the main bullet is clear UE C-DRX is not configured, there is no timer for cell DTX.  The FFS for L1-RSRP, the hierarchy of the discussion is a bit mixed up. The CSI reporting includes L1-RSRP/SINR as well as other reporting quantities, such as CQI, PMI. If we have ‘Periodic/Semi-persistent CSI-RS (for CSI reporting)’ in the main bullet point, it is understood that L1-RSRP/SINR are included unless otherwise stated while we have separate bullet point in the FFS. Thus, it seems leveling the hierarchy of the discussion seems needed.  Similarly, RLM-RS can be configured for BF detection, RLM purpose, or both. Thus, listing ‘for RLM’ and ‘for BFD’ on the same level makes confusion.  HARQ-ACK for DG PDSCH should be removed, no company requires to keep the HARQ-ACK for DG PDSCH in the first round and a clear majority company requires to remove it, we don’t see the reason why it is still kept in the proposal.  We also prefer to remove the HARQ-ACK for SPS PDSCH, but can live with it for FFS. |
| Qualcomm | For both proposals, we suggest updating “Rel-18 UE” to “Rel-18 UE supporting cell DTX/DRX” since there may have some Rel-18 UEs that do not support this feature.  On Proposal #4-1B, agree with suggestion from ETRI. Furthermore, we suggest removing “and” before “when the UEs are not configured with DRX”.  On Proposal #4-2B, 3rd bullet can be removed or moved to FFS. |
| vivo | For Proposal #4-1B:  **Comment 1**: We suggest to remove PDCCH part since RAN2 is discussing it.  We think the proposal here is not complete for PDCCH, for example in the following cases PDCCH should be monitored:  *- ra-ContentionResolutionTimer* (as described in clause 5.1.5) or *msgB-ResponseWindow* (as described in clause 5.1.4a) is running; or  - a Scheduling Request is sent on PUCCH and is pending (as described in clause 5.4.4 or 5.22.1.5). If this Serving Cell is part of a non-terrestrial network, the Active Time is started after the Scheduling Request transmission that is performed when the *SR\_COUNTER* is 0 for all the SR configurations with pending SR(s) plus the UE-gNB RTT; or  - a PDCCH indicating a new transmission addressed to the C-RNTI of the MAC entity has not been received after successful reception of a Random Access Response for the Random Access Preamble not selected by the MAC entity among the contention-based Random Access Preamble (as described in clauses 5.1.4 and 5.1.4a).  **Comment 2:** Agree with Samsung that Periodic/Semi-persistent CSI-RS (for CSI reporting) includes Periodic/Semi-persistent CSI-RS (for L1-RSRP, L1-SINR). This should be further clarified.  **Comment 3:** For the FFS, suggest to change into the following   * FFS UE behavior when UE is configured with DRX.   For Proposal #4-2B:  **Comment 1:** Same as Proposal #4-1B, when the UEs are not configured with DRX should be added into the main bullet.  **Comment 2:** Suggest to put FFS before HARQ feedback for SPS PDSCH. It is better to be discussed when more details are clear for cell DTX/DRX activation  **Comment 3:** Suggest to remove the final FFS |
| CMCC | For Proposal #4-1B, agree with Samsung for CSI-RS reporting that it also includes L1-RSRP/SINR. We think for CSI-RS for CSI reporting, whether to receive it can base on gNB configuration. Since the periodicity of cell DTX is not clear now, if long inactive period is configured, the transmit efficiency will be reduced without CSI measurement and reporting, especially when the channel changes fast for UE. So the following modification is proposed in blue text,   * PDCCH in USS   + FFS UE behavior when retransmission timer is running according to TS 38.321   + FFS: if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation * PDCCH in Type-3 CSS   + FFS UE behavior when retransmission timer is running according to TS 38.321   + FFS: if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation * Periodic/Semi-persistent CSI-RS (for CSI reporting) based on gNB configuration * FFS:   + PRS   + Periodic/Semi-persistent CSI-RS (for RRM)   + Periodic/Semi-persistent CSI-RS (for RLM)   + Periodic/Semi-persistent CSI-RS (for L1-RSRP, L1-SINR)   + Periodic/Semi-persistent CSI-RS (for BFD)   + Periodic/Semi-persistent CSI-RS (for tracking) |
| ZTE, Sanechips | For proposal #4-1B   * We agree with vivo the PDCCH is being discussed by RAN2, duplicated discussion should be avoided. “when the UEs are not configured with DRX” (i.e., no retransmission timer is configured) in the main bullet is contradictory with “UE behavior when retransmission timer is running according to TS 38.321”. It seems the first FFS is added to address the retranmission issue, therefore, we suggest to make it more generic to include the case “when the UEs are not configured with DRX” * For periodic/Semi-persistent CSI-RS measurement for channel information, we agree with CMCC that it is important for the upcoming scheduling. Dropping all the measurement will impact the scheduling. The suggestion by CMCC is okay for us, i.e., whether to dropping the CSI measurement depends on gNB configuration    Proposal #4-1B From RAN1 point of view, Rel-18 UE does not expect to receive and/or process the following signals/channels from the gNB, during inactive periods of cell DTX (if cell DTX information is provided to the UEs) and when the UEs are not configured with DRX. Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.   * PDCCH in USS   + FFS UE behavior for retransmission ~~when retransmission timer is running according to TS 38.321~~   + FFS: if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation * PDCCH in Type-3 CSS   + FFS UE behavior for retransmission ~~when retransmission timer is running according to TS 38.321~~   + FFS: if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation * Periodic/Semi-persistent CSI-RS (for CSI reporting) based on gNB configuration   For proposal #4-2B   * Similar with CSI measurement/SRS transmission, the CSI report/SRS transmission also needs to be allowed during non-active period for gNB to obtain CSI information. * For HARQ-ACK reporting, we think it should be allowed as well.   Some suggestions are as below. Proposal #4-2B From RAN1 point of view, Rel-18 UE is not expected to transmit the following signals/channels to the gNB during inactive periods of cell DRX (if cell DRX information is provided to the UEs). Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.   * Periodic/Semi-persistent CSI report based on gNB configuration * Periodic/Semi-persistent SRS based on gNB configuration * ~~HARQ feedback for SPS PDSCH~~ * FFS:   + HARQ feedback for DG PDSCH   + HARQ feedback for SPS PDSCH |
| Panasonic | On Proposal #4-1B :   * We agree the update on the main bullet is valid. In our impression, more relaxed wording of “UE is not required to…” or “UE is allowed not to…” may fit better in the style of the current specification describing UE DRX. * The SPS PDSCH should be put into FFS bullet. But we can be okay with the current way if it accommodate majorities’ view, as we see the main bullet explain other channels/signals can be discussed later.   On Proposal #4-2B:   * We agree on the first two bullets. * We are not sure whether specification impact is needed for the last two bullets, as how to handle the SPS and DG PDSCH are not discussed yet when Cell DRX is configured but DL signals/channels can be transmitted. |
| Huawei, HiSilicon | It seems that different companies had different views on this proposal and reaching an agreement seems not possible. Note that in RAN2 there is a premeeting email tried that has started 3 to 3 weeks ago and yet no concrete agreement was reached in this direction.  Hence, to facilitate possible convergence in the next-level discussion, we may first discuss **how serious the impact if cell DTX/DRX inactive periods is on various types of RAN1 signals/channels. What latency/throughput/coverage/etc. impact there is on each consider signal/channel. And based on that if this channel can be exempt from cell DTX/DRX**  From our understanding, Theoretically, cell DTX/DRX inactive time could be applied to all signals and channels since the BS is the master of the communication, However, If the following channels/signals cannot be transmitted during the inactive time of cell DTX/DRX, the impact on the QoS of the UE is serious.   1. CSI-RS for SCell BFR: In current network, UE may not be configured with SSB on SCell. In this case, UE can only perform measurements through the configured CSI-RS. If this kind of signal is impacted by cell DTX inactive time and UE detects beam failure on SCell during the inactive time of Cell DTX, it may failed to choose a candidate beam. 2. SR for SCell BFR: In current spec, when UE starts a BFR procedure on SCell and no UL-SCH resource is available for the transmission of BFR MAC CE, the UE can transmit a SR, which is dedicated for SCell BFR, and wait for UL grant to transmit the related BFR MAC CE. Thus, if this kind of signal is impacted by cell DRX and UE detects beam failure on SCell during the inactive time of Cell DRX, it may failed to transmit the related BFR MAC CE.   C:\Users\j00781913\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\8ED778D0.tmp  Other RAN1 signals/channels, could be added to the above list we started.  We think that from RAN1 perspective, we need to further think the necessity for each exclusion from cell DTX/DRX inactive time signals/channel (especially in low/medium traffic scenario  Then we could send an LS to RAN2 informing them about RAN1 finding. |
| Apple | We share similar view as QC that for the main bullet, it is preferred to modify “Rel-18 UE” to “Rel-18 UE supporting cell DTX/DRX”.  For the listing of CSI-RS, we also see some confusion here, since CSI-RS for L1-RSRP or L1-SINR can be interpreted in multiple ways, either can be used for L1-RSRP or L1-SINR reporting for beam management, or can be used for RLM, BFD, CBD. Our understanding for the CSI-RS (for L1-RSRSP, L1-SINR) under the FFS is to consider the BM case, so we suggest modify it as:   * + Periodic/Semi-persistent CSI-RS (for L1-RSRP or L1-SINR reporting)   For the HARQ feedback for SPS PDSCH, we would also prefer to put it in the FFS, since RAN2 is currently discussing on SPS part. |
| InterDigital | On Proposal #4-2A, we are generally ok with the current list, although we think some clarification as indicated by Samsung is useful on having ‘Periodic/Semi-persistent CSI-RS (for L1-RSRP, L1-SINR)’ in FFS when ‘for CSI reporting’ is in main bullet.  On Proposal #4-2B, we share companies’ view to move HARQ feedback for SPS PDSCH to FFS. We are ok to either removing or keeping in FFS, the HARQ feedback for DG PDSCH. |
| Lenovo2 | **Proposal #4-2B:**  Can we list SRS separately for ifferent usage, e.g., SRS for beam management is listed separately from SRS for antenna switching/codebook/non-codebook? |
| CATT | We don’t agree with the formula in Proposal #4-1A since the spec does not mention that the configured CSI-RS is used for CSI, L3-RSRP for RRM, L1-RSRP for Beam management, and RLM.  For proposal#4-2B, We should add the presumptions that Rel-18 UEs are configured with the physical channels/signals to be transmitted during the inactive time of cell DTX/DRX. Rel-18 UEs are not expected the configured physical channels/signals to be transmitted during the inactive time of the cell DTX/DRX.  Our suggestion of modification is as follows,  Rel-18 UEs are configured with the physical channels/signals to be transmitted during the inactive time of cell DTX/DRX. From RAN1 point of view, Rel-18 UE does not expect to receive and/or process the following signals/channels from the gNB, during inactive periods of cell DTX ~~(if cell DTX information is provided to the UEs)~~ ~~and when the UEs are not configured with DRX~~. Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.   * PDCCH in USS   + FFS UE behavior when retransmission timer is running according to TS 38.321   + FFS: if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation * PDCCH in Type-3 CSS   + FFS UE behavior when retransmission timer is running according to TS 38.321   + FFS: if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation * Periodic/Semi-persistent CSI-RS ~~(for CSI reporting)~~ * FFS:   + PRS   + ~~Periodic/Semi-persistent CSI-RS (for RRM)~~   + ~~Periodic/Semi-persistent CSI-RS (for RLM)~~   + ~~Periodic/Semi-persistent CSI-RS (for L1-RSRP, L1-SINR)~~   + ~~Periodic/Semi-persistent CSI-RS (for BFD)~~   + ~~Periodic/Semi-persistent CSI-RS (for tracking)~~ * FFS whether different UE behavior will be specified when UE is configured with DRX. * Note: UE to expecting and/or processing signals/channels may be revisited depending on impact on related RAN4 requirements  Proposal #4-2B From RAN1 point of view, Rel-18 UE is not expected to transmit the following signals/channels to the gNB during inactive periods of cell DRX (if cell DRX information is provided to the UEs). Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.   * Periodic/Semi-persistent CSI report * Periodic/Semi-persistent SRS * HARQ feedback for SPS PDSCH * FFS:   + HARQ feedback for DG PDSCH |
| Nokia/Nsb | Comments above from companies already captured on what we had in mind, with summary as following:  On Proposal #4-1B   * What exactly the meaning of CSI-reporting needs to be clarified, current wording create confusion * UE behavior with retransmission timer running or not needs to be FFS * “non-active” period instead of “in-active” in the main bullet, to be align with RAN2 terminology * As commented by HW, and also as we commented in 2.6, we may also discuss whether and how the cell DTX/DRX may **impact** legacy procedures like RLM/BFD/BFR.   On Proposal #4-2B  The third bullet should be moved to FFS, and waiting for RAN2 outcome for this issue. |
| Intel | Mostly Ok with the updated proposals, with some changes below. Agree with Samsung that retransmission timer in FFS can be removed. We suggest to include SPS PDSCH and SR to complete the list. If it cannot be agreed, at least it should be kept in FFS. If RAN2 provides further feedback that can be updated later as well. Proposal #4-1B From RAN1 point of view, Rel-18 UE does not expect to receive and/or process the following signals/channels from the gNB, during inactive periods of cell DTX (if cell DTX information is provided to the UEs) and when the UEs are not configured with DRX. The list of signals/channels may be updated based on RAN2 input and other signals/channels are not precluded from further discussions.   * PDCCH in USS   + ~~FFS UE behavior when retransmission timer is running according to TS 38.321~~   + FFS: if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation * PDCCH in Type-3 CSS   + ~~FFS UE behavior when retransmission timer is running according to TS 38.321~~   + FFS: if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation * Periodic/Semi-persistent CSI-RS (for CSI reporting) * SPS-PDSCH * FFS:   + PRS   + Periodic/Semi-persistent CSI-RS (for RRM)   + Periodic/Semi-persistent CSI-RS (for RLM)   + Periodic/Semi-persistent CSI-RS (for L1-RSRP, L1-SINR)   + Periodic/Semi-persistent CSI-RS (for BFD)   + Periodic/Semi-persistent CSI-RS (for tracking) * FFS whether different UE behavior will be specified when UE is configured with C-DRX. * Note: UE on expecting and/or processing signals/channels during inactive periods of cell DTX may be revisited depending on impact on related RAN4 requirements  Proposal #4-2B From RAN1 point of view, Rel-18 UE is not expected to transmit the following signals/channels to the gNB during inactive periods of cell DRX (if cell DRX information is provided to the UEs). The list of signals/channels may be updated based on RAN2 input and other signals/channels are not precluded from further discussions.   * Periodic/Semi-persistent CSI report * Periodic/Semi-persistent SRS * HARQ feedback for SPS PDSCH * SR * FFS:   + HARQ feedback for DG PDSCH |
| Fujitsu | **Proposal #4-1B**  We share with Samsung that the classification of P/SP CSI-RS is confusing. Since CSI-RS for L1-RSRP and L1-SINR are in FFS, we suggest excluding them from CSI reporting to make it clear. We also support Apple’s update regarding CSI-RS for L1-RSRP or L1-SINR reporting. Thus, we propose the following update:   * Periodic/Semi-persistent CSI-RS (for CSI reporting except L1-RSRP or L1-SINR reporting)   **Proposal #4-2B**  We share the similar view with several companies that HARQ feedback for SPS PDSCH can be moved to FFS. |
| China Telecom | We are generally fine with the proposal. and what Nokia/NSB summarized is just what we want to comment. |
| OPPO | For Proposal #4-1B, we prefer the following modification (in blue):  Proposal #4-1B  From RAN1 point of view, Rel-18 UE does not expect to receive and/or process the following signals/channels from the gNB, during inactive periods of cell DTX (if cell DTX information is provided to the UEs) and when the UEs are not configured with DRX. Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.   * PDCCH in USS   + FFS UE behavior when retransmission timer is running according to TS 38.321   + FFS: if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation * PDCCH in Type-3 CSS   + FFS UE behavior when retransmission timer is running according to TS 38.321   + FFS: if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation * Periodic/Semi-persistent CSI-RS (for CSI reporting) * SPS PDSCH * FFS:   + PRS   + Periodic/Semi-persistent CSI-RS (for RRM)   + Periodic/Semi-persistent CSI-RS (for RLM)   + Periodic/Semi-persistent CSI-RS (for L1-RSRP, L1-SINR)   + Periodic/Semi-persistent CSI-RS (for BFD)   + Periodic/Semi-persistent CSI-RS (for tracking) * FFS whether different UE behavior will be specified when UE is configured with DRX. * Note: UE to expecting and/or processing signals/channels may be revisited depending on impact on related RAN4 requirements   In our view, if SPS-PDSCH is activated under cell DTX configuration case, the SPS-PDSCH should be received/processed during active periods and should be muted during inactive periods of the cell DTX.  For Proposal #4-2B, we think all the HARQ feedback should be transmitted timely to ensure data transmission performance. We prefer the following modification (in blue):  Proposal #4-2B  From RAN1 point of view, Rel-18 UE is not expected to transmit the following signals/channels to the gNB during inactive periods of cell DRX (if cell DRX information is provided to the UEs). Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.   * Periodic/Semi-persistent CSI report * Periodic/Semi-persistent SRS * ~~HARQ feedback for SPS PDSCH~~ * ~~FFS:~~   + ~~HARQ feedback for DG PDSCH~~ |
| LG Electronics | We think that a signal/channel to be turned off from the Cell DTX/DRX non-active period can be configured for each signal/channel, as CMCC and ZTE suggested. Also, in our view, we need to discuss whether to allow the transmission of DL or UL signals for an exception case (e.g., C-RNTI monitoring after transmitting beam failure request) during the Cell DTX/DRX non-active period.  For Proposal #4-2B, in general we are OK. But some clarification could be helpful, for HARQ feedback corresponding to SPS PDSCH, if it includes the HARQ-ACK PUCCH in the inactive period for the SPS-PDSCH received in the active period. |
| Ericsson1 | We have below comments for 4-1B.  C-DRX is most used in deployments today, so we prefer to focus on case where UE C-DRX is configured. Suggest removing “when UEs are not configured with DRX” in the main paragraph. If companies want to have separate behavior for UE not configured with DRX, suggest updating the FFS related to DRX as follows “FFS whether different UE behavior will be specified when UE is not configured with DRX.”, otherwise the FFS can be dropped.  Regarding PDCCH, as we mentioned in GTW, PDCCH transmissions can be turned off today already by gNB implementation. If a UE is already configured to monitor PDCCH in type 0/01A/1/2 search spaces in some slots/symbols, we do not see the additional UE power consumption implications if UE monitors PDCCH in USS and Type-3 CSS in such slots/symbols, even during non-active periods. Moreover, since C-DRX is overlaid on top, UE would continue to enjoy power savings based on C-DRX. RAN2 may also be discussing this. Given these reasons, more discussion is needed and the PDCCH parts should be FFS.  We also prefer to leave the last note related to RAN4 requirements out. It is not clear if this is referring to existing RAN4 requirements and if so which ones, or to new RAN4 requirements that may be developed for cell DTX/DRX.  Overall, our suggested updates are as follows. Proposal #4-1B From RAN1 point of view, if cell DTX information is provided to a Rel-18 UE, the Rel-18 UE does not expect to receive and/or process the following signals/channels ~~from the gNB~~, during ~~inactive~~ non-active periods of cell DTX ~~(if cell DTX information is provided to the Ues) and when the Ues are not configured with DRX~~. Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.   * FFS: PDCCH in USS   + FFS UE behavior when retransmission timer is running according to TS 38.321   + FFS: if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation * FFS: PDCCH in Type-3 CSS   + FFS UE behavior when retransmission timer is running according to TS 38.321   + FFS: if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation * Periodic/Semi-persistent CSI-RS (for CSI reporting) * FFS:   + PRS   + Periodic/Semi-persistent CSI-RS (for RRM)   + Periodic/Semi-persistent CSI-RS (for RLM)   + Periodic/Semi-persistent CSI-RS (for L1-RSRP, L1-SINR)   + Periodic/Semi-persistent CSI-RS (for BFD)   + Periodic/Semi-persistent CSI-RS (for tracking) * FFS whether different UE behavior will be specified when UE is not configured with DRX. * ~~Note: UE to expecting and/or processing signals/channels may be revisited depending on impact on related RAN4 requirements~~   For 4-2B,  Suggest similar update as 4-1B. Since SPS PDSCH behavior is TBD, the HARQ feedback behavior should also be FFS. Below are suggested updates. Proposal #4-2B From RAN1 point of view, if cell DRX information is provided to a Rel-18 UE, the Rel-18 UE is not expected to transmit the following signals/channels ~~to the gNB~~ during ~~inactive~~ non-active periods of cell DRX ~~(if cell DRX information is provided to the Ues)~~. Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.   * Periodic/Semi-persistent CSI report * Periodic/Semi-persistent SRS * FFS: HARQ feedback for SPS PDSCH * FFS:   + HARQ feedback for DG PDSCH |
| Xiaomi | Generally fine with the two proposals, and for P#4-1B, we think the yellow part and blue part are overlapping. Only keep one is OK Proposal #4-1B From RAN1 point of view, Rel-18 UE does not expect to receive and/or process the following signals/channels from the gNB, during inactive periods of cell DTX (if cell DTX information is provided to the UEs) and when the UEs are not configured with DRX. Other signals/channels may be added based on RAN2 input and are not precluded from further discussions.   * PDCCH in USS   + FFS UE behavior when retransmission timer is running according to TS 38.321   + FFS: if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation * PDCCH in Type-3 CSS   + FFS UE behavior when retransmission timer is running according to TS 38.321   + FFS: if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation * Periodic/Semi-persistent CSI-RS (for CSI reporting) * FFS:   + PRS   + Periodic/Semi-persistent CSI-RS (for RRM)   + Periodic/Semi-persistent CSI-RS (for RLM)   + Periodic/Semi-persistent CSI-RS (for L1-RSRP, L1-SINR)   + Periodic/Semi-persistent CSI-RS (for BFD)   + Periodic/Semi-persistent CSI-RS (for tracking) * FFS whether different UE behavior will be specified when UE is configured with DRX. * Note: UE to expecting and/or processing signals/channels may be revisited depending on impact on related RAN4 requirements |
| DOCOMO | * Proposal #4-1B   + For main bullet, we share similar view as QC. It is preferred to modify “Rel-18 UE” to “Rel-18 UE supporting cell DTX/DRX”.   + For PDCCH part, we prefer to remove the two FFS. This proposal is for the case where UE C-DRX is not configured and special handling for some RNTIs may lead to UE power consumption.   + For CSI-RS part, we share the same comment as other companies that “for CSI reporting” should be clarified. * Proposal #4-2B   + Basically, we are fine with the proposal, but it is preferred to modify “Rel-18 UE” to “Rel-18 UE supporting cell DTX/DRX”. |
| MTK2 | * From symmetry point of view, it is strange to exclude DRX for DL while no such restriction for UL. From reading the proposal for DL, it looks universal with and without DRX. In this regard, the suggested revision from Ericsson looks reasonable for us. |

##### Issue #2

Continue discussion on the on handling of

* HARQ-ACK codebook generation,
* PUCCH deferral operation during cell DRX

If there is specific proposal that companies would like to get agreement on, please provide the proposal. Moderator will capture the proposal and RAN1 can debate on the proposal for agreement.

|  |  |
| --- | --- |
| Company | Comments |
| CEWiT | The impact of cell DTX and cell DRX on existing operations such as HARQ-ACK codebook generation are needed to be discussed. |
| ETRI | Fine to further discuss Issue #2. |
| Samsung | As we clarified in the first round, collision handling for overlapping channels in case of cell DTX/DRX should also be discussed  We suggest the following update.  Continue discussion on the on handling of   * HARQ-ACK codebook generation, * PUCCH deferral operation during cell DRX * Collisions for overlapping channels during cell DTX/DRX |
| Qualcomm | We suggest adding “PUCCH/PUSCH repetitions” in the list for further discussion.  This issue can be discussed after related issue #1 and RAN2 progress on impacted channels are clear. |
| ZTE, Sanechips | The following two bullets depending on the outcome of other proposals, we suggest to discuss it later or add FFS.  Continue discussion on the on handling of   * FFS: HARQ-ACK codebook generation, * FFS:PUCCH deferral operation during cell DRX |
| CATT | We could discuss these issues after Proposal #4-1B and #4-2B being finalized |
| Nokia/NSB | In addition to HARQ-ACK codebook generation and PUCCH deferral, we think that the joint operation with PUCCH cell switching would also need to be discussed.  We are also fine to consider the suggestions from Samsung and QC, on considering the joint operation with handling overlapping channels and with UL repetitions. |
| LG Electronics | We are fine to further discuss Issue #2. We are also fine to consider the PUSCH/PUCCH repetition suggested by Qualcomm and Nokia. |
| Xiaomi | We support that the impact of cell DTX and cell DRX on existing operations such as HARQ-ACK feedback/ CSI report codebook are needed to be discussed.  We also suggest to add another issue “PUCCH switching to another non active cell” to the list. |
| DOCOMO | This can be discussed after Proposal #4-1B and #4-2B. |
|  |  |

#### == Summary of 2nd Round of Discussions ==

Before summary of 2nd round of discussions are made, moderator would like to inform companies about latest RAN2 agreements on cell DTX/DRX.

**RAN2 Agreements**

1. A periodic cell DTX/DRX configuration is explicitly signalled to the UEs.

2. A periodic cell DTX/DRX pattern is configured by UE specific RRC signalling.

3. The Cell DTX/DRX configuration contains at least: periodicity, start slot/offset, on duration.

4. As a baseline Cell DTX/DRX is activated/deactivated implicitly by RRC signalling, i.e. activated immediately once configured by RRC and deactivated once the RRC configuration is released.

5. From RAN2 point of view, majority companies see a benefit with L1 signalling for Cell DTX/DRX activation/deactivation, send a LS to RAN1 (email 308) with our preference and ask about feasibility and design details. Ask about feasibility and reliability of using L1 signaling. Clarify that the question is about activation/deactivation copy the agreement from last meeting that we are focusing on single configuration. Extract a few key benefits of dynamic signaling from email discussion and online discussions.

6. As baseline, UE doesn’t monitor SPS occasions during Cell DTX non-active period. As baseline, gNB is assumed to be not transmitting PDSCH to that UE on such SPS occasions during the Cell DTX non-active period

7. As baseline, UE does not transmit on CG occasions during Cell DRX non-active periods

Based on comments received moderator has updated Proposal #4-1B and #4-2B.

Moderator has removed the text on if cell DTX/DRX information is provided, since RAN2 has decided that this information will be explicitly signaled by gNB. Moderator also has clarified the CSI-RS configured with tracking or repetition and updated the text on the ambiguity of CSI-RS for CSI report or other purposes.

###### Proposal #4-1C

From RAN1 point of view, Rel-18 UE supporting cell DTX/DRX does not expect to receive and/or process the following signals/channels from the gNB, during non-active periods of cell DTX ~~(if cell DTX information is provided to the UEs) and~~ when the UEs are not configured with DRX. The list of ~~Other~~ signals/channels may be ~~added~~ updated based on RAN2 input and other signals/channels are not precluded from further discussions.

* Periodic/Semi-persistent CSI-RS configured with {trs-Info ‘false’ repetition ‘off’} and associated with CSI report in CSI-ReportConfig (for CSI reporting)
* FFS:
  + PDCCH in USS
    - ~~FFS UE behavior when retransmission timer is running according to TS 38.321~~
    - FFS UE behavior for retransmission
    - FFS if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation
  + PDCCH in Type-3 CSS
    - ~~FFS UE behavior when retransmission timer is running according to TS 38.321~~
    - FFS UE behavior for retransmission
    - FFS if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation
  + PRS
  + ~~Periodic/Semi-persistent~~ CSI-RS configured by measObjectNR (for RRM)
  + Periodic/Semi-persistent CSI-RS associated with RadioLinkMonitoringConfig and BeamFailureDectection (for RLM and BFD)
  + ~~Periodic/Semi-persistent CSI-RS (for L1-RSRP, L1-SINR)~~
  + ~~Periodic/Semi-persistent CSI-RS (for BFD)~~
  + Periodic/Semi-persistent CSI-RS configured with trs-Info ‘true’ (for tracking)
  + Periodic/Semi-persistent CSI-RS configured with repetition ‘on’ (for BM)
* ~~FFS whether different UE behavior will be specified when UE is configured with DRX.~~
* FFS UE behavior when UE is configured with DRX.
* FFS whether there will be exception case(s) for UE receiving and/or processing listed signals/channels during non-active periods of DTX
* [Note: UE ~~to~~ on expecting and/or processing signals/channels during non-active periods of cell DTX may be revisited depending on impact on related RAN4 requirements]

###### Proposal #4-2C

From RAN1 point of view, Rel-18 UE supporting cell DTX/DRX is not expected to transmit the following signals/channels to the gNB during non-active periods of cell DRX ~~(if cell DRX information is provided to the UEs)~~ when the UEs are not configured with DRX. The list of ~~Other~~ signals/channels may be ~~added~~ updated based on RAN2 input and other signals/channels are not precluded from further discussions.

* Periodic/Semi-persistent CSI report based on gNB configuration
* Periodic/Semi-persistent SRS based on gNB configuration
* FFS:
  + HARQ feedback for SPS PDSCH
  + HARQ feedback for DG PDSCH
* FFS whether there will be exception case(s) for UE transmitting listed signals/channels during non-active periods of DRX

Based on comments received moderator has formulated Proposal #4-3.

###### Proposal #4-3

Further study the following in RAN1:

* Handling of HARQ-ACK codebook generation for HARQ-ACK that overlap with cell DTX/DRX non-active periods
* Handling of PUCCH deferral operation during non-active periods of cell DRX
* Handling of collisions for overlapping channels during non-active periods of cell DTX/DRX

#### == Conclusion from Wed GTW Session ==

**Agreement**

From RAN1 point of view, Rel-18 UE supporting cell DTX does not expect to receive and/or process the following signals/channels from the gNB, during non-active periods of cell DTX. The list of signals/channels may be updated based on RAN2/RAN4 input and other signals/channels are not precluded from further discussions.

* Periodic/Semi-persistent CSI-RS configured in CSI report configuration in CSI-ReportConfig with reportQuantity including RI (for CSI reporting)
* FFS:
  + PDCCH in USS
    - UE behavior for retransmission
    - if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation
  + PDCCH in Type-3 CSS
    - UE behavior for retransmission
    - if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation
  + PRS
  + CSI-RS configured by measObjectNR (for RRM)
  + CSI-RS associated with RadioLinkMonitoringConfig and BeamFailureDectection (for RLM and BFD)
  + Periodic CSI-RS configured with trs-Info ‘true’ (for tracking)
  + Periodic/Semi-persistent CSI-RS (for BM)
    - FFS on how to differentiate (if needed) with other CSI-RS used for CSI reports for BM
* FFS: Whether the same or different UE behavior is applicable with or without C-DRX
* FFS: Whether the list of impacted signals/channels can be configurable
* FFS: Whether there will be exception case(s) for UE receiving and/or processing listed signals/channels during non-active periods of DTX
* FFS: RAN1 to consider impact on system if the channels/signals are not transmitted during non-active period

#### [OPEN-3rd Round of Discussions]

Moderator suggests continuing discussion using updated proposal in #4-1C, #4-2C, and #4-3.

Proposal #4-1C (no change marks)

From RAN1 point of view, Rel-18 UE supporting cell DTX/DRX does not expect to receive and/or process the following signals/channels from the gNB, during non-active periods of cell DTX when the UEs are not configured with DRX. The list of signals/channels may be updated based on RAN2 input and other signals/channels are not precluded from further discussions.

* Periodic/Semi-persistent CSI-RS configured with {trs-Info ‘false’ repetition ‘off’} and associated with CSI report in CSI-ReportConfig (for CSI reporting)
* FFS:
  + PDCCH in USS
    - FFS UE behavior for retransmission
    - FFS if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation
  + PDCCH in Type-3 CSS
    - FFS UE behavior for retransmission
    - FFS if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation
  + PRS
  + CSI-RS configured by measObjectNR (for RRM)
  + Periodic/Semi-persistent CSI-RS associated with RadioLinkMonitoringConfig and BeamFailureDectection (for RLM and BFD)
  + Periodic/Semi-persistent CSI-RS configured with trs-Info ‘true’ (for tracking)
  + Periodic/Semi-persistent CSI-RS configured with repetition ‘on’ (for BM)
* FFS UE behavior when UE is configured with DRX.
* FFS whether there will be exception case(s) for UE receiving and/or processing listed signals/channels during non-active periods of DTX
* [Note: UE on expecting and/or processing signals/channels during non-active periods of cell DTX may be revisited depending on impact on related RAN4 requirements]

Proposal #4-2C (no change marks)

From RAN1 point of view, Rel-18 UE supporting cell DTX/DRX is not expected to transmit the following signals/channels to the gNB during non-active periods of cell DRX when the UEs are not configured with DRX. The list of signals/channels may be updated based on RAN2 input and other signals/channels are not precluded from further discussions.

* Periodic/Semi-persistent CSI report based on gNB configuration
* Periodic/Semi-persistent SRS based on gNB configuration
* FFS:
  + HARQ feedback for SPS PDSCH
  + HARQ feedback for DG PDSCH
* FFS whether there will be exception case(s) for UE transmitting listed signals/channels during non-active periods of DRX

Proposal #4-3

Further study the following in RAN1:

* Handling of HARQ-ACK codebook generation for HARQ-ACK that overlap with cell DTX/DRX non-active periods
* Handling of PUCCH deferral operation during non-active periods of cell DRX
* Handling of collisions for overlapping channels during non-active periods of cell DTX/DRX

###### Proposal #4-1D

From RAN1 point of view, Rel-18 UE supporting cell DTX/DRX does not expect to receive and/or process the following signals/channels from the gNB, during non-active periods of cell DTX when the UEs are not configured with DRX. The list of signals/channels may be updated based on RAN2 input and other signals/channels are not precluded from further discussions.

* Periodic/Semi-persistent CSI-RS configured ~~with {trs-Info ‘false’ repetition ‘off’} and associated with~~ in CSI report in CSI-ReportConfig with reportQuantity set to CRI/RI/LI/PMI/CQI (for CSI reporting)
* FFS:
  + PDCCH in USS
    - FFS UE behavior for retransmission
    - FFS if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation
  + PDCCH in Type-3 CSS
    - FFS UE behavior for retransmission
    - FFS if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation
  + PRS
  + CSI-RS configured by measObjectNR (for RRM)
  + Periodic/Semi-persistent CSI-RS associated with RadioLinkMonitoringConfig and BeamFailureDectection (for RLM and BFD)
  + Periodic/Semi-persistent CSI-RS configured with trs-Info ‘true’ (for tracking)
  + Periodic/Semi-persistent CSI-RS ~~configured with repetition ‘on’~~ (for BM)
    - FFS on how to differentiate (if needed) with other CSI-RS used for CSI reports for BM
* FFS UE behavior when UE is configured with C-DRX.
* FFS Whether the list of impacted signals/channels can be configurable
* FFS whether there will be exception case(s) for UE receiving and/or processing listed signals/channels during non-active periods of DTX
* [Note: UE on expecting and/or processing signals/channels during non-active periods of cell DTX may be revisited depending on impact on related RAN4 requirements]

###### Proposal #4-2D

From RAN1 point of view, Rel-18 UE supporting cell DTX/DRX is not expected to transmit the following signals/channels to the gNB during non-active periods of cell DRX when the UEs are not configured with DRX. The list of signals/channels may be updated based on RAN2 input and other signals/channels are not precluded from further discussions.

* Periodic/Semi-persistent CSI report ~~based on gNB configuration~~
* Periodic/Semi-persistent SRS ~~based on gNB configuration~~
  + FFS: SRS for positioning
* FFS:
  + HARQ feedback for SPS PDSCH
  + HARQ feedback for DG PDSCH
* FFS whether there will be exception case(s) for UE transmitting listed signals/channels during non-active periods of DRX
* FFS Whether the list of impacted signals/channels can be configurable by gNB

###### Proposal #4-2E

From RAN1 point of view, Rel-18 UE supporting cell ~~DTX/~~DRX is not expected to transmit the following signals/channels to the gNB during non-active periods of cell DRX ~~when the UEs are not configured with DRX~~. The list of signals/channels may be updated based on RAN2/RAN4 input and other signals/channels are not precluded from further discussions.

* Periodic/Semi-persistent CSI report
* Periodic/Semi-persistent SRS
  + FFS: SRS for positioning
* FFS:
  + HARQ feedback for SPS PDSCH
  + HARQ feedback for DG PDSCH
* FFS whether there will be exception case(s) for UE transmitting listed signals/channels during non-active periods of DRX
* FFS Whether the list of impacted signals/channels can be configurable by gNB
* FFS: Whether the same or different UE behavior is applicable with or without C-DRX
* FFS: RAN1 to consider impact on system if the channels/signals are not transmitted during non-active period

###### Proposal #4-3A

Further study the following in RAN1:

* Handling of HARQ-ACK codebook generation for HARQ-ACK that overlap with cell DTX/DRX non-active periods
* Handling of PUCCH deferral operation during non-active periods of cell DRX
* Handling of collisions for overlapping channels during non-active periods of cell DTX/DRX
* Handling of PUCCH/PUSCH repetition during non-active periods of cell DRX

##### Company Comments – Sub-Discussion #A

Please provide further comments on Proposal ~~#4-1D,~~ #4-2D, #4-3A. Moderator also ask companies to also provide way forward on how RAN1 can further resolve the FFS. There are too many FFS. Ideally, they should be all resolved soon.

**Update:** Please focus the discussion on #4-2E, and #4-3A.

Also please provide comments on how to address the FFS from the agreement made from Wednesday GTW Session.

|  |  |
| --- | --- |
| Company | Comments |
| Qualcomm3 | Thanks a lot FL for great effort and updated proposal.  On #4-1C, we suggest the **following update**:   * Periodic/Semi-persistent CSI-RS configured ~~with {trs-Info ‘false’ repetition ‘off’} and associated with~~ in CSI report in CSI-ReportConfig with *reportQuantity* set to cri/RI/LI/PMI/CQI (for CSI reporting) * FFS   + Periodic/Semi-persistent CSI-RS ~~configured with repetition ‘on’~~ (for BM)   Reason of the update   * It may not be true to use “trs-Info ‘false’ repetition ‘off’” to exclude CSI-RS for beam management since when the setting is provided this way, it is also meant that the gNB transmission beam refinement during BM. The case of “trs-Info ‘false’ repetition ‘on’” only covers UE Rx beam refinement. * There is common framework for CSI report for BM and CSI report for CQI related parameters. To know whether it is for BM or for CQI related, it is based on *reportQuantity* setting. For example, if it is cri-RSRP or ssb-Index-RSRP, the CSI report is for BM. Let’s further discuss CSI-RS for both Tx beam refinement and Rx beam refinement.   On #4-2C, we suggest the **following update**:   * Periodic/Semi-persistent CSI report ~~based on gNB configuration~~   + FFS: whether transmission or not is based on gNB configuration * Periodic/Semi-persistent SRS ~~based on gNB configuration~~   + FFS: whether transmission or not is based on gNB configuration   + FFS: SRS for positioning   We understand the motivation to have configurability for flexibility. However, there is likely to have L1/2 signalling for cell DTX/DRX activation/deactivation. It is not clear whether we need a separate gNB configuration. In the other FFS, we prefer to have FFS for SRS for positioning.  On 4-3, as we commented earlier, we prefer to have further discussion on impact of cell DTX/DRX on PUCCH/PUSCH repetitions. Proposal #4-3 Further study the following in RAN1:   * Handling of HARQ-ACK codebook generation for HARQ-ACK that overlap with cell DTX/DRX non-active periods * Handling of PUCCH deferral operation during non-active periods of cell DRX * Handling of collisions for overlapping channels during non-active periods of cell DTX/DRX * Handling of PUCCH/PUSCH repetition during non-active periods of cell DRX |
| Intel | We suggest following updates to P4-1 and P4-2 (in blue font). We think list of signals/channels that can be impacted can be configurable. It provides better flexibility in achieving trade-off between NES and impact to UE. Also, we think “based on gNB configuration” is not needed. It maybe also possible that UE drops occasions that overlap with non-active period. There is no need to update gNB configuration upon activation of cell DTX/DRX. Proposal #4-1C (no change marks) From RAN1 point of view, Rel-18 UE supporting cell DTX/DRX does not expect to receive and/or process the following signals/channels from the gNB, during non-active periods of cell DTX when the UEs are not configured with DRX. The list of signals/channels may be updated based on RAN2 input and other signals/channels are not precluded from further discussions.   * Periodic/Semi-persistent CSI-RS configured with {trs-Info ‘false’ repetition ‘off’} and associated with CSI report in CSI-ReportConfig (for CSI reporting) * FFS:   + PDCCH in USS     - FFS UE behavior for retransmission     - FFS if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation   + PDCCH in Type-3 CSS     - FFS UE behavior for retransmission     - FFS if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation   + PRS   + CSI-RS configured by measObjectNR (for RRM)   + Periodic/Semi-persistent CSI-RS associated with RadioLinkMonitoringConfig and BeamFailureDectection (for RLM and BFD)   + Periodic/Semi-persistent CSI-RS configured with trs-Info ‘true’ (for tracking)   + Periodic/Semi-persistent CSI-RS configured with repetition ‘on’ (for BM) * FFS UE behavior when UE is configured with C-DRX. * FFS Whether the list of impacted signals/channels can be configurable * FFS whether there will be exception case(s) for UE receiving and/or processing listed signals/channels during non-active periods of DTX * [Note: UE ~~to~~ on expecting and/or processing signals/channels during non-active periods of cell DTX may be revisited depending on impact on related RAN4 requirements]  Proposal #4-2C (no change marks) From RAN1 point of view, Rel-18 UE supporting cell DTX/DRX is not expected to transmit the following signals/channels to the gNB during non-active periods of cell DRX when the UEs are not configured with DRX. The list of signals/channels may be updated based on RAN2 input and other signals/channels are not precluded from further discussions.   * Periodic/Semi-persistent CSI report ~~based on gNB configuration~~ * Periodic/Semi-persistent SRS ~~based on gNB configuration~~ * FFS:   + HARQ feedback for SPS PDSCH   + HARQ feedback for DG PDSCH * FFS whether there will be exception case(s) for UE transmitting listed signals/channels during non-active periods of DRX * FFS Whether the list of impacted signals/channels can be configurable |
| Moderator | Updated proposal based on Qualcomm and Intel comments.  Please provide further comments on Proposal #4-1D, #4-2D, #4-3A.  Since #4-3 seem like further discussion is needed, and its anyway a FFS. Let’s continue discussion using email to stabilize the proposal and even make further progress on the issues. |
| Moderator | **Update:** Please focus the discussion on #4-2E, and #4-3A.  Also please provide comments on how to address the FFS from the agreement made from Wednesday GTW Session. |
| Xiaomi | For #4-3A, about the possible enhancements, we suggest to make the list open and also add our proposal that “PUCCH switching during non-active period to an active cell”, modified as the following, Proposal #4-3A Further study the following in RAN1:   * Handling of HARQ-ACK codebook generation for HARQ-ACK that overlap with cell DTX/DRX non-active periods * Handling of PUCCH deferral operation during non-active periods of cell DRX * Handling of collisions for overlapping channels during non-active periods of cell DTX/DRX * Handling of PUCCH/PUSCH repetition during non-active periods of cell DRX * Handling of PUCCH switching during non-active period to an active cell * Other enhancements are not precluded. |
| Samsung | Regarding the first FFS in the new agreement, a simple and unified solution could be RRC configures whether to receive CSI-RS/PDCCH during non-active time. In addition, it is also beneficial for network scheduling.  C-DRX impact can be discussed later when UE behaviour is clear for cell DTX only.  Regarding Proposal #4-2E, fine in principle except DG HARQ-ACK should be removed. The reasons have been clarified in our previous responses and in our contribution.  Regarding Proposal #4-3A, fine in principle, PDSCH/PDCCH repetitions can also be considered similar as PUCCH/PUSCH. |
| DOCOMO | We are fine with both Proposal #4-2E and #4-3A. |
| vivo | For Proposal#4-2E, we prefer to remove HARQ feedback for DG PDSCH |
| Fraunhofer | We are fine with Proposals #4-2E and #4-3A. |
| Nokia/NSB | It is OK, but isn’t so these two proposals depend on below Sub-Discussion #B?  To our understanding, some of the aspects are overlapped between these two Sub-Discussions. |
| ZTE, Sanechips | For Proposal #4-2E,we support the suggestion by Intel. Moreover, we agree with other companies that “DG HARQ-ACK should be removed”. Furthermore, HARQ feedback for SPS PDSCH should also be removed since RAN2 agreed to drop SPS during nonactive period. For Proposal #4-3A,we think that the handling behaviors are discussed after the impact on signals/channels by cell DTX/DRX is resolved.Moreover, in the 3rd bullet, the handling of collisions for overlapping channels during non-active periods should be clarified. |
| Apple | For Proposal #4-2E, we are fine as it is now and RAN2 is actually going to discuss on PDCCH monitoring, we can wait for their inputl.Fine with #4-3A. For RSs that has RAN4 measurement requirement, we consider it necessary to send an LS to RAN4 to trigger their discussion. RAN1 could provide a list of signals under discussion now and ask if these signals are disabled during non-active periods of cell DTX/DRX, whether a relaxation of measurement requirement is needed and if needed, whether the relaxed requirement can be accepted? |
| Huawei, HiSilicon | For Proposal #4-1D, #4-2E, we are open to discuss the signals/channel in FFS. However, as we discussed in the last round, we may first discuss **how serious the impact if cell DTX/DRX inactive periods is on various types of RAN1 signals/channels. What latency/throughput/coverage/etc. impact there is on each consider signal/channel. And based on that if this channel can be exempted from cell DTX/DRX.** Also, we prefer to have a baseline as a start. With the baseline, we can further think whether some types of signals/channels are configurable, or whether this can be achieved through different cell DTX/DRX patterns. From this aspect, as we proposed before, we need to further think the necessity for each exclusion from cell DTX/DRX inactive time signals/channel, especially in low/medium traffic scenario. The current discussion the Sub-Discussion B can be a good start. |
| Intel | P# 4-2 E looks fine. Ok to remove HARQ-ACK for DG PDSCH from the FFS Ok to study but we suggest to discuss P # 4-3A later after we get a clear idea about the impacted signals/channels. |
| CATT | We are PL with Proposal 4-2E. We are fine to discuss further on Proposal 4-3A |
| Qualcomm4 | We are fine with both proposals |
| CEWiT | We are ok for the Proposals. |
| ETRI | We support both proposals. |
| China Telecom | We support the both proposals. |
| LG Electronics | We are fine with both Proposal 4-2E and Proposal 4-3A. |
| CMCC | For proposal #4-2E, the highlighted FFS, although there are same as the agreed DL proposal, there can be different understanding of this sentence. Since it says the list can be configurable, we don’t think the gNB will configure a list impacted signals/channels. What can be configured is whether the signals/channels is impacted during the non-active periods, so we propose the following modification in blue text. Proposal #4-2E From RAN1 point of view, Rel-18 UE supporting cell ~~DTX/~~DRX is not expected to transmit the following signals/channels to the gNB during non-active periods of cell DRX ~~when the UEs are not configured with DRX~~. The list of signals/channels may be updated based on RAN2/RAN4 input and other signals/channels are not precluded from further discussions.   * Periodic/Semi-persistent CSI report * Periodic/Semi-persistent SRS   + FFS: SRS for positioning * FFS:   + HARQ feedback for SPS PDSCH   + HARQ feedback for DG PDSCH * FFS whether there will be exception case(s) for UE transmitting listed signals/channels during non-active periods of DRX * FFS Whether the above listed ~~of impacted~~ signals/channels are impacted or not can be configurable by gNB * FFS: Whether the same or different UE behavior is applicable with or without C-DRX * FFS: RAN1 to consider impact on system if the channels/signals are not transmitted during non-active period |
| Ericsson2 | Regarding 4-2E , we are OK.  Regarding 4-3A, we prefer to first focus on channels/signals and conditions under which they may be impacted. |

##### Company Comments – Sub-Discussion #B

Moderator would like to use this section to get a room temperature of whether we can resolve certain FFS during this meeting.

Please provide inputs on each signal/channel whether they can be disabled during non-active periods of cell DTX or DRX.

* DL
  + PDCCH in USS
  + PDCCH in Type-3 CSS
  + PRS
  + CSI-RS configured by measObjectNR (for RRM)
  + Periodic/Semi-persistent CSI-RS associated with RadioLinkMonitoringConfig and BeamFailureDectection (for RLM and BFD)
  + Periodic/Semi-persistent CSI-RS configured with trs-Info ‘true’ (for tracking)
  + Periodic/Semi-persistent CSI-RS (for BM)
* UL
  + SRS for positioning
  + HARQ feedback for SPS PDSCH
  + HARQ feedback for DG PDSCH

Please comment for each signal/channel. Moderator would like to use the following input to also discuss the blacklist signal/channel from disablement during non-active periods of cell DTX/DRX. ***Please directly edit the following table:***

|  |  |  |
| --- | --- | --- |
| **DL Signal/Channel** | **Poll of Company Views**  **Channels disabled during non-active periods of cell DTX?** | **Notes:** |
| *example* | *Yes: CompanyA, CompanyB, …*  *No: CompanyC, …* | *<CompanyB : add description of the specific notes that they would like to highlight>*  *<CompanyC: add description of the of the specific notes that they would like to highlight>*  *…* |
| PDCCH in USS | **Yes: Xiaomi, Samsung, Nokia/Nsb, Apple, Huawei/Hisi, Intel, CATT, Qualcomm, China Telecom, CMCC,ZTE/ Sanechips**  **No: Ericsson2(FFS)** | vivo: handling of special case such as retransmission, contention resolution timer running and etc. should be discussed  Nokia/NSB: Dynamic scheduling can be always avoided by network implementation  Intel: While it is true that gNB can turn off dynamic transmissions any time, it is essential to have common understanding for both gNB and UE, otherwise UE will waste power for nothing if gNB intends to observe NES.  CMCC: we notice that MCS-RNTI is not included in the impacted RNTI for UE C-DRX, whether they can be monitored during cell DTX/DRX can be discussed, since it may be used by URLLC services.  Ericsson2: Can proponents explain how this help with NW energy savings compared to what is currently supported? |
| PDCCH in Type-3 CSS | **Yes: Xiaomi, Samsung, Nokia/Nsb, Apple, Intel, CATT, Qualcomm, CMCC**  **No:**  **Yes or No: Huawei/HiSi, Ericsson2(FFS), ZTE/ Sanechips(FFS if PDCCH in type-3 CSS is used for cell DTX/DRX activation, or other DCI, like DCP)** | vivo: handling of special case such as retransmission, contention resolution timer running and etc. should be discussed separately  Nokia/NSB: Dynamic scheduling can be always avoided by network implementation  Huawei/Hisi: We understand the purpose that cell DTX/DRX impact these channels/signals. However, it seems that the search space related to group-common L1 signaling is totally blocked during the inactive time of Cell DTX with this proposal. We may need to further think about the impact to section 2.2.  CMCC: whether exceptions is allowed can be further discussed, since the PDCCH format for L1 activation/deactivation signalling is not decided yet.  Ericsson2: Can proponents explain how this help with NW energy savings compared to what is currently supported? |
| PRS | **Yes: Xiaomi, Samsung, Intel, CATT, China Telecom, LG Electronics**  **No: vivo, Qualcomm (when PRS is used for positioning purpose), Ericsson2 (FFS since used also by idle/inactive UEs)**   * FFS: when PRS is used for R17 propagation delay compensation purpose | vivo: PRS can be used for idle and inactive UE  Nokia/NSB: “Yes or No” may depend on how much positioning accuracy is allowed to be compromised.  Apple: RAN4 input needed  Intel: Agree with Nokia, however network could make on/off configurable so that it can be enabled when some loss in accuracy can be tolerated  Qualcomm:   * Dropping PRS reduces positioning accuracy and latency. If the UE requests the positioning before or during the cell DTX non-active time, the time to the first positioning fix will be longer. For positioning update, PRS dropping means less samples for averaging; hence impacting positioning accuracy. * It should also be noted that the UE may be configured with PRS at the serving cell (by *nr-dl-PRS-PDC-Info* in *ServingCellConfig*) for R17 propagation delay compensation. For this PRS type, we are open to discuss possibility of dropping it.   China Telecom: in our understanding, the cell DTX/DRX mainly aims at the low burden network, where the positioning may not be an important issue. Therefore, we think the PRS can be muted. |
| CSI-RS configured by measObjectNR (for RRM) | **Yes: Xiaomi, Samsung, Nokia/Nsb, Apple, Intel, CATT, Qualcomm (with some additional consideration), China Telecom, LG Electronics, Ericsson2(OK if configurable), ZTE/ Sanechips(OK if configurable)**  **No:** | vivo: RAN4 involvement may be needed  Nokia/NSB: it is not needed if no transmission is expected during non-active period  Apple: RAN4 input needed, where we could ask RAN4 to check whether a relaxation of measurement requirement is needed and whether the relaxed requirement can be accepted?  Intel: The applicability of cell DTX should be per cell. Therefore, the disablement should only apply to serving cell. The applicability for non-serving cell CSI-RS for mobility should be left FFS.  Qualcomm: neighbor cells may not support cell DTX/DRX or support cell DTX/DRX but cell DTX/DRX is not activated. One of the following should be considered when dropping CSI-RS based RRM   * **Option 1**: The UE is provided with cell DTX configurations associated with the cells that UE performs RRM measurement. * **Option 2**: gNB further indicates a subset of the cell DTX non-active time for RRM measurement.   LG Electronics: The gNB can separately configure/indicate the RS signals to be monitored for each time period, for example, in the Cell DTX inactive period, SSB can be configured to be used for BFR/RRM/RLM while CSI-RS is configured in Cell DTX active period. |
| CSI-RS associated with RadioLinkMonitoringConfig and BeamFailureDectection (for RLM and BFD) | **Yes: Samsung, CATT, Qualcomm (for RLM), LG Electronics, Ericsson2(OK if configurable), ZTE/ Sanechips(OK if configurable)**  **No: Xiaomi, Huawei/Hisi(partly), Qualcomm (for BFD),** | vivo: RAN4 involvement may be needed  Nokia/NSB: For a long non-active period, the CSI-RS measurement on RLM and BFD can be impacted, could there be a relaxation of RAN4 measurement requirement in such non-active period allowed? If yes, then there can be still CSI-RS transmission but with longer periodicity compared with active period.  Apple: RAN4 input needed, where we could ask RAN4 to check whether a relaxation of measurement requirement is needed and whether the relaxed requirement can be accepted?  Huawei/Hisi: We think for SpCell, since UE can perform measurement through SSB, these types of signal can be impacted by cell DTX/DRX; But for SCell, especially for BFR(or known as CBD), associated CSI-RS should be excluded.  Intel: RAN4 involvement maybe needed  Qualcomm: The discussion seems focusing on the CSI-RS that is shared for both RLM and BFD. However, we should also discuss the case where the CSI-RS is not shared.  LG Electronics: The gNB can separately configure/indicate the RS signals to be monitored for each time period, for example, in the Cell DTX inactive period, SSB can be configured to be used for BFR/RRM/RLM while CSI-RS is configured in Cell DTX active period.  CMCC: we are ok for RAN4 involvement to reduce impact on normal transmission, and share similar view with Nokia that longer period can be considered during non-active period, which can be configurable by gNB |
| Periodic CSI-RS configured with trs-Info ‘true’ (for tracking) | **Yes: Intel, CATT, China Telecom, Ericsson2**  **No: Samsung, vivo, Apple, Huawei/Hisi, Qualcomm (when the signal is not configured for R17 propagation delay compensation purpose), CMCC**   * FFS: when the signal is configured for R17 propagation delay compensation purpose | <Nokia/NSB: To our understanding based on discussions, with no TRS transmission at all can be issues in practice as commented by companies.  With one alternative as an example, we could allow to have longer TRS transmission periodicity during non-active period compared with active period. And we are open to discuss other alternatives.  Huawei/Hisi: In Rel-17 WID for UE power saving, it was mentioned that potential TRS/CSI-RS occasion(s) available in connected mode may be reused for idle/inactive-mode UEs. Therefore, it is recommended that cell DTX not affect this type of CSI-RS.  Intel: For idle/inactive mode UEs, impact can be avoided by use of availability indication. For connected mode UEs, UE may receive TRS in next active period first before receiving scheduling grant and data. So we do not see any critical impact.  Qualcomm: Some reasons to not drop TRS:   * The UE is not able to perform T/F tracking and AGC adjustment based on TRS before PDCCH monitoring. Hence, it impacts PDCCH/PDSCH reception performance and UE power consumption. Note that SSB based T/F tracking is not good enough due to narrow BW, sparse transmission and possible SSB collision across cells. Furthermore, based on analysis in TR 38.940, using TRS instead of SSB for receiving PDCCH/PDSCH can save 19%-38% UE power consumption (although the analysis was for paging, it is also true for any PDCCH/PDSCH reception in general). Hence, dropping TRS removes UE power savings gain that TRS brings. * TRS is typically shared across UEs in the cell in practical implementation although it is a UE-specific signal. In addition, there are R18 UEs that are incapable of supporting cell DTX/DRX feature. If the R18 UEs incapable of the feature share TRS with the R18 UEs capable of the feature, TRS can’t be dropped due to spec-incompliant impact to feature-incapable R18 UEs. On the other hand, if the R18 UEs incapable of the feature do not share TRS with the R18 UEs capable of the feature, the gNB needs to send separate TRS for different R18 UE types, consuming more network power. * Idle mode UEs are not able to use R17 TRS feature for improving T/F tracking for paging reception – @**Intel**: This is less important than two other points. * It should be noted that the UE may be configured with TRS for R17 propagation delay compensation i.e., CSI-RS resource set *NZP-CSI-RS-ResourceSet* with *trs-info* set to *true* and with *pdc-info-r17* set to *true*. For this TRS type, we are open to discuss possibility of dropping it.   China Telecom: we share the similar with Intel, especially for the Periodic TRS. |
| Periodic/Semi-persistent CSI-RS (for BM) | **Yes: Samsung, vivo, Intel, CATT, China Telecom, Ericsson2(if configurable)**  **No: Qualcomm** | Nokia/NSB: UEs can be moving during non-active period. If there is no CSI-RS for BM at all, the BM can be impacted. If “No” is to be agreed, then we need to find solution to tackle the impact due to no CSI-RS BM transmissions.  Apple: RAN4 input needed, where we could ask RAN4 to check whether a relaxation of measurement requirement is needed and whether the relaxed requirement can be accepted?  Qualcomm: The UE performs beam management for beam refinement based on CSI-RS before PDCCH monitoring. Hence, dropping CSI-RS impacts PDCCH reception performance  CMCC: configurable by gNB can be considered if totally not transmitted will affect system performance. |
| *<list any other signal channel that should be discussed>* | **Yes:**  **No:** |  |
| **UL Signal/Channel** | **Poll of Company Views**  **Channels disabled during non-active periods of cell DRX?** | **Notes:** |
| SRS for positioning | **Yes: Xiaomi, Samsung, Intel, CATT, China Telecom, LG Electronics**  **No: vivo, Qualcomm, Ericsson2(FFS positioning impact)** | Nokia/NSB: “Yes or No” may depend on how much positioning accuracy is allowed to be compromised.  Apple: RAN4 input needed, where we could ask RAN4 to check whether a relaxation of measurement requirement is needed and whether the relaxed requirement can be accepted?  Qualcomm: If the signal is dropped, there will be no SRS based positioning to be supported during non-active time of cell DRX. This significantly impacts user experience especially when the non-active time of cell DRX is long. |
| HARQ feedback for SPS PDSCH | **Yes: Xiaomi, Nokia/NSB, Intel, CATT, China Telecom, LG Electronics, CMCC**  **No: Samsung, Ericsson2 (FFS),ZTE/Sanechips** | vivo: This could be FFS.  Nokia/NSB: Based on latest RAN2 agreement, if there is no SPS PDSCH during non-active period, then there is no point for such HARQ feedback for SPS PDSCH  Apple: Agree with Nokia  LG Electronics: If the SPS-PDSCH is turned off in the Cell DTX non-active period, it can be automatically configuring to turn off together. In addition, it may be necessary to discuss whether or not to allow PUCCH transmission for SPS-PDSCH received just before the non-active period.  Ericsson2: consider the case of SPS PDSCH received inside cell active period and feedback occasion overlaps with cell inactive period. |
| HARQ feedback for DG PDSCH | **Yes: CATT**  **No: Xiaomi, Samsung, vivo, Intel, China Telecom, Ericsson2, ZTE/Sanechips** | Nokia/NSB: To our knowledge, the RAN2 has the corresponding discussion on whether the DG PDSCH should be transmitted or not. RAN1 should wait on RAN2 outcome on this matter.  Apple: Agree with Nokia  Ericsson2: UE should provide feedback as requested in DCI. |
| *<list any other signal channel that should be discussed>* | **Yes:**  **No:** |  |

## 2.5 Combining Spatial/Power Domain Enhancement with cell DTX/DRX enhancements

* [4] Nokia/NSB
  + Proposal 13: Enhancement on cell DTX/DRX mechanism can be jointly considered with adaptation of spatial and power domain techniques.
* [17] Samsung
  + Proposal 10: Support joint operation of cell DTX/DRX and NES spatial/power domain techniques.

#### Summary of Issues

Few companies suggested that enhancements for cell DTX/DRX mechanism can be jointly considered with adaptation of spatial and power domain techniques. Further clarification and discussion on what would be the specification common framework that would support both spatial/power adaptation and cell DTX/DRX will look like is likely needed

#### Suggestions for further Discussions

Moderator suggest discussing other aspects first, while RAN1 make further progress on the feature framework for spatial and power domain enhancements. Once some agreements on spatial and power domain enhancements are made, RAN1 could further discuss on methods to potentially combine cell DTX/DRX related operations with spatial/power domain enhancements.

#### [CLOSED-1st Round of Discussions]

Companies are asked to provide comments on combining the cell DTX/DRX operations with spatial and power domain techniques. Moderator will take the inputs and suggestions and create a formal proposal (with proposal #) for conclusion and/or agreement.

|  |  |
| --- | --- |
| Company | Comments |
| Spreadtrum | No. Separate discussion is better for now. |
| Apple | Agree with FL’s suggestion. We don’t see the need or benefits to combine them now. These two schemes can work independently well. |
| DOCOMO | Agree with FL’s suggestion. |
| Nokia/Nsb | From signalling aspect, the cell DTX/DRX pattern(s) can be associated with different spatial/power domain pattern(s). And even for the active-period or non-active-period of a given DTX/DRX pattern, the associated spatial/power domain pattern(s) can be also varied, e.g. compared with active period, much less spatial elements could be turned-on during non-active period for better energy saving.  Furthermore, considering of the active-period of cell DTX, there can be different partitions in time associated with different spatial patterns to be specified. |
| ZTE, Sanechips | It can be discussed later when the solutions to spatial/power domain adaptation, cell DTX/DRX are clear. |
| Lenovo | Prefer to deprioritize until further progress is made on the two agendas |
| MTK | For UE point of view, if there is a unified L1 adaptation framework for NES adaptations, it implies lowest UE implementation and verification effort. On the other hand, if majority companies think to separately make mature the features of the two agenda item under 9.7, we can go with this direction as well. Yet, a final unified indication design for NES is still our best preference. |
| Futurewei | Support FL’s suggestion. |
| Fraunhofer | It is better to consider the solutions separately for now until they are more clear. If they start to converge/overlap, then it would be a good time to propose joint operation. |
| Intel | We think the solutions can be independently developed. If any interactions need to be discussed, that can be done later. |
| Moderator | Please continue to provide comments on this issue. |
| Samsung | We are fine to deprioritize the issue for this meeting, but we think the issue should be discussed when the details of both features become clearer. |
| CEWiT | Separate discussion is better for now |
| ETRI | This issue can be discussed later after more progress is achieved in the two NES AIs. |
| CMCC | We also think the common framework is not clear now. For spatial/power domain, we are discussion the CSI resource/report configuration, CSI feedback, and adaption signalling, which of those enhancement can be applied to cell DTX/DRX is not clear, is it mean the adaption signalling? |
| Panasonic | Agree with FL that we should focus on other topics for now. |
| ITRI | We are fine with FL’s suggestion. |
| Lenovo2 | This issue is also discussed in agenda 9.7.1. Can the moderators coordinate with the chairman on how this can be handled to avoid duplicate discussion/effort? |
| CATT | WE believe separate discussion would be sufficient. |
| China Telecom | We agree with FL that it shouldn’t be discussed at the current stage. |
| OPPO | We prefer to have separate discussion. |
| LG Electronics | Agree with FL’s suggestion. We don’t see the need to combine them at this stage. |
| Ericsson1 | Regarding joint operation between cell DTX/DRX and spatial/power domain, these are separate features and should be operable independently. RAN1 should first focus on defining functionality for the respective objectives - we do not prefer linking them pre-maturely. |

#### == Summary of 1st Round of Discussions ==

Majority of the companies agree with moderator that joint framework design between spatial/power domain enhancements and cell DTX/DRX operation can be put on hold until design for each enhancements have progressed further.

Please note that given that same issues are being discussed in agenda 9.7.1 as well, RAN1 may need to coordinate which agenda item this issue will be discussed in.

#### [ON HOLD-Next Round of Discussions]

Discussion on joint framework design between spatial/power domain enhancements and cell DTX/DRX operation are deferred until further notice.

## 2.6 Any Other Issues

#### [CLOSED-1st Round of Discussions]

Companies are asked to provide comments on any other issues that need to be discussed in RAN1 that is not correctly reflected in the discussion summary above. Moderator will take the inputs and suggestions and create a formal proposal (with proposal #) for conclusion and/or agreement.

|  |  |
| --- | --- |
| Company | Comments |
| Nokia/Nsb | Apart from what have been discussed above, we may discuss whether and how the cell DTX/DRX may impact legacy procedures like RLM/BFD/BFR. |
| Moderator | Please continue to provide comments on this issue. |
| Samsung | The joint operation of cell DTX/DRX and existing collision handling should be discussed. As we clarified under Issue#2, the different order of cancelling the channel/signal transmissions/receptions due to cell DTX/DRX and performing the existing collision handling would have different results. The UE behaviour should be defined for these cases. |

#### == Summary of 1st Round of Discussions ==

Nokia has commented that further discussion on cell DTX/DRX impact to RLM/BFD/BFR procedure should be discussed.

Samsung has commented on further discussion of channel collusions, moderator has added this to proposal #4-3.

###### Proposal #6-1

Further study the following in RAN1:

* Potential UE behavior changes to RLM, BFD, and BFR when cell DTX/DRX is configured and enabled by the gNB.

#### [OPEN-3rd Round of Discussions]

Please provide comments on Proposal #6-1 from Nokia.

Beyond Proposal #6-1, moderator asks companies to provide further comments on any other proposal (not part of discussions above) that they would like to discuss and agree to.

|  |  |
| --- | --- |
| Company | Comments |
| Xiaomi | Generally fine with the proposal |
| Samsung | Fine |
| DOCOMO | Fine |
| Fraunhofer | We are fine with proposal #6-1 |
| ZTE, Sanechips | It can be discussed when the FFSs are resolved in the agreements regarding channel/signal transmission during cell DTX inactive period. |
| Apple | Support |
| Intel | This maybe discussed after signals/channels under Sub-Discussion #B is confirmed? |
| Qualcomm4 | We can discuss this proposal later when we have clear understandings on how channels are impacted. For example, if CSI-RS for BM/BFD is not dropped, the related part of proposal is not needed. In another, if CSI-RS for RLM is dropped, it should be fine since SSB based RRM is sufficient and CSI-RS based RLM is not currently supported in field. |
| InterDigital | Agree with Intel and QC to discuss defer this proposal to later discussion |
| LG Electronics | We are fine with the proposal. And as for QC's comments, we think the current specification may be enough, but it may not be, so further discussion is necessary anyway. |
| CMCC | Similar view as Qualcomm that this proposal will be more clear when proposals in section 2.4 is settled. |
| Ericsson2 | Not needed - we prefer to first focus on which/how channels/signals are impacted. |

# List of Moderator Proposals for Conclusion/Agreement

# List of Conclusions/Agreements from RAN1 #112-bis-e

**Agreement**

From RAN1 point of view, Rel-18 UE supporting cell DTX does not expect to receive and/or process the following signals/channels from the gNB, during non-active periods of cell DTX. The list of signals/channels may be updated based on RAN2/RAN4 input and other signals/channels are not precluded from further discussions.

* Periodic/Semi-persistent CSI-RS configured in CSI report configuration in CSI-ReportConfig with reportQuantity including RI (for CSI reporting)
* FFS:
  + PDCCH in USS
    - UE behavior for retransmission
    - if some specific RNTI scrambled PDCCH in USS will be excluded from cell DTX operation
  + PDCCH in Type-3 CSS
    - UE behavior for retransmission
    - if some specific RNTI scrambled PDCCH in Type-3 CSS will be excluded from cell DTX operation
  + PRS
  + CSI-RS configured by measObjectNR (for RRM)
  + CSI-RS associated with RadioLinkMonitoringConfig and BeamFailureDectection (for RLM and BFD)
  + Periodic CSI-RS configured with trs-Info ‘true’ (for tracking)
  + Periodic/Semi-persistent CSI-RS (for BM)
    - FFS on how to differentiate (if needed) with other CSI-RS used for CSI reports for BM
* FFS: Whether the same or different UE behavior is applicable with or without C-DRX
* FFS: Whether the list of impacted signals/channels can be configurable
* FFS: Whether there will be exception case(s) for UE receiving and/or processing listed signals/channels during non-active periods of DTX
* FFS: RAN1 to consider impact on system if the channels/signals are not transmitted during non-active period

# Reference

1. R1-2302334, “Cell DTX/DRX for NES,” FUTUREWEI
2. R1-2302338, “Cell DTX/DRX mechanism for network energy saving,” Huawei, HiSilicon
3. R1-2302390, “Cell DTX/DRX enhancement for network energy saving,” Panasonic
4. R1-2302394, “Enhancements on cell DTX/DRX mechanism,” Nokia, Nokia Shanghai Bell
5. R1-2302499, “Discussions on enhancements on cell DTX/DRX mechanism,” vivo
6. R1-2302562, “Discussion on enhancements on cell DTX/DRX mechanism,” OPPO
7. R1-2302614, “Discussion on enhancements on cell DTXDRX mechanism,” Spreadtrum Communications
8. R1-2302717, “DTX/DRX for network Energy Saving,” CATT
9. R1-2302747, “Cell DTX/DRX Configuration for Network Energy Saving,” NEC
10. R1-2302810, “Discussion on enhancements on cell DTX/DRX mechanism,” Intel Corporation
11. R1-2302913, “Discussion on cell DTX/DRX mechanism,” Fujitsu
12. R1-2302945, “Discussion on cell DTX/DRX,” ZTE, Sanechips
13. R1-2302996, “Discussions on cell DTX-DRX for network energy saving,” xiaomi
14. R1-2303025, “Discussion on enhancements on cell DTX/DRX mechanism,” InterDigital, Inc.
15. R1-2303031, “Discussion on mechanism of cell DTX/DRX for network energy saving,” China Telecom
16. R1-2303057, “Network Energy Saving on Cell DTX and DRX,” Google
17. R1-2303142, “Enhancements on cell DTX/DRX mechanism,” Samsung
18. R1-2303203, “Enhancements on cell DTX/DRX mechanism,” ETRI
19. R1-2303248, “Discussion on cell DTX DRX enhancements,” CMCC
20. R1-2303310, “Discussion on cell DTX/DRX mechanism for network energy saving,” CEWiT
21. R1-2303345, “On NW energy saving enhancements for cell DTX/DRX mechanism,” MediaTek Inc.
22. R1-2303380, “Discussion on Enhancement on cell DTX DRX mechanism,” Transsion Holdings
23. R1-2303427, “Discussion on cell DTX/DRX mechanism,” LG Electronics
24. R1-2303497, “Discussion on cell DTX/DRX mechanisms,” Apple
25. R1-2303532, “Enhancements on cell DTX/DRX mechanism,” Lenovo
26. R1-2303604, “Enhancements on cell DTX and DRX mechanism,” Qualcomm Incorporated
27. R1-2303647, “Discussion on cell DTX/DRX mechanism,” Rakuten Mobile, Inc
28. R1-2303723, “Discussion on enhancements on Cell DTX/DRX mechanism,” NTT DOCOMO, INC.
29. R1-2303758, “RAN1 aspects of cell DTX/DRX,” Ericsson
30. R1-2303781, “Discussion on potential enhancements on cell DTX/DRX mechanism for NR,” ITRI
31. R1-2303815, “RAN1 Considerations for Cell DTX and DRX,” Fraunhofer IIS, Fraunhofer HHI