**3GPP TSG-WG2 #**

**Bengaluru, India, 25 - 29 August 2025**

**Agenda item: 8.4.1**

**Source: Apple**

**Title: Collection of comments and Open issues to 38.321 CR for LP-WUS**

**WID/SID: NR\_LPWUS-Core – Release 19**

**Document for: Discussion and Decision**

# 1 Introduction

This is a summary document on collection of comments to TS 38.321 CR for LP-WUS during below running CR discussion:

* [Post130][213][LPWUS] Running CR for 38.321 (Apple)

Intended outcome: Updated and reviewed the CR for endorsement, update the open issue list if needed, can also discuss open issues to form proposals to the next meeting

Companies are invited to provide comments/additional issues in the below table by 31st July, 2025.

# 2 Collection of comments

Please provide your comments in below table, and Rapporteur will response. Please do not insert any comments in running CR directly, which is hard for Rapporteur to follow all comments.

|  |  |  |
| --- | --- | --- |
| **Company** | **Detailed comments** | **Rapporteur response** |
| vivo #1 | **CR:**  1> if DCP monitoring is configured for the active DL BWP as specified in TS 38.213 [6], clause 10.3, or if LP-WUS monitoring is configured as specified in TS 38.213 [6], clause 10.X; and  1> if the current symbol n occurs within *drx-onDurationTimer* duration; and  1> if *drx-onDurationTimer* associated with the current DRX cycle is not started as specified in this clause:  2> if the MAC entity would not be in Active Time considering *lpwus-PDCCHMonitoringTimer* is not running (if configured)/grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause; and  **Comment:** for Option 1-2, when LP-WUS is received and *lpwus-PDCCHMonitoringTimer* is indicated to be started, the MAC entity would also be in Active Time, which should be excluded for the case of “ MAC entity would not be in Active Time”. The corresponding change is made above. | Add the following bullet to address this issue:  2> if the MAC entity would not be in Active Time considering LP-WUS indication received but the associated lpwus-PDCCHMonitoringTimer is not running (if configured); and  New update in v16\_Rapp(r1)   * Use wording suggested by IDCC to address this issue. |
| Huawei #1 | We have some sympathy on vivo’s comment #1, for LP-WUS case, *lpwus-PDCCHMonitoringTimer* impacting the Active time should also be considered.  However, we understand the previous intention of the text is for 4ms ambiguity period due to DCI/MAC CE/SR, but for the running timer of *lpwus-PDCCHMonitoringTimer*, do we still need to consider 4ms ambiguity period, since the current sentence is “considering *lpwus-PDCCHMonitoringTimer is not running* (if configured) until 4 ms prior to symbol n…”?  Another way may be “2> if the MAC entity would not be in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to symbol n, or LP-WUS received (if configured) until X prior to symbol n, when evaluating all DRX Active Time conditions as specified in this clause; and”. X is UE’s transition time from LP-WUS reception to PDCCH monitoring. No very strong view, the detailed wording can be further discussed. | Add the following bullet to address this issue:  2> if the MAC entity would not be in Active Time considering LP-WUS indication received but the associated lpwus-PDCCHMonitoringTimer is not running (if configured); and  New update in v16\_Rapp(r1)   * Use wording suggested by IDCC to address this issue. |
| Huawei #2 | Editorial (naming):  *lpwus-PDCCHMonitoringTimer in RRC spec 🡺 lpwus-PDCCH-MonitoringTimer* | Updated in latest version. |
| Huawei #3 | Editorial:  2> else if LP-WUS monitoring is configured:  3> if *lpwus-PDCCHMonitoringTimer* is not configured:  4> if LP-WUS indication associated with the current DRX cycle received from lower layer indicated to start *drx-onDurationTimer*, as specified in TS 38.213 [6]; or  Proposed Change:  4> if LP-WUS indication associated with the current DRX cycle received from lower layer indicate~~d~~s to start *drx-onDurationTimer*, as specified in TS 38.213 [6]; or  Editorial: same changes as above.  1> if LP-WUS monitoring is configured and the *lpwus-PDCCHMonitoringTimer* for this DRX group is configured  2> if LP-WUS indication is received from lower layer indicated to start *lpwus-PDCCHMonitoringTimer*, as specified in TS 38.213 [6]:  3> start *lpwus-PDCCHMonitoringTimer* from the beginning of the subframe indicated from lower layer.  Proposed change:  2> if LP-WUS indication is received from lower layer indicate~~d~~s to start *lpwus-PDCCHMonitoringTimer*, as specified in TS 38.213 [6]: | Updated in latest version. |
| Eri #1 | Concerning vivo #1 and Huawei #1:  In case a correction is made, it should be here in our view:  1> if *drx-onDurationTimer* associated with the current DRX cycle is not started as specified in this clause or *lpwus-PDCCHMonitoringTimer* is not started as specified in this clause:  2> if the MAC entity would not be in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause; and  The DCP processing time is also not include in the ambiguity for the Active Time. | Add the following bullet to address this issue:  2> if the MAC entity would not be in Active Time considering LP-WUS indication received but the associated lpwus-PDCCHMonitoringTimer is not running (if configured); and |
| Eri #2 | The UE can receive LP-WUS indication when either option 1-1 or 1-2 are configured:  - *lpwus-PDCCHMonitoringTimer* (optional): the duration of the UE's PDCCH monitoring activity for the MAC entity after receiving the LP-WUS indication and *lpwus-PDCCHMonitoringTimer* is configured. | Add “ LP WUS Option 1-2 ” to clarify the timer is used in Option 1-2.   * *lpwus-PDCCHMonitoringTimer* (optional): the duration of the UE's PDCCH monitoring activity for the MAC entity after receiving the LP-WUS indication in LP-WUS Option1-2.   In addition, as nowhere to describe the LP-WUS Option 1-1 and Option 1-2, but the term is used for the parameter description, the following brief description on these two options are added in this section.  *DRX functionality can be configured with LP-WUS. There are two LP-WUS options to control the UE’s PDCCH monitoring activity. In LP-WUS Option 1-1, if the MAC entity does not receive a LP-WUS indication from lower layer, it does not monitor the PDCCH during the next occurrence of the on-duration. In LP-WUS Option 1-2, if the MAC entity receives a LP-WUS indication from lower layer, after a time offgset it starts a PDCCH monitoring timer for UE’s PDCCH monitoring.* |
| Eri #3 | On initial reading this is a bit confusing:  2 else if LP-WUS monitoring is configured:  3> if *lpwus-PDCCHMonitoringTimer* is not configured  Not sure if this improves it? Maybe the existing wording is fine:  2 else if LP-WUS monitoring (*LPWUS-Config*) is configured:  3> if *lpwus-PDCCHMonitoringTimer* is not configured | For DCP configuration, we use “ if DCP monitoring is configured” to describe it.  In the same way, for LP-WUS configuration, we use “if LP-WUS monitoring is configured”. |
| Eri #4 | Add for this DRX group below:  1> if the Long DRX cycle is used for a DRX group and the *drx-NonIntegerLongCycleStartOffset* is not configured, and [(SFN × 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset*; or  1> if the Long DRX cycle is used for a DRX group and the *drx-NonIntegerLongCycleStartOffset* is configured, and floor([(*DRX\_SFN\_COUNTER* × 10240) + (SFN × 10) + subframe number] modulo (*drx-NonIntegerLongCycle*)) = *drx-StartOffset*:  2> if DCP monitoring is configured for the active DL BWP as specified in TS 38.213 [6], clause 10.3:  3> if DCP indication associated with the current DRX cycle received from lower layer indicated to start *drx-onDurationTimer*, as specified in TS 38.213 [6]; or  3> if all DCP occasion(s) in time domain, as specified in TS 38.213 [6], associated with the current DRX cycle occurred in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to start of the last DCP occasion, or during a measurement gap, or when the MAC entity monitors for a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* of the SpCell identified by the C-RNTI while the *ra-ResponseWindow* is running (as specified in clause 5.1.4); or  3> if *ps-Wakeup* is configured with value *true* and DCP indication associated with the current DRX cycle has not been received from lower layers:  4> start *drx-onDurationTimer* after *drx-SlotOffset* from the beginning of the subframe.  2> else if LP-WUS monitoring is configured:  3> if *lpwus-PDCCHMonitoringTimer* is not configured:  4> if LP-WUS indication associated with the current DRX cycle received from lower layer indicated to start *drx-onDurationTimer*, as specified in TS 38.213 [6]; or  4> if all LP-WUS monitoring occasion(s) in time domain, as specified in TS 38.213 [6], associated with the current DRX cycle occurred in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to start of the last LP-WUS occasion, or during a measurement gap, or when the MAC entity monitors for a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* of the SpCell identified by the C-RNTI while the *ra-ResponseWindow* is running (as specified in clause 5.1.4):  5> start *drx-onDurationTimer* for this DRX group after *drx-SlotOffset* from the beginning of the subframe.  2> else:  3> start *drx-onDurationTimer* for this DRX group after *drx-SlotOffset* from the beginning of the subframe.  1> if LP-WUS monitoring is configured and the *lpwus-PDCCHMonitoringTimer* for this DRX group is configured  2> if LP-WUS indication is received from lower layer indicated to start *lpwus-PDCCHMonitoringTimer*, as specified in TS 38.213 [6]:  3> start *lpwus-PDCCHMonitoringTimer* from the beginning of the subframe indicated from lower layer. | Added.  “5> start *drx-onDurationTimer* for this DRX group after *drx-SlotOffset* from the beginning of the subframe.” |
| IDCC #1 | Wrt. vivo #1, Huawei #1, and Eri #1, we don’t fully understand why would we not add a separate condition for the  *lpwus-PDCCHMonitoringTimer*?  Our proposal would be:  1> if DCP monitoring is configured for the active DL BWP as specified in TS 38.213 [6], clause 10.3, or if LP-WUS monitoring is configured as specified in TS 38.213 [6], clause 10.X; and  1> if the current symbol n occurs within *drx-onDurationTimer* duration; and  1> if *drx-onDurationTimer* associated with the current DRX cycle is not started as specified in this clause:  2> if the MAC entity would not be in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause; and  2> if *allowCSI-SRS-Tx-MulticastDRX-Active* is not configured, or if *cfr-ConfigMulticast* is not configured for any of the active BWP(s) of the Serving Cell(s), or if all multicast DRXes would not be in Active Time considering multicast assignments/DRX Command MAC CE for MBS multicast received until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in Clause 5.7b and all multicast sessions are configured with multicast DRX; and  2> if *lpwus-PDCCHMonitoringTimer* is not running:  3> not transmit periodic SRS and semi-persistent SRS defined in TS 38.214 [7];  (…)  “not running” obviously covers also the case the timer is not configured. | New update in v16\_Rapp(r1)  Agree that adding a new condition would be simpler and clearer.  In v1 version, I add a new condition to describe the case. And I think your suggested wording is much more concise.   * Use wording suggested by IDCC to address this issue. |
| IDCC #2 | 1> if LP-WUS monitoring is configured and the *lpwus-PDCCHMonitoringTimer* for this DRX group is configured  2> if LP-WUS indication is received from lower layer indicated to start *lpwus-PDCCHMonitoringTimer*, as specified in TS 38.213 [6]:  3> start *lpwus-PDCCHMonitoringTimer* from the beginning of the subframe indicated from lower layer.  Do you think we would support a scenario where the  *lpwus-PDCCHMonitoringTimer* is configured for the other DRX group but not the other? It seems such a scenario was not included in the agreement we made.  Hence, we would prefer to remove the “for this DRX group”. Another option is of course to write in RRC field description that the timer needs to be configured in both DRX groups in case it is configured for one. | New update in v16\_Rapp(r1)  “For this DRX group” is to indicate the  *lpwus-PDCCHMonitoringTimer* is applied per DRX group.  If the different timer value is allowed for different DRX group (open issue1-3), the timer applied on each DRX group is with different value;  If the same time value is for both DRX groups, the timer applied on each DRX group is with same value. |
|  |  |  |
|  |  |  |
|  |  |  |

# 2 Open issue list

Followings are the Editor’s NOTE in the running CR.

|  |
| --- |
| Editor’s NOTE: The parameter name may be further updated to align with the name used in RRC specification.  <Dual DRX group>  Editor’s NOTE: FFS whether *lpwus-PDCCHMonitoringTimer* is configured per DRX group or common to DRX groups.  Editor’s NOTE: The case where *lpwus-PDCCHMonitoringTimer* is not configured includes legacy DRX operation and LP-WUS option 1-1, but not LP-WUS option 1-2.  <Option 1-1>  Editor’s NOTE: The case where LP-WUS monitoring is configured without *lpwus-PDCCHMonitoringTimer* is LP-WUS Option 1-1.  Editor’s NOTE: The DRX operation in LP-WUS Option 1-1 takes DCP description as baseline.  Editor’s NOTE: The working assumption for UE operation under collision for Option 1-1 needs to be confirmed.  <Option 1-2>  Editor’s NOTE: The case where *lpwus-PDCCHMonitoringTimer* is configured is LP-WUS Option 1-2.  Editor’s NOTE: The LP-WUS based DRX model is that LP-WUS monitoring and sending LP-WUS indication (together with the timepoint to start timer in Option 1-2) to MAC is captured in RAN1 spec (38.213), and the DRX operation based on the LP-WUS indication is captured in MAC spec.  Editor’s NOTE: The relationship between UE's LP-WUS monitoring and DRX active time is assumed to be reflected in RAN1 spec (38.213), so we will not capture this part in MAC spec.  Editor’s NOTE: FFS in Option 1-2 whether the UE should start the *lpwus\_PDCCHMonitoringTimer* (as if LP-WUS was detected) when the UE is not able to monitor the LP-WUS occasion(s). |

The following RAN2 progress needs further confirmation.

|  |
| --- |
| **RAN2#129bis progress**   * Working assumption for the case of potential collision (if any): In Option 1-1, when the UE is not able to monitor the LP-WUS occasion(s) the UE should start the drx-OnDurationTimer (as if LP-WUS was detected). FFS for Option 1-2. |
| **RAN2#130 progress**   * Working assumption: LP-WUS can be configured on the PCell with secondary DRX. LP-WUS with secondary DRX is supported with option 1-1 and 1-2, i.e. the UE monitors LP-WUS before the on-duration occasion or periodically outside ActiveTime. When LP-WUS is detected, then UE starts the drx-onDurationTimer (with option 1-1) or the lpwus-PDCCHMonitoringTimer (with option 1-2) in both DRX groups. * Check whether we need to capture in MAC that UE is not expected to monitor LP-WUS if not in Cell DTX active period. |

According to the EN list in running CR, and the RAN2 working assumptions for further confirmation, MAC open issues can be summarized as follows:

* Open issue 1: Support of LPWUS with dual DRX group.
* Open issue 2: UE operation for potential collision.
* Open issue 3: MAC spec impact to support the LP-WUS in Cell DTX operation.

In addition to the above 3 Open issues, please provide your comments on any other MAC specific open issues for discussion in the table.

|  |  |  |
| --- | --- | --- |
| **Company** | **Open issue** | **Rapporteur response** |
| vivo | FFS whether to start or restart the *bwp-InactivityTimer* when UE receives the LP-WUS for PDCCH monitoring. | It’s not the essential issue and may need to be discussed in RAN1.  **Issue: The impact to the BWP switching mechanism**  **Issue Type:** not essential  **How to address it:** can be discussed based on companies’ contribution |
| vivo | For LP-WUS option 1-2, whether only one LP-WUS cycle is supported or two LP-WUS cycle, e.g. long LP-WUS cycle and short LP-WUS cycle are supported. | It’s optimization.  **Issue: Whether to consider the multiple LP-WUS cycles?**  **Issue Type:** not essential  **How to address it:** can be discussed based on companies’ contribution |
| Huawei | FFS whether UE can switch from LR to MR if it detects LR link quality is not good enough, and inform it to the gNB.  Many papers raised one issue that if the UE detects LR link quality is not good enough, UE can switch to MR and inform it to the gNB. In connected state, the gNB only knows the measurement results from MR based on existing RRC measurement report. Sometimes even when the MR measurement is good, the link quality of LR can be bad due to the weaker tolerance for adjacent-channel interference for LR. That’s why in idle/inactive, we introduce MR and LR based threshold. Both connected and idle/inactive should share the same logic. | There is no link quality of LR supported in CONNECTED LP-WUS, and the fallback mechanism was not agreed in RAN1 discussion.  Regarding the need to have the UAI for LP-WUS usage preference, it’s like the optimization, and can be discussed if RAN2 have time.  **Issue: UAI of the LP-WUS preference**  **Issue Type:** not essential  **How to address it:** can be discussed based on companies’ contribution |
| Huawei | FFS whether the transition time from LR to MR is aware or transparent to MAC, and how to know it (if needed).  Based on this Editor’s NOTE:  The LP-WUS based DRX model is that LP-WUS monitoring and sending LP-WUS indication (together with the timepoint to start timer in Option 1-2) to MAC is captured in RAN1 spec (38.213), and the DRX operation based on the LP-WUS indication is captured in MAC spec.  For LP-WUS triggered, the transition time seems transparent to MAC, MAC starts the *lpwus-PDCCHMonitoringTimer* based on PHY indication. However, to UL data triggered case, there is the case MAC needs to determine the SR occasion or RACH occasion, MAC needs to avoid the overlap between SA/RACH occasions and transition time, otherwise, the MAC indicates PHY to transmit SR or preamble but actually PHY cannot successfully send it.    Thus, MAC needs to know when the MR is ready, e.g., 1) MAC knows how long the transition time is, or 2) MAC knows when MR is ready based on PHY indication. | For UL data trigger case, UE will initiate SR/RACH transmission via MR, so it’s reasonable that UE MAC will find the 1st available SR occasion or RACH occasion when MR is ready.  And it should not be affected by the CONNECTED LP-WUS operation.  If any clarification is needed, we can confirm that the available UL occasions (e.g. SR occasion, RACH occasion, CG occassion) are MR-ready occasions.  **Proposal: RAN2 confirm that the available UL occasions (e.g. SR occasion, RACH occasion, CG occasion) are MR-ready occasions.** |
| Qualcomm | FFS on how to support monitor switching between LR and MR. This should guarantee there is no PDCCH monitoring missed. | UE is in DRX active time for UE’s PDCCH monitoring activity. The switching time considered in LP-WUS based operation has already considered in the time-offset configuration.  For the common PDCCH monitoring (e.g. RACH), if UE intends to monitor and receive it, UE implementation will wakeup MR and there seems no impact on the specified procedure. |
| Qualcomm | RAN2 should clarify whether UE monitors paging using legacy paging or using LP-WUS monitor as IDLE state if the UE is in CONNECTED state. If using LP-WUS monitor, UE needs to support monitor two different LP-WUS signalling, UE may not have such capability. | In CONNECTED mode, the LP-WUS is only used to control the UE’s PDCCH monitoring activity, not for paging reception.  For CONNECTED UE, it’s UE implementation to select the PO for the paging reception in order to acquire the SI change notification information. And CONNECTED UE should not be required to monitor LP-WUS for this type’s paging reception. |
| CATT | When LP-WUS is not monitored during Cell DTX inactive time, whether to start the next *drx-onDurationTimer* for Option 1-1 or *lpwus-PDCCHMonitoringTimer* for Option 1-2 during Cell DTX active time. | According to RAN1 agreement, UE is not expected to monitor LP-WUS in CDRX inactive time.  In other words, network implementation should not transmit the LP-WUS during CDRX inactive time. And no other spec effort is needed. |
|  |  |  |

**Summary**

**Proposal X1: RAN2 to consider the following open issues related to MAC for CONNECTED LP-WUS operation.**

|  |  |  |
| --- | --- | --- |
| **Index** | **Issue description** | **Rapporteur suggestion** |
| MAC-X1 | **The impact to the BWP switching mechanism** | **Issue Type:** not essential  **How to address it:** can be discussed based on companies’ contribution |
| MAC-X2 | **Whether to consider the multiple LP-WUS cycles?** | **Issue Type:** not essential  **How to address it:** can be discussed based on companies’ contribution |
| MAC-X3 | **UAI of the LP-WUS preference** | **Issue Type:** not essential  **How to address it:** can be discussed based on companies’ contribution |

**Proposal X2: RAN2 confirm that the available UL occasions (e.g. SR occasion, RACH occasion, CG occasion) are MR-ready occasions.**

# 3 Discussion of the Open issues

## Open issue 1: Support of LP-WUS with dual DRX group

There are three sub-issues:

* + Issue 1-1: Confirm the RAN2 WF or not?
  + Issue 1-2: If supported, whether to monitor LP-WUS on PCell if the secondary DRX group is in DRX active time?
  + Issue 1-3: If supported, for option 1-2, is lpwus-PDCCHMonitoringTimer configured per DRX group or common for both groups?

Open issue 1-1: Confirm to support the LP-WUS with dual DRX group.

RAN2 made the following working assumption to support the LP-WUS with dual DRX group in RAN2#130 meeting.

As no concerns were raised during the online discussion, Rapporteur think that we can confirm it and discuss the details.

**Proposal 1: Confirm the following working assumption to support LP-WUS with dual DRX group.**

|  |
| --- |
| **RAN2#130 progress**   * Working assumption: LP-WUS can be configured on the PCell with secondary DRX. LP-WUS with secondary DRX is supported with option 1-1 and 1-2, i.e. the UE monitors LP-WUS before the on-duration occasion or periodically outside ActiveTime. When LP-WUS is detected, then UE starts the drx-onDurationTimer (with option 1-1) or the lpwus-PDCCHMonitoringTimer (with option 1-2) in both DRX groups. |

**Companies are invited to provide comments on whether to agree the proposal 1.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments, if any** |
| OPPO | Yes | Support of LP-WUS with dual DRX group would be beneficial for UE power saving. |
| vivo | See comments | Supporting LP-WUS with dual DRX group may need more discussion on multiple details in both RAN1 and RAN2, e.g. whether *lpwus-PDCCHMonitoringTimer* on two DRX groups are same or different, how to ensure minimum offset for both FR1 and FR2 if FR1 and FR2 have different numerology (this is also related to RAN1), whether to monitor LP-WUS in one carrier if it is active time in another carrier, etc.  Besides, RAN1 has agreed that UE is not able to operate LR and MR simultaneously in Rel-19. Thus, LP-WUS cannot be monitored in case UE is in active time in any DRX group. With this, the benefit for LP-WUS in dual DRX becomes very margin.  Considering this WI in RAN1 has already completed, and only one meeting is left in RAN2, we prefer not to support LP-WUS with dual DRX group in last minutes. |
| Huawei | Yes |  |
| NEC | Yes | The NW could configure dual DRX groups when the offset is suitable for both FR1 and FR2 cell groups, i.e., it is up to NW implementation.  Therefore in order to support dual DRX, I guess we need to further consider issue 1-2 and 1-3 listed by rapporteur below. |
| LGE | Yes |  |
| Ericsson | Yes | Agree with NEC that the NW can configure a suitable time offset for both FR1 and FR2. |
| Lenovo | Yes |  |
| Samsung | Yes |  |
| DOCOMO | Yes |  |
| CATT | Yes | We share the sympathy with vivo that there may be some issues raised by supporting LP-WUS with dual DRX group. But we agree with NEC that some of the issues have been covered by the following open issues or by proper network configuration. |
| Apple | Yes |  |
| IDCC | Yes |  |

**Summary: Almost all companies agree to confirm the working assumption.**

**Proposal 1: Confirm the following working assumption to support LP-WUS with dual DRX group.**

Open issue 1-2: If supported, whether to monitor LP-WUS on PCell if the secondary DRX group is in DRX active time?

If the secondary DRX group is not configured, UE only monitor LP-WUS when UE is not in DRX active time.

With the secondary DRX group configuration, there is a new case that the default DRX group (including PCell) is not in DRX active time, but the secondary DRX group is in DRX active time.

For this new case, there are three options:

* Option 1: UE monitors LP-WUS when both DRX groups are not in DRX active time;
* Option 2: UE monitors LP-WUS when the default DRX group is not in DRX active time and secondary DRX group is in DRX active time.

According to the following RAN1#121 agreement which is indicated in RAN1 LS (R1-2504888), UE is not able to operate LR and MR simultaneously in Rel-19, which means UE cannot monitor LP-WUS and PDCCH at the same time.

|  |
| --- |
| **RAN1 Agreement:**  As the reply to RAN2 LS in R1-2503616, RAN1 assumes that UE is not able to operate LR and MR simultaneously in Rel-19. RAN1 understanding is that the terminology of LR and MR operations are for discussion purpose and will not be specified   * LR operation is the UE operation for LP-WUS monitoring * MR operation is the UE operation for all other NR signals/channels transmissions/receptions in connected mode |

Therefore, if the secondary DRX group is in active time, UE will monitor PDCCH on MR, and UE cannot monitor LP-WUS on LR simultaneously.

**Observation: According to RAN1 agreements, UE cannot monitor LP-WUS and PDCCH simultaneously.**

Based on the RAN1 agreements and the observation, if secondary DRX group is configured, UE cannot monitor LP-WUS when any DRX group is in DRX active time. We can only go for Option 1.

**Proposal 2: If secondary DRX group is configured, UE monitors LP-WUS only when both DRX groups are not in DRX active time.**

**Companies are invited to provide comments on whether to agree proposal 2.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments, if any** |
| OPPO | Yes |  |
| Vivo | Yes | According to RAN1 agreement, proposal 2 is the only way. |
| Huawei | Yes | Agree with vivo. |
| NEC | Yes | This is based on RAN1 agreement. And further consideration is that if any one of DRX group is in active time overlapping with LP-WUS monitoring, the collision handling described as below open issue 2 can be applied, i.e., when the UE is not able to monitor LP-WUS, the UE can start active timer. |
| LGE | Yes |  |
| Ericsson | Yes | This is a corner case, i.e. typically FR2 (secondary DRX group) is configured with a shorter inactivity timer than FR1 and FR2 is not in AT when FR1 is outside AT.  Agree with NEC that the general rule applies that when the UE is not able to monitor LP-WUS then the UE enters AT, i.e. starts *lpwus-PDCCHMonitoringTimer*. |
| Lenovo | Yes |  |
| Qualcomm | No | I understand RAN1 agreement is applicable for same frequency band. For different frequency bands cases, e.g. FR1-FR2 DC, CA with dual groups, there would be two separate receivers. So it is possible that UE operates on LR and MR on different bands. RAN1 will continue to discuss UE capabilities in DC/CA.  For dual DRX group, it is assumed to be used in FR1 an FR2, then it is possible that LR is only supported on one band and MR is used on another band.  [Rapp] There is no restriction for this RAN1 agreement.  [Qualcomm] If RAN1 working assumption also covers different bands, then the working assumption has collision with RAN2 agreement that LP-WUS in MCG and SCG can be configured independently. In DC, it is impossible that MN and SN coordinate scheduling to avoid LR and MR operate simultaneously.  Easy way for RAN2 is: Following RAN2 agreements on DC, RAN2 assumes RAN1 assumption is only applied for single frequency band and complete RAN2 work. Send LS for RAN1 confirmation.  For 2 DRX group, option 2 is easier and more beneficial. For option 1, UE has to wait for non-active time on both DRX groups, UE power saving will be lost if one DRX group has always data transmission and always in active time.  New update in v16\_Rapp(r1)  [Rapp]  The LP-WUS DRX operation is different in CA and DC.  In DC, DRX operation of MCG and SCG is independent due to different MAC entities; if the UE has the capability, LP-WUS can be configured on both CGs, and in this case, the DRX operation based on LP-WUS can be assumed to be independent for each CG/MAC entity.  But in CA, there is only one MAC entity and LP-WUS can only be configured on PCell, so the LP-WUS based DRX operation is not independently per DRX group in CA.  Based on QC’s concern, we can update the summary as below:  1) Regarding RAN1 agreement on not supporting simultaneous LR and MR operation, check with RAN1 whether it is applicable to DC or CA, and whether it has any impact on per CG DRX operation.  2) For the proposal 2 in the discussion, RAN2 can continue the discussion based on company view. |
| Samsung | Yes |  |
| DOCOMO | Yes |  |
| CATT | Yes |  |
| Apple | Yes |  |
| IDCC | Yes |  |

**Summary:**

**Except for one company, all other companies agreed proposal 2.**

**Regarding the RAN1 agreement on not supporting simultaneous LR and MR operation, further check with RAN1 whether the agreement is applicable to DC and CA, and whether it has any impact on per CG DRX operation.**

**Proposal 2: If secondary DRX group is configured, UE monitors LP-WUS only when both DRX groups are not in DRX active time. (NOTE: One company has concern)**

**Proposal 2a: If secondary DRX group is configured, UE monitors LP-WUS only when both DRX groups are not in DRX active time. Regarding the RAN1 agreement on not supporting simultaneous LR and MR operation, further check with RAN1 whether the agreement is applicable to DC and CA, and whether it has any impact on per CG DRX operation.**

Open issue 1-3: If supported, for option 1-2, is *lpwus-PDCCHMonitoringTimer* configured per DRX group or common for both groups?

In legacy dual DRX group configuration, the *drx-onDurationTimer* and *drx-InactivityTimer* can be configured with different values for two DRX groups, and the value for the secondary DRX group should be smaller than that for the default DRX group.

A screenshot of a computer

AI-generated content may be incorrect.

For the LP-WUS configuration with the secondary DRX group configuration, according to the existing configuration, in Option 1-1, the *drx-onDurationTimer* configuration and the restriction for dual DRX groups should be kept.

* The *drx-onDurationTimer* configuration for secondary DRX group is smaller than that for the default group.

For Option 1-2, the same principle should be also applied for *lpwus-PDCCHMonitoringTimer* configuration.

* The *lpwus-PDCCHMonitoringTimer* configuration for secondary DRX group is smaller than that for the default group.

**Proposal 3: If secondary DRX group is configured, the *lpwus-PDCCHMonitoringTimer* configuration for secondary DRX group is different from that for the default DRX group.**

**Proposal 3a: The *lpwus-PDCCHMonitoringTimer* configuration for secondary DRX group is smaller than that for the default DRX group.**

**Companies are invited to provide comments on whether to agree proposal 3 and 3a.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments, if any** |
| OPPO | Yes | Similar to drx-onDurationTimer and drx-InactivityTimer, support of a separate lpwus-PDCCHMonitoringTimer with a smaller timer length for secondary DRX group can enable UE to sleep faster in FR2 cells in case there is no scheduling in FR2 so that more UE power can ba saved. |
| Vivo | Yes with comments | We are fine to follow the similar design, i.e. separate configuration for two DRX groups. But another question is how to define the time outside active time. It would be different for two DRX groups. |
| Huawei | Yes | To simplify the solution, we understand the transition time from LR to MR can be same for FR1 and FR2. Since RAN1 agreed that the transition time is irrelevant to SCS, and the TR 38.840 does not have differentiation.  C:\Users\k00373258\AppData\Roaming\eSpace_Desktop\UserData\k00373258\imagefiles\8C52F440-B3EB-471F-8ECE-B02F04E226FE.png |
| NEC | Yes | It is straightforward mechanism for dual DRX groups, in fact if no different lpwus-PDCCHMonitoringTimer value (LP-WUS option 1-2) configured, there is no gain. |
| LGE | Yes | We also think that separate lpwus-PDCCHMonitoringTimer value and drx-InactivityTimer should be considered. Otherwise, there is no power saving gain. |
| Ericsson | Yes | Agree with P3 and P3a |
| Lenovo | Yes | Same principle can be reused for *lpwus-PDCCHMonitoringTimer,* i.e., separate configuration with smaller value, but share the vivo’s concern that the active time for two DRX groups are different, then the UE behaviours on MR/LR when outside the active time may need to be further clarified. |
| Qualcomm | Yes | Follow legacy configuration. |
| Samsung | Yes |  |
| DOCOMO | Yes | Agree with P3 and P3a |
| CATT | Yes | Different configuration on *lpwus-PDCCHMonitoringTimer* brings the power saving gain. |
| Apple | Yes |  |
| IDCC | Yes |  |

**Summary: all companies agree proposal 3 and proposal 3a.**

**Proposal 3: If secondary DRX group is configured, the *lpwus-PDCCHMonitoringTimer* configuration for secondary DRX group is different from that for the default DRX group.**

**Proposal 3a: The *lpwus-PDCCHMonitoringTimer* configuration for secondary DRX group is smaller than that for the default DRX group.**

## Open issue 2: UE operation for the potential collision

There are three sub-issues:

* + Issue 2-1: Confirm the RAN2 WF on UE operation for potential collision for Option 1-1?
  + Issue 2-2: What cases are considered as the potential collision?
  + Issue 2-3: What’s the UE operation for potential collision in Option 1-2?

Open issue 2-1: Confirm the RAN2 WF on UE operation for potential collision for Option 1-1?

RAN2 made the following progress in RAN2#129bis, and RAN1 confirmed the collision case in RAN1#121 agreements and indicated it in RAN1 LS (R1-2504888)

|  |
| --- |
| **RAN2#129bis progress**   * Working assumption for the case of potential collision (if any): In Option 1-1, when the UE is not able to monitor the LP-WUS occasion(s) the UE should start the drx-OnDurationTimer (as if LP-WUS was detected). FFS for Option 1-2. |
| **RAN1#121 Agreement:**  As the initial reply to RAN2 LS in [R1-2503616](http://www.3gpp.org/ftp//tsg_ran/WG1_RL1/TSGR1_121/Docs//R1-2503616.zip), RAN1 confirms that at least the collision with Active Time, measurement gap, and RAR window monitoring for BFR can be considered for the cases/scenarios on when the UE is not able to monitor LP-WUS. |

Therefore, Rapporteur think that we can confirm it for option 1-1

**Proposal 4: Confirm the following RAN2#129bis working assumption for Option 1-1.**

|  |
| --- |
| **RAN2#129bis progress**   * Working assumption for the case of potential collision (if any): In Option 1-1, when the UE is not able to monitor the LP-WUS occasion(s) the UE should start the drx-OnDurationTimer (as if LP-WUS was detected). FFS for Option 1-2. |

**Companies are invited to provide comments on whether to agree the proposal 4.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments, if any** |
| OPPO | Yes |  |
| Vivo | Yes |  |
| Huawei | Yes |  |
| NEC | Yes |  |
| LGE | Comment | Generally, we agree with the intention of WA above.  However, the collision case in RAN1 reply LS does not contain the interruption caused by BWP switching, while RAN2 considers the interruption caused by BWP switching as a collision case.  Thus, we think that RAN2 needs to re-define the potential collision case. |
| Ericsson | Yes |  |
| Lenovo | Yes |  |
| Qualcomm | Yes |  |
| Samsung | Yes |  |
| DOCOMO | Yes |  |
| CATT | Yes with comments | It was agreed that  ***Agreement***  *For RRC CONNECTED mode when LP-WUS is configured with Cell DTX, during Cell DTX inactive time, the UE is not expected to monitor LP-WUS both for Option 1-1 and 1-2*  Hence, the LP-WUS will not be monitored during Cell DTX inactive time. Then, it is FFS on whether to start the next *drx-onDurationTimer* for Option 1-1 or *lpwus-PDCCHMonitoringTimer* for Option 1-2 during Cell DTX active time.  In our view, LP-WUS during Cell DTX inactive time should also be considered as one collision case. |
| Apple | Yes |  |
| IDCC | Yes |  |

**Summary: All companies agree to confirm the RAN2#129bis WA on the potential collision cases.**

**Proposal 4: Confirm the following RAN2#129bis working assumption for Option 1-1.**

Open issue 2-2: What cases are considered as the potential collision?

RAN1 LS/agreements confirm the two collision cases:

Case 1) measurement gap, and Case 2) RAR window monitoring for BFR.

|  |
| --- |
| **RAN1#121 Agreement:**  As the initial reply to RAN2 LS in R1-2503616, RAN1 confirms that at least the collision with Active Time, measurement gap, and RAR window monitoring for BFR can be considered for the cases/scenarios on when the UE is not able to monitor LP-WUS. |

As LP-WUS Option 1-1 design takes DCP as baseline, we should also consider the UE internal processing timing which is highlighted in yellow in current DCP part (as below) in LP-WUS operation, and consider the same description for LP-WUS operation in Option 1-1.

* Current DCP text to capture the UE operation for the collision and timing issue.

|  |
| --- |
|  |

* The proposed LP-WUS text to capture the UE operation in Option 1-1 for the collision and timing issue.

|  |
| --- |
|  |

**Companies are invited to provide comments on the proposed LP-WUS operation in Option 1-1 for potential collision and internal processing timing issue.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments, if any** |
| OPPO |  | Fine to follow the DCP text |
| vivo | Yes |  |
| Huawei | Yes with comments | Fine to follow the DCP text as baseline, but we found that “MUSIM gap” has the same issue and should also be considered. During MUSIM gap, the UE needs to do the activities in SIM2 and the transmission/reception in SIM1 is interrupted. In this case, the UE is not able to monitor LP-WUS.  We think MUSIM gap is missing because DCP was discussed in Rel-16, but MUSIM gap was introduced in Rel-17. So MUSIM gap was not considered for the original DCP text and is still missing after it was introduced. The same update may be needed for DCP but it is Rel-16 CR which does not need to be discussed here.  The update can be:  …, or during a measurement gap, or during a MUSIM gap, or when the MAC entity monitors for a PDCCH transmission on the search space indicated by… |
| NEC | Yes |  |
| LGE | Yes |  |
| Ericsson | Yes | The same MR processing times apply before the DCP occasions (MR) and LP-WUS occasions (LR).  Agree to add MUSIM gap. |
| Lenovo | Yes, with comments | Agree to follow current DCP collision case. Additionally, we also identify another LP-WUS specific collision case caused by the LR ramp-up time. If the duration between the end of active time and the start of the most recent LP-WUS MO is shorter than the required LR ramp-up time, UE is not able to monitor the LP-WUS occasion(s) because LR is not ready. We think this LP-WUS specific collision case needs to be considered. |
| Qualcomm | Yes | Also fine with Huawei’s proposal on MUSIM gap. |
| Samsung | Yes |  |
| DOCOMO | Yes |  |
| CATT | Yes | Also agree with HW to add MUSIM gap.  Moreover referring our comments on Open issue 2-1, we think LP-WUS during Cell DTX inactive time should also be considered as one collision case.  The further update can be:  …, or during a measurement gap, or during a MUSIM gap, or during Cell DTX inactive time, or when the MAC entity monitors for a PDCCH transmission on the search space indicated by… |
| Apple | Yes | Agree that same operation will be applicable for the MUSIM case. We can add the MUSIM in the LPWUS MAC CR. And for the impact in legacy DCP operation, the maintenance CR may be needed. |
| IDCC | Yes |  |

**Summary: All companies agree the TP for the collision case, and majority agree the additional case of MUSIM gap.**

**Proposal 5: Agree the proposed LP-WUS TP (with the addition MUSIM gap case) to capture the UE operation in Option 1-1 for the collision and timing issue.**

Issue 2-3: What’s the UE operation for potential collision in Option 1-2?

Regarding the UE operation for the potential collision in Option 1-2, it’s FFS in RAN2#129bis discussion and RAN1 would like RAN2 to make decision for Option 1-2.

|  |
| --- |
| **RAN2#129bis progress**  Working assumption for the case of potential collision (if any): In Option 1-1, when the UE is not able to monitor the LP-WUS occasion(s) the UE should start drx-OnDurationTimer (as if LP-WUS was detected). FFS for Option 1-2. |
| **RAN1#121 Conclusion**  From RAN1 perspective, for the case of potential collision (if any) in Option 1-2, when the UE is not able to monitor all the LP-WUS MO(s) in a LP-WUS periodicity,   * It is up to RAN2 to further discuss and finalize the specification support, if any. |

We need to check companies view on whether and how to handle the collision in Option 1-2. There are three options:

* Option 1: UE starts the *lpwus-PDCCHMonitoringTimer* when there is collision. (Same operation as Option 1-1)
* Option 2: UE doesnot start the *lpwus-PDCCHMonitoringTimer* when there is collision.
* Option 3: NW can configure UE whether to start the *lpwus-PDCCHMonitoringTimer* or not when there is collision.

**Companies are invited to provide the preference amongst the 3 options for collision in Option 1-2.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred Option** | **Comments, if any** |
| OPPO | Option 1 |  |
| vivo | Option 2 | For Option 1-1, since the typical configuration of WUS monitoring occasions/periodicity are sparse and aligned with the long DRX cycle. If UE does not start *drx-OnDurationTimer* when the UE is not able to monitor the LP-WUS occasion(s), the delay for waking up the UE will be as long as one long DRX cycle (e.g., 160ms), which is unacceptable.  However, for option 1-2, for the collision cases/scenarios on when the UE is not able to monitor the LP-WUS occasion(s), **it is more reasonable that the UE does NOT start the *LP-WUS\_PDCCHMonitoringTimer*.** Because different from option 1-1, option 1-2 typically has more frequent WUS monitoring occasion configuration. Network has sufficient flexibility and opportunities to send WUS to timely wake up MR. If we follow the same solution as for option 1-1, considering the dense LP-WUS monitoring occasions and short periodicity which results in more frequent collisions, the MR will be always waked up unnecessarily and the power consumption will be increased significantly. Therefore, a more reasonable solution should be that for Option 1-2, the UE only wakes up upon detecting a LP-WUS. |
| Huawei | Option 2 | For option 1-2, the period of monitoring occasions for LP-WUS will be shorter than that of Option 1-1, i.e., the monitoring occasions for LP-WUS appear more frequently. If there will be many overlaps, the *lpwus\_PDCCHMonitoringTimer* will be started frequently, which increase the power consumption. If there won’t be many overlaps, the next monitoring occasion for LP-WUS comes immediately, the impact on the latency is negligible. |
| NEC | Option 1 | From our perspective, the collision handling (i.e., the UE could blindly start active timer) is beneficial for the scheduling robust or latency.  As long as the periodicity of LP-WUS option 1-2 is larger than LP-WUS\_PDCCHMonitoringTimer, this collision handling works, for example, LP-WUS\_PDCCHMonitoringTimer = 5ms while LP-WUS periodicity is 20ms.  And we assume the reasonable configuration is that periodicity of LP-WUS should be larger than LP-WUS\_PDCCHMonitoringTimer duration.  Therefore, option 1 can be supported. |
| LGE | Option 1 | For the collision case, if the UE does not start lpwus-PDCCHMonitoringTimer, there may be a case where scheduling is delayed and the UE can receive the scheduling after the next LP-WUS occasion. Although UE power saving is important, we think it is not desirable way to cause scheduling delay.  In addition, we believe that there may not frequent collision if lpwus-PDCCHMonitoringTimer is shorter than LP-WUS monitoring periodicity. |
| Ericsson | Option 1 and 2 | Whether the UE should start the *lpwus\_PDCCHMonitoringTimer* when there is a collision depends on the configured LP-WUS periodicity. When there are frequent LOs then the UE can miss one or two occasions without starting the timer. But when the LOs are in-frequent then the UE should start the timer to not impact the latency. |
| Lenovo | Option 1 | Similar way should also be applied to option 1-2 to avoid UE missing potential scheduling. Agree with NEC and LGE that in option 1-2, l*pwus-PDCCHMonitoringTimer* is shorter than LP-WUS monitoring periodicity, and it’s beneficial to start *lpwus-PDCCHMonitoringTimer* in collision case to guarantee the scheduling latency and robustness. |
| Samsung | Option 1 | We somewhat agree with Ericsson’s perspective that the issue is linked to the configured LP-WUS periodicity. However, aligning with Lenovo’s emphasis on latency and robustness, we prefer the UE to start the *lpwus-PDCCHMonitoringTimer* in the event of a collision.  If collisions are rare, this approach is unlikely to lead to significant issues, such as frequent wake-ups or excessive power consumption in MR. |
| DOCOMO | Option 2 | We share the similar view with vivo and Huawei. There should be frequent LOs in Option 1-2. If Option 1 is adopted, power saving gain will be reduced. |
| CATT | Option 2 | Typically, option 1-2 has more frequent WUS monitoring occasion configuration. Considering frequent start of *lpwus-PDCCHMonitoringTimer* will decrease the power saving gain, Option 2 is straightforward. Regarding the latency, we think the network can send LP-WUS to timely wake up MR with sufficient flexibility. |
| Apple | Option 1 or Option 3 |  |
| IDCC | Option 3? | *lpwus-PDCCHMonitoringTimer* periodicity is up to NW configuration and it seems reasonable to allow NW configure also to start the timer if the periodicity is in-frequent. |

**Summary: The company views are diverse. Rapp propose to go for the compromised solution, i.e. Option 3.**

**Proposal 6: For Option 1-2, NW configures UE whether to start the *lpwus-PDCCHMonitoringTimer* in collision cases, i.e. when the UE is not able to monitor the LP-WUS occasion(s).**

## Open issue 3: MAC spec impact to support the LP-WUS in Cell DTX operation

RAN1#120bis agreed that UE doesnot monitor LP-WUS during Cell DTX inactive time.

|  |
| --- |
| **Agreement**  For RRC CONNECTED mode when LP-WUS is configured with Cell DTX, during Cell DTX inactive time, **t**he UE is not expected to monitor LP-WUS both for Option 1-1 and 1-2 |

And RAN2 needs to further check the MAC spec impact to reflect the RAN1 agreements.

|  |
| --- |
| **RAN2#130 progress**   * Check whether we need to capture in MAC that UE is not expected to monitor LP-WUS if not in Cell DTX active period. |

After further check the RAN1 agreed R19 38.213 CR for LP-WUS (R1-2504971), it has been captured in RAN1 spec as below.

|  |
| --- |
| 10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED **……**  A UE does not monitor WUS during DTX inactive period for the primary cell. |

Therefore, the change in MAC spec is not needed. and RAN2 doesnot need to further discuss this issue.

**Proposal 5: There is no MAC spec impact to reflect the LP-WUS operation in Cell DTX operation.**

**Companies are invited to provide the comments if have different view.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments, if any** |
| OPPO | Yes | It is sufficient to capture this in RAN1 spec. |
| Vivo | Yes |  |
| Huawei | Yes |  |
| NEC | Yes |  |
| LGE | Yes |  |
| Ericsson | Yes |  |
| Lenovo | Yes |  |
| Qualcomm | Yes |  |
| Samsung | Yes |  |
| DOCOMO | Yes |  |
| CATT | Yes |  |
| Apple | Yes |  |
| IDCC | Yes |  |

**Summary: All companies agree there is no MAC spec impact.**

**Proposal 7: There is no MAC spec impact to reflect the LP-WUS operation in Cell DTX operation.**

# 3 Conclusion

Based on post-meeting email discussion,