**3GPP TSG-RAN WG2 Meeting #129bisR2-250xxxx**

**, , 7th - 11th April 2025**

**Agenda item: 8.4.1**

**Source: CATT**

**Title:  [Post129][212][LPWUS] Running CR for TS 38.304 (CATT)**

**Document for: Discussion and Decision**

# Introduction

This document is the report of the following discussion:

* [Post129][212][LPWUS] Running CR for TS 38.304 (CATT)

Intended outcome: Running CR for submission to the next meeting

Deadline: Long (Mar. 21st 10:00 UTC)

Please provide your comments by Thursday March 20th 10:00 UTC to allow 24h for the rapporteur to update the CR before the deadline.

Companies providing input to this email discussion are requested to leave contact information below.

|  |  |  |
| --- | --- | --- |
| **Company** | **Delegate name** | **Email address** |
| Xiaomi | Yanhua Li | Liyanhua1@xiaomi.com |
| Ericsson | Martin van der Zee | martin.van.der.zee@ericsson.com |
| NEC | Rao | shi\_rao@nec.cn |
| Samsung | Byounghoon Jung | bh14.jung@samsung.com |
| Huawei, HiSilicon | Rama Kumar Mopidevi | rama.kumar@huawei.com |
| Sharp | LIU Lei | lei.liu@cn.sharp-world.com |
| Lenovo | Jie Hu | hujie14@lenovo.com |
| Interdigital | Jongwoo Hong | jongwoo.hong@interdigital.com |
| Nokia | Jussi Koskinen | jussi-pekka.koskinen@nokia.com |
| Qualcomm | Jianhua Liu | jianhua@qti.qualcomm.com |
| Vivo | Chenli | Chenli5g@vivo.com |
| OPPO | Haocheng Wang | [Wanghaocheng1@oppo.com](mailto:Wanghaocheng1@oppo.com) |
| Apple | Fangli XU | fangli\_xu@apple.com |

# Discussion

## How to capture RRM relaxation and offloading in TS 38.304

According to RAN2 agreements, RAN2 focus on specifying the offloading and relaxation criteria.

Rel-16 relaxed RRM measurements mechanism in idle/inactive, i.e. the possible configuration options and the possible combinations of fulfilment of low mobility and/or not-at-cell-edge, were captured in both TS 38.304 and TS38.133. In [1] it mentioned this duplication had led to many LS exchanges between RAN2 and RAN4. Furthermore the way captured was different in TS 38.304 and 38.133 which made it difficult to compare them, as shown below.



In [1], to avoid overlap between RAN2 and RAN4 specification, it is proposed that RAN2 captures the relaxation and offloading criteria while RAN4 captures different use cases that can be identified based on the configuration and which criteria are fulfilled.

Rapporteur shares the same view. In addition, in Rel-16 relaxed RRM measurements mechanism in idle/inactive in TS38.304, it also distinguishes intra-frequency case and NR inter-frequency/ inter-RAT frequency cases, as shown below [2]:

|  |
| --- |
| - if *cellEdgeEvaluation* is configured and *lowMobilityEvaluation* is not configured; and  - if the relaxed measurement criterion in clause 5.2.4.9.2 is fulfilled:  - the UE may choose to perform relaxed measurements for intra-frequency cells according to relaxation methods in clauses 4.2.2.9 and 4.2C.2.7 in TS 38.133 [8];  - if the serving cell fulfils Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ:  - the UE may choose to perform relaxed measurements for NR inter-frequency cells or inter-RAT frequency cells according to relaxation methods in clauses 4.2.2.10, 4.2.2.11 and 4.2C.2.8 in TS 38.133 [8]; |

Rapporteur proposes to discuss how to capture RRM relaxation and offloading in TS 38.304 and TS 38.133 in advance. RAN2 can capture the general description on RRM relaxation and offloading for LP-WUS (e.g. not to capture intra-frequency, inter-frequency or inter-frequency cases) and criteria of RRM relaxation and offloading for LP-WUS. Other details are captured in RAN4.

**Proposal 1: The general description on RRM relaxation and offloading for LP-WUS (e.g. not to capture intra-frequency, inter-frequency or inter-frequency cases) and criteria of RRM relaxation and offloading for LP-WUS are captured in TS 38.304. Other details of RRM relaxation and offloading for LP-WUS are captured in RAN4.**

Companies are invited to give comments on proposal 1.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No on proposal 1** | **Comments** |
| Xiaomi | Yes | RAN2 captures the criteria of RRM relaxation and RAN4 captures how UE performs the RRM relaxation. |
| Ericsson | “Yes”, see comments | **It would be good to agree that as a general principle the RRM requirements will not be duplicated in 38.304 and 38.133.**  We suspect that RAN4 will proceed to capture the LP-WUS RRM requirements in a similar way in 38.133 as has been done for PEI. We support to have a “**general description**” in 38.304, i.e. this could avoid overlap and potential conflicts between 38.304 and 38.133. |
| NEC | Yes | Indeed in previous Rel-16 measurement relaxation discussion, overlapping issue between RAN2 and RAN4 was discussed for a long time. For now by only specifying criterion in RAN2 and requirement in RAN4, this can make things very simple. But should we inform RAN4 of this decision? |
| Samsung | Yes | Agree to capture general description and criteria of RRM relaxation and offloading for LP-WUS in TS 38.304. |
| Huawei, HiSilicon | Yes |  |
| Sharp | Yes |  |
| Lenovo | Yes | RAN2 to capture the general description and criteria of RRM measurement relaxation and offloading, while RAN4 to capture the other details of RRM measurement relaxation and offloading. Can coordinate with RAN4 on the split to avoid duplicate responses. |
| InterDigital | Yes |  |
| Nokia | Yes |  |
| Qualcomm | Yes, see the comment | RAN2 should capture UE behavior for RRC relaxation |
| Vivo | Object. See comment | We are fine to avoid the duplication between 38.304 and 38.133.  During the discussion in Rel-16, it was agreed in RAN2 that RAN2 specification will capture the RRM relaxation behaviour, while RAN4 specification will capture the corresponding requirements.  The reason the behaviour should be captured in RAN2 is that some essential information is missing in RAN4 specification, e.g. the below information cannot be reflected in RAN4 specification. Similarly, there are a lot of other information.  - if the UE has performed normal intra-frequency, NR inter-frequency, or inter-RAT frequency measurements for at least TSearchDeltaP after (re-)selecting a new cell; and  - if the relaxed measurement criterion in clause 5.2.4.9.1 is fulfilled for a period of TSearchDeltaP; and  We are very happy to discuss if all these essential information is captured in RAN4 specification.  We could in general agree that we should try to minimum the duplication between RAN2 and RAN4 specification. |
| Apple | Yes | I don't think any company wants to have duplication in the RAN1 and RAN4 specifications. So we can agree to this principle, but how to implement it can be discussed specifically. |

**Summary:**

**Yes: 11. In addition, one company asks whether we should inform RAN4 of this decision and one company proposes to coordinate with RAN4 on the split to avoid duplicate responses. And one company suggest we can agree to this principle but how to implement it can be discussed specifically.**

**No: 1. One company points out that the reason the behaviour should be captured in RAN2 is that some essential information is missing in RAN4 specification.**

Rapp proposes to discuss:

**Proposal 1: General description and criteria of RRM relaxation and offloading for LP-WUS are captured in TS 38.304. Other details of RRM relaxation and offloading for LP-WUS are captured in RAN4.**

**Proposal 2: Send an LS to inform RAN4.**

## Comments on TS 38.304 running CR

Companies can provide comments and suggestions to the uploaded running CR in this table. Please do not add changes, suggestions, or comments directly to the draft CR document.

|  |  |  |
| --- | --- | --- |
| Company + Issue Number (e.g., C001) | Detailed comments | Rapporteur response |
| X001 | 5.2.4.9.x Relaxed measurement criterion for LP-WUS Comment1:  FFS different UE types, OOK and OFDM need to be considered.  Comment2:  The entry condition for serving cell RRM relaxation is fulfilled when:  - Srxlev > SLP\_WUS\_RelaxEntryThresholdP\_MR, and,  - Srxlev\_lr > SLP\_WUS\_RelaxEntryThresholdP\_LR, if SLP\_WUS\_RelaxEntryThresholdP\_LR is configured,  and,  - Squal > SLP\_WUS\_RelaxEntryThresholdQ\_MR, if SLP\_WUS\_RelaxEntryThresholdQ\_MR is configured, and  - Squal\_lr > SLP\_WUS\_RelaxEntryThresholdQ\_LR, if SLP\_WUS\_RelaxEntryThresholdQ\_LR is configured,  RSRQ is optionally configured for MR or LR. We can further consider the wording.  Comment3:  FFS whether to consider fully offloading and partial offloading. | [Rapporteur]  To Comment1:  Add FFS for different UE types in clause 5.2.4.9.x and 5.2.4.9.z.  To Comment2:  With the following highlighted part, RSRQ for both MR and LR can be optionally configured. Considering it is FFS for the metrics of serving cell RRM relaxation, we keep it as it is and companies can provide the wording with latest conclusions.  - Squal > SLP\_WUS\_RelaxEntryThresholdQ\_MR, if SLP\_WUS\_RelaxEntryThresholdQ\_MR is configured, and  - Squal\_lr > SLP\_WUS\_RelaxEntryThresholdQ\_LR, if SLP\_WUS\_RelaxEntryThresholdQ\_LR is configured,  To Comment3:  RAN4 agreed case #1 fully offloading case and case #3 Relaxed case b. And according to RAN2 agreement, we had agreements on criteria of serving cell measurement offloading and relaxation. But we didn’t have any agreement on partial offloading yet. Hence the FFS whether to consider fully offloading and partial offloading is not added. But we are open to discuss the FFS based on contribution. |
| X002 | 5.2.4.9.z Offloading measurement criterion for LP-WUS Do not understanding of the intention of this part. Is this the same thing as 5.2.4.9.x Relaxed measurement? | [Rapporteur]  This is according to the following agreements in RAN2#127:   * For serving cell measurement offloading (i.e., there is no serving cell measurement by MR):   + - The entry conditions for serving cell measurement offloading can be defined as at least MR greater than a certain RSRP threshold, and LR could also be considered.     - The exit condition is based on the LR measurement results.   So change to “5.2.4.9.z serving cell measurement offloading criterion for LP-WUS”. Descriptions in clause 5.2.4.2, 5.2.4.9.y and 5.2.4.9.z are updated accordingly. |
| X003 | 7.x.1 Condition for LP-WUS monitoring  Comment1:  “The exit condition for LP-WUS monitoring is fulfilled when:  - Srxlev\_lr < SLP\_WUS\_ExitThresholdP\_LR, if SLP\_WUS\_ExitThresholdP\_LR is configured, or,  - Squal\_lr < SLP\_WUS\_ExitThresholdQ\_LP, if SLP\_WUS\_ExitThresholdQ\_LR is configured,  ”  Comment2:  We can further discuss whether the Entry/exit conditions for LP-WUS monitoring is the same as the entry/exit conditions for RRM relaxation. If it is, then this part is not needed. | [Rapporteur]  To Comment1:Updated.  To Comment2:  Open to discuss it. If it is agreed, then this part is updated accordingly. In addition, an FFS is added in 5.2.4.9.x. |
| X004 | 7.x.0 General Comment1:  FFS whether “*lastUsedCellOnly*” is introduced for LP-WUS as in PEI. | To Comment1:  We think the issue will be discussed no matter whether it is captured as an FFS. So prefer to keep as it is. |
|  | The UE monitors the legacy PO (and may monitor PEI)  Comment2:  “When the UE starts LP-WUS monitoring, if the UE detects LP-WUS and the LP-WUS indicates the subgroup the UE belongs to monitor its associated PO (and may PEI), as specified in clause 10.xx in TS 38.213 [4], the UE monitors the associated PO (and may PEI) as specified in clause 7.1.” If UE does not detect a LP-WUS on the monitored LO or the LP-WUS does not indicate the subgroup the UE belongs to monitor its associated PO (and may PEI), as specified in clause 10.xx in TS 38.213 [4], the UE is not required to monitor the associated PO (and may PEI) as specified in clause 7.1.  Comment3:  If single value is configured for *lo-Offset*, and if the gap between the LO and the corresponding PO is no less than the wake-up delay that the UEsupports, the UE monitors the PO associated with the offset after receiving a wake-up indication in a LP-WUS, otherwise UE follows the paging monitoring procedure as described in clause 7.1 and/or 7.2. | To Comment2:  Updated considering with the comment in SS003 together.  To Comment3:  Updated. |
| E001 | LR Low power wake-up Receiver | Updated. |  |
| E002 | LP-WUS UE may further perform RRM neighbour measurement relaxation as specified in clause 5.2.4.9.0 or RRM serving cell measurement offloading and relaxation as specified in clause 5.2.4.9.x.  If the UE supports LP-WUS and LP-WUS is configured in SIB [details FFS]…  In 38.304 “RRM measurements” typically only refer to neighbour cell measurements, i.e. serving cell relaxation and offloading is new. From that perspective I think it is better to have serving cell relaxation/offloading in a separate section and clearly make this as “**serving** cell measurement relaxation/offloading”.  In 38.300 also the wording “**further**” RRM relaxation is used for the new Rel-19 scaling factors for neighbour cell measurements, i.e. propose to keep it. | RAN4 agreed case #1 fully offloading case and case #3 Relaxed case b as follows.   |  |  |  |  | | --- | --- | --- | --- | | **RRM measurement case index** | **MR serving cell measurement** | **MR neighboring cell measurement** | **LR measurement** | | #1 Fully offloading case | Off | Off: FFS the condition and the details | ON | | #3 Relaxed case b | On with relaxation measurement | On with relaxation measurement | ON |   Hence, we prefer to put MR serving cell relaxation and MR neighbor cell relaxation together as it is. If RAN2 further agree MR serving cell relaxation and MR neighbor cell relaxation are separate features, we can have separate sections for those two features. Considering “RRM” is removed considering it has not been used in TS 38.304 yet. |
| E003 | LP-WUS UE may choose to perform relaxed measurement according to requirements specified in TS 38.133 [8] if the entry condition for RRM measurement relaxation in clause 5.2.4.9.x is fulfilled.  Agree, but an LP-WUS UE should also be allowed to perform relaxed Rel-16 neighbour cell measurements using the LR serving cell measurements, e.g. when “low mobility” is fulfilled the LP-WUS UE is not required to measure intra-frequency at all. This is even stronger than the Rel-19 “further” relaxation. Maybe you can add an FFS for that case. | It is unclear if an LP-WUS UE should also be allowed to perform relaxed Rel-16 neighbour cell measurements using the LR serving cell measurements or using the MR serving cell measurements. Maybe we can discuss the issue with contributions directly. |
| NEC001 | 5.2.4.9.x Relaxed measurement criterion for LP-WUS UE5.2.4.9.z Offloading measurement criterion for LP-WUS UE **Comment: it should be LP-WUS UE.** | Updated. |
| NEC002 | 5.2.4.9.x Relaxed measurement criterion for LP-WUS The entry condition for serving cell RRM measurement relaxation is fulfilled when: **Comment: it should be RRM measurement relaxation, to align with others** | Updated. |
| NEC003 | 5.2.4.9.x Relaxed measurement criterion for LP-WUS The entry condition for serving cell RRM relaxation is fulfilled when:  - Srxlev > SLP\_WUS\_RelaxEntryThresholdP\_MR, and,  - Srxlev\_lr > SLP\_WUS\_RelaxEntryThresholdP\_LR, if SLP\_WUS\_RelaxEntryThresholdP\_LR is configured, and,  - Squal > SLP\_WUS\_RelaxEntryThresholdQ\_MR, if SLP\_WUS\_RelaxEntryThresholdQ\_MR is configured, and  - Squal\_lr > SLP\_WUS\_RelaxEntryThresholdQ\_LR, if SLP\_WUS\_RelaxEntryThresholdQ\_LR is configured,  Where:  - Srxlev = current Srxlev value of the serving cell based on MR (dB).  - Squal = current Squal value of the serving cell based on MR (dB).  - Srxlev\_lr= current measured cell RX level value of the serving cell based on LR (dB).  - Squal\_lr = current measured cell quality value of the serving cell based on LR (dB).  **Comment: no strong view, but think it is worth to highlight “based on MR” since now we have two separate radio. Also apply to 7.x.1.** | Although during our discussion MR is used to distinguish LR, Srxlev value of the serving cell based on MR is the existing definition Srxlev in clause 5.2.3.2. If we add “based on MR”, further clarification is needed and it is not aligned with the definition in other relaxed measurement criteria. |
| NEC004 | If single value is configured for *lo-Offset*, and if the gap between the LO and the corresponding PO is no less than the wake-up delay that the UE reports, the UE monitors the PO associated with the offset after receiving a wake-up indication in a LP-WUS, otherwise the UE follows the paging monitoring procedure as described in clause 7.1 and/or 7.2.  If more than one values are configured for *lo-Offset*, and if the gap between the LO associated with the largest offset and the corresponding PO is no less than the wake-up delay the UE reports, the UE monitors the LO associated with the smallest offset value that has a gap between the LO and the PO associated with the offset no less than the wake-up delay, otherwise the UE follows the paging monitoring procedure as described in clause 7.1 and/or 7.2.  **Comment: it should be “the UE”, and we need to align the term (either support or report), since this is a UE capability with parameter, slightly prefer “reports”.** | “the” is added. But “support” is kept to align with RAN1 agreement. |
| NEC005 | SubgroupID = (floor(UE\_ID/(N\*Ns\*Np)) mod subgroupsNumForUEID\_LP) + (subgroupsNumPerPO\_LP – subgroupsNumForUEID\_LP),  where:  N: number of total paging frames in T, which is the DRX cycle of RRC\_IDLE state as specified in clause 7.1  Ns: number of paging occasions for a PF  Np is the number of subgroupNumsForUEID for PEI, if configured; otherwise, Np is 1  **Comment-1: subgroupNumForUEID should be subgroupNumsForUEID.**  **Comment-2: in our understanding, no matter the UE supports PEI or not, there is no harm to use a unified LP-WUS formula which already can further reduce false alarm. And on top of further reduce false alarm, if different UE use different parameter Np, it can make the formula computation a little bit messed. However since this is our agreement, we can further discuss this issue based on contribution.** | To Comment-1:  Changed to *subgroupsNumForUEID*.  To Comment-2:  It’s better to further discuss the issue based on contribution. |
| NEC006 | The UE monitors one LP-WUS occasion per DRX cycle.  **Comment: even though multiple offsets corresponding to the same PO is introduced by RAN1, this is from NW perspective, we think that the UE only need to select ONE LP-WUS for monitoring. Also this is to refer to PEI description.** | Updated. |
| SS001 | The terminology ‘LP-WUS UE’ must be defined. | In RAN2#127, it was agreed:  =>RAN2 only discuss RRM measurement offloading/relaxation for LP-WUS UEs.  We are fine to add an FFS for LP-WUS UE in clause 5.2.4.2.  Editor’s NOTE: FFS on the terminology LP-WUS UE. |
| HW001 | As Samsung commented, the terminology “LP-WUS UE” needs to be defined. In 38.300 running CR, “UE configured with LP-WUS” is used. If it’s common understanding that “UE configured with LP-WUS” refers to “a UE capable of LP-WUS functionality is configured with LP-WUS configuration by the NW, and the LP-WUS functionality is enabled”, then “UE configured with LP-WUS” can be used across all specs. | See above. An FFS for LP-WUS UE is added in clause 5.2.4.2. |
| HW002 | Section 5.2.4.9.x:  Comment: It’s not agreed that “relaxed measurement criteria is different from LP-WUS monitoring entry criteria”. So this should be FFS. (We mean the parameters “SLP\_WUS\_RelaxEntryThresholdP\_MR, and SLP\_WUS\_RelaxEntryThresholdP\_LR”) | An FFS is added. |
| HW003 | Section 7.x.0 General:  As the UE may monitor PEI first, and PO later, suggest: “The UE monitors PO (or may monitor PEI, and PO ~~and may monitor PEI~~) and may stop LP-WUS monitoring if the exit condition in clause 7.x.1 is fulfilled” | If the UE does not detect PEI on the monitored PEI occasion or the PEI does not indicate the subgroup the UE belongs to monitor its associated PO, the UE is not required to monitor the associated PO. Hence, only change “and” “or”. |
| HW004 | Section 7.x.0 General:  “If more than one values are configured for *lo-Offset*”  Comment: According to RAN1 agreement, “it’s FFS whether gNB can configure 3 offset values”. This is not captured in the editor’s NOTE. | The FFS whether gNB can configure 3 offset values impacts RRC specification. But in section 7.x.0, “more than one value” has already covered the case of 3 offset values. |
| HW004 | Section 7.y.0, 7.y.1, 7.y.2:  Comment: it’s better to align the description with PEI’s description in Section 7.3.0, 7.3.1, 7.3.2 | Section 7.y.0, 7.y.1, 7.y.2 have aligned the PEI’s description in Section 7.3.0, 7.3.1, 7.3.2 as much as possible. |
| HW005 | Section 7.y.2:  Comment: UE\_ID based subgrouping ID formula is used when the following condition is fulfilled, (i.e., the same condition as in 7.3.2), it’s better to clarify it.  “If the UE is not configured with a CN assigned subgroup ID, or if the UE configured with a CN assigned subgroup ID is in a cell supporting only UE\_ID based subgrouping, the subgroup ID of the UE is determined by the formula below:”  This will be address if the description is aligned as commented in HW004. | Share the same view with Huawei. But currently there is no any clear agreement on this issue. The following EN is added in 7.y.0. We can further discuss.  Editor’s NOTE: FFS on how the UE to determine the type of LP-WUS subgrouping considering the LP-WUS subgrouping configuration in the cell. |
| Sharp 001 | **A general Comment**: It is unclear what “LP-WUS UE” is, clarification/definition in the spec is needed. However not sure whether “LP-WUS UE” is supporting LP-WUS or configured with LP-WUS, maybe FFS can be added. | An FFS is added in clause 5.2.4.2. |
| Sharp 002 | Section 5.2.4.2: LP-WUS UE may further perform RRM measurement relaxation as specified in clause 5.2.4.9.0 or RRM measurement offloading as specified in clause 5.2.4.9.x.  **Comment**: The reference causes seem incorrect. A possible change: LP-WUS UE may further perform serving cell RRM measurement relaxation as specified in clause 5.2.4.9.x or serving cell RRM measurement offloading as specified in clause 5.2.4.9.y and 5.2.4.9.z. | According to RAN4 agreement, case #1 fully offloading case and case #3 Relaxed case b, which includes MR serving cell measurement with relaxation and MR neighbor cell measurement with relaxation, were agreed. Hence, the general description on measurement relaxation with LP-WUS UE is specified in clause 5.2.4.9.0 while the general description on serving cell offloading measurement is specified in clause 5.2.4.9.y. Hence, “5.2.4.9.x” is changed to “5.2.4.9.y”. |
| Sharp 003 | Section 7.x.0.  **Comment:** The agreement “If UE starts LP-WUS monitoring, it may stop the legacy PO monitoring before UE receives LP-WUS indicating wake-up” seems not be captured. | In RAN1#118bis, the following was agreed:  **Agreement**  From RAN1 perspective, when a UE is monitoring LP-WUS (based on the entry/exit condition for LP-WUS), a UE is not required to monitor a PO if   * it does not detect a LP-WUS on the monitored LO * or the LP-WUS does not indicate a wake-up indication for the UE’s corresponding subgroup   Hence, the agreement “If UE starts LP-WUS monitoring, it may stop the legacy PO monitoring before UE receives LP-WUS indicating wake-up” has already been covered by the above agreement. |
| Len001 | 5.2.4.9.0 Relaxed Measurement and Offloading Measurement  LP-WUS UE may choose to perform relaxed RRM serving cell measurement according to requirements specified in TS 38.133 [8]…. | Clause 5.2.4.9.x covers both serving cell RRM measurement relaxation and neighbor cell RRM measurement relaxation. |
| Len002 | 5.2.4.9.x Relaxed measurement criterion for LP-WUS The entry condition for serving cell RRM measurement relaxation is fulfilled when:  ……  5.2.4.9.z Offloading measurement criterion for LP-WUS  The entry condition for serving cell RRM ~~mearement~~ measurement offloading is fulfilled when:  ……  The exit condition for serving cell RRM ~~mearement~~ measurement offloading is fulfilled when:  …..  [Comment]: to align with the description of relaxation and offloading cases, and the offloading case also only limited on the serving cell. | Updated. |
| Len003 | 7.x.0 General  The UE may monitor LP-WUS in RRC\_IDLE and RRC\_INACTIVE states in order to reduce power consumption. If LP-WUS configuration is provided in system information, the UE in RRC\_IDLE or RRC\_INACTIVE state supporting LP-WUS may start LP-WUS monitoring using LP-WUS ~~parameters~~ configuration in system information according to the procedure described below if the entry condition in clause 7.x.1 is fulfilled. The UE monitors PO (and may monitor PEI) and may stop LP-WUS monitoring if the exit condition in clause 7.x.1 is fulfilled.  When the UE starts LP-WUS monitoring, if the UE detects LP-WUS and the LP-WUS indicates the subgroup the UE belongs to ~~monitor its associated PO~~, as specified in clause 10.xx in TS 38.213 [4], the UE monitors the associated PEI and/or PO as specified in clause 7.1  [Comment]: the wording is a bit misleading because the UE may either monitor PEI after receiving LP-WUS or it may directly monitor PO (provided the LPWUS indicates the UE’s subgroup ID). | “LP-WUS parameters” is aligned with the description in PEI. Hence, keep it as it is.  The following sentence covers the case UE may monitor PEI after receiving LP-WUS or it may directly monitor PO.  If the UE supports PEI and PEI is configured by the gNB, after the UE receives LP-WUS indicating the subgroup the UE belongs to monitor its associated PO, it is up to UE implementation whether to monitor PEI or not. |
| Len004 | Since neighbouring cell measurement relaxation impacts have also been discussed in previous meetings. It is suggested to capture related agreement as below (FFS point) in 5.2.4.9:  ‘FFS (if needed) on enhancements based on R16 criteria (e.g., based on the LR measurements) for the case when MR serving cell measurement results are not available.’ | Added. |
| IDC001 | If we use the term “MR” in the specification, it would be better to add definition of MR in the 3.2 Abbreviations section such as “Main Radio”. | Added. |
| IDC002 | *According to RAN2#126 agreement “For serving cell measurement offloading* *(i.e., serving cell measurement fully offloaded to LR and no serving cell measurement via MR is required.*  When the offloading condition satisfied, then the serving cell measurement via MR is not required based on the RAN2 agreements.  Do we need to add this details in the general description (e.g., difference relaxed and offloading measurement, whether serving cell measurement via MR is required or not) or left to all detail descriptions up to RAN4 specification? | Added for serving cell measurement offloading in clause 5.2.4.9.y. |
| Nokia 001 | Clause 7.x.0:  It would be better to specify what the UE shall instead of what the UE may do, otherwise UE behaviour would not be clear. Our proposal would be to remove all the sentences with “UE may” until further progress is made. | “UE may” is according to RAN1/RAN2 agreements and aligned with the behaviour of PEI in clause 7.2.1. |
| Nokia 002 | Many RAN1 agreements are now captured in RAN2 spec. How can we ensure that the same things are not specified in both RAN1 and RAN2 specifications? | This is aligned with the descriptions of PEI in clause 7.2.1 as much as possible. |
| Qualcomm 001 | The following highlight part should be changed to is not required or may not. UE based on implementation can perform MR measurement. 5.2.4.9.y Offloading measurement rules LP-WUS UE may choose to perform RRM measurement offloading according to requirements specified in TS 38.133 [8] if the entry condition for RRM measurement offloading in clause 5.2.4.9.z is fulfilled. LP-WUS UE is not allowed to perform RRM measurement offloading according to requirements specified in TS 38.133 [8] if the exit condition for RRM measurement offloading in clause 5.2.4.9.z is fulfilled. | Changed to “is not required” |
| Qualcomm 002 | In 5.2.4.9.z Offloading measurement criterion for LP-WUS, RSRQ should be considered if configured. | Whether RSRQ needs to be considered in serving cell measurement offloading criterion is an FFS.  Editor’s NOTE: FFS for the metrics of RRM measurement offloading. |
| SS002 | We propose to replace ‘LP-WUS UE’ with ‘UE supporting LP-WUS’ or ‘UE configured with LP-WUS’, as Sharp and Huawei mentioned. | An FFS is added in clause 5.2.4.2. |
| V001 | LP-WUS UE may further perform RRM measurement relaxation as specified in clause 5.2.4.9.0 or RRM measurement offloading as specified in clause 5.2.4.9.y | Updated. |
| V002 | “LP-WUS UE may choose to perform relaxed measurement according to requirements specified in TS 38.133 [8] if the entry condition for RRM measurement relaxation in clause 5.2.4.9.x is fulfilled.”  This is stage-3 specification, but not stage-2 specification. This general description didn’t reflect the UE behaviour. | A general description for RLM/BFD relaxation is added in TS 38.331. The similar general description is added here. |
| V003 | “FFS on exit condition for serving cell RRM relaxation, e.g., whether a separate exit condition other than ‘not fulfilling the entry condition’ is needed, or whether exit condition include MR and/or LR-based measurement”  This EN is not needed, as it is already captured in 5.2.4.9.x. | We can keep it and some descriptions maybe added in 5.2.4.9.0 when the FFS is removed. |
| V004 | 7.y Subgrouping for LP-WUS This part is almost the same as PEI. Suggest to merge them. | There are some differences, e.g. parameters are separated configured for PEI and LP-WUS, and the formula for UE\_ID based subgrouping for LP-WUS is different from that for PEI. Hence, prefer to keep them separately. |
| V005 | “The reference point is the start of the PF, or the first PF of the PF(s) (if mapping of POs from multiple PFs to one LO is supported), associated with the LO.”  Suggests to change it as the description of PEI in section 7.2.1, since the reference point is for LP-WUS frame not for the PF of the LP-WUS corresponding to. | In RAN1#120, it was agreed:  **Agreement**  For the offset value(s) between an LO and a reference PO/PF, at least a frame-level offset is provided.   * The reference point (reference PO/PF) for the frame-level offset is the start of the PF, or the first PF of the PF(s) (if mapping of POs from multiple PFs to one LO is supported), associated with the LO.   FFS other offset value(s) to determine the MOs of the LO  Hence, the reference point is a reference PO/PF according to RAN1 agreement. An LO is determined by the reference PO/PF and the configured frame-level offset. But in the description of PEI in section 7.2.1, the reference point is the start of a reference frame, which is similar as the time domain of an LO in LP-WUS. Maybe we can wait for RAN1’s further conclusion to decide the wording. |
| V006 | “the UE monitors the PO associated with the offset after receiving a wake-up indication in a LP-WUS,”  Suggests to changes it as “the UE could monitor the LO and monitors the PO associated with the offset after receiving a wake-up indication in a LP-WUS” , since we focus on the UE could monitor LP-WUS in this case. | This is captured according to RAN1’s agreement. |
| V007 | “, the UE monitors the LO associated with the smallest offset value that has a gap between the LO and the PO associated with the offset no less than the wake-up delay”  Suggest to change it “UE could monitor…” | This is captured according to RAN1’s agreement. |
| V008 | Suggest to add an EN as below:  Editor’s NOTE: FFS whether to change the term in PEI section, for example CN assigned subgrouping to change it as CN assigned subgrouping for PEI. | It is unclear where to add the EN. We can discuss it further. |
| OPPO001 | 3.3 Abbreviations In 3.3 Abbreviations, we can add the definition of LP-WUR, i.e., LP-WUR: Low Power-Wake Up Receiver | “LP-WUR” is not used in TS 38.304. |
| OPPO002 | In clause 5.2.4.9.z, for the exit condition of full offloading, the threshold maybe mandatory.  The exit condition for RRM mearement offloading is fulfilled when:  - Srxlev\_lr < SLP\_WUS\_offloadingExitThresholdP\_LR~~, if S~~~~LP\_WUS\_offloadingExitThresholdP\_LR~~ ~~is configured~~, | Updated. |
| Apple001 | Same comment as HW, SS on the definition of LP-WUS UE. The the term of LP-WUS UE should be defined clearly, whether it’s refer to UE supporting LP-WUS or configured with LP-WUS; whether it’s related to LP-WUS monitoring or LR based measurement or both. | An FFS for LP-WUS UE is added in clause 5.2.4.2. |
| Apple002 | Section 5.2.4.9.0/x/y/z  In Section 5.2.4.9.0, the new added part is for LR based serving cell measurement relaxation, but the legacy description is for neighbor cell measurement relaxation.  So it's better to provide the LR based serving cell measurement relaxation/offloading in the a new section and cover the Section 5.2.4.9.x/y/z. | No strong view whether to add a new section for the general description of serving cell measurement relaxation and neighbour cell measurement relaxation. Glad to hear more companies’ view on the issue. |
| Apple003 | Section 5.2.4.9.0  For neighbor measurement, RAN2 made some agreements and open issues as below, so it’s better to clarify the condition is based on serving cell quality measured by MR and capture some in the Editor’s NOTE in the spec.  *RAN2#126*  *=> RAN2 understand that the RRM measurement of the neighboring cell can only be performed by MR. Can discuss again if RAN1 inform us otherwise.*  *=> RAN2 will further discuss the neighbor cell measurement relaxation criteria (if the UE is using LR to measure the serving cell), e.g., considering reuse Rel-16 criteria for ‘not at cell edge’ and ‘low mobility’*  *RAN2#127bis*  *Working assumption*  *=>For neighbor cell measurement relaxation for UEs capable of LP-WUS, do not define additional MR-based criterion over the R16 criteria. RAN2 assume ‘UE not at cell edge’ is reused, FFS on ‘UE with low mobility’.*  *=>FFS (if needed) on enhancements based on R16 criteria (e.g., based on the LR measurements) for the case when MR serving cell measurement results are not available.*  *RAN2#128*  *=> FFS if the entry condition for serving cell RRM measurement relaxation is the same as neighbour cell RRM measurement relaxation* | For the understanding that RRM measurement of the neighbour cell can only be performed by MR, it doesn’t impact the general description or criteria of RRM measurement relaxation and serving cell offloading. We don’t need to capture it in TS 38.304.  It is unclear how to clarify the condition is based on serving cell quality measured by MR and capture some in the Editor’s NOTE in the spec. Maybe this can be captured in stage 2. |
| Apple004 | For serving cell measurement offloading/relaxation part, we may need to describe the OOK based and OFDM based operation/configuration. | An FFS on UE types is added. |
| SS003 | From Section 7.x.0,  ‘When the UE starts LP-WUS monitoring, if the UE detects LP-WUS and the LP-WUS indicates the subgroup the UE belongs to monitor its associated PO, as specified in clause 10.xx in TS 38.213 [4], the UE monitors the associated PO as specified in clause 7.1. If UE does not detect a LP-WUS on the monitored LO or the LP-WUS does not indicate the subgroup the UE belongs to monitor its associated PO, as specified in clause 10.xx in TS 38.213 [4], the UE is not required to monitor the associated PO as specified in clause 7.1. If the UE supports PEI and PEI is configured by the gNB, after the UE receives LP-WUS indicating the subgroup the UE belongs to monitor its associated PO, it is up to UE implementation whether to monitor PEI or not. ’  The yellow and green texts are contradictory. If a UE supports both LP-WUS and PEI, yellow text indicates to always monitor PO, while the green text indicates to monitor PEI (or not). If UE monitors PEI, whether to monitor PO or not should be based on PEI, not LP-WUS. | The green part is moved to the beginning of the paragraph. |
| SS004 | From Section 7.x.0, The below two paragraphs are not consistent. One talk about PO monitoring and other about LO monitoring. So we suggest to reword as follows:  ‘If single value is configured for *lo-Offset*, and if the gap between the LO and the corresponding PO is no less than the wake-up delay that the UE reports, the UE monitors the LO ~~PO~~ associated with the offset ~~after receiving a wake-up indication in a LP-WUS~~, otherwise UE does not monitor LO and follows the paging monitoring procedure as described in clause 7.1 and/or 7.2.  If more than one values are configured for *lo-Offset*, and if the gap between the LO associated with the largest offset and the corresponding PO is no less than the wake-up delay a UE supports, the UE monitors the LO associated with the smallest offset value that has a gap between the LO and the PO associated with the offset no less than the wake-up delay, otherwise UE does not monitor LO and follows the paging monitoring procedure as described in clause 7.1 and/or 7.2.’ | Updated. |

# Conclusion

Based on company feedback in section 2.1, the following is proposed:

**Proposal 1: General description and criteria of RRM relaxation and offloading for LP-WUS are captured in TS 38.304. Other details of RRM relaxation and offloading for LP-WUS are captured in RAN4.**

**Proposal 2: Send an LS to inform RAN4.**

The draft running CR has been updated according to the input in section 2.2. In addition, the following editor’s notes are added; companies are encouraged to address these open issues in their tdocs.

Editor’s NOTE: FFS on the terminology LP-WUS UE.

Editor’s NOTE: FFS (if needed) on enhancements based on R16 criteria (e.g., based on the LR measurements) for the case when MR serving cell measurement results are not available.

Editor’s NOTE: FFS on exit condition for serving cell RRM relaxation, e.g., whether a separate exit condition other than ‘not fulfilling the entry condition’ is needed, or whether exit condition include MR and/or LR-based measurements.

Editor’s NOTE: FFS for the metrics of serving cell RRM relaxation (i.e. RSRP and/or RSRQ).

Editor’s NOTE: FFS serving cell quality by MR is existing Srxlev/ Squal or Qrxlevmeas/ Qqualmeas (i.e. measured value).

Editor’s NOTE: FFS serving cell quality by LR is measured value.

Editor’s NOTE: FFS on exit condition for serving cell RRM relaxation, e.g., whether a separate exit condition other than ‘not fulfilling the entry condition’ is needed, or whether exit condition include MR and/or LR-based measurements.

Editor’s NOTE: FFS if the entry condition for serving cell RRM measurement relaxation is the same as neighbour cell RRM measurement relaxation.

Editor’s NOTE: FFS whether/how to capture separate thresholds for different UE types.

Editor’s NOTE: FFS relaxed measurement criteria is different from LP-WUS monitoring entry criteria.

Editor’s NOTE: FFS for the metrics of serving cell measurement offloading.

Editor’s NOTE: FFS whether/how to capture separate thresholds for different UE types.

Editor’s NOTE: FFS if entry/exit conditions are always configured.

Editor’s NOTE: FFS whether/how to capture separate entry/exit thresholds for OFDM-based and OOK-based WUR.

Editor’s NOTE: FFS on how the UE to determine the type of LP-WUS subgrouping considering the LP-WUS subgrouping configuration in the cell.

Editor’s NOTE: FFS X for UE\_ID.

# References

1. R2-2501094, LP-WUS and RRM measurements, Ericsson , discussion, RAN2#129

3GPP TS 38.304: "NR; User Equipment (UE) procedures in Idle mode and RRC Inactive state", v18.4.0