**3GPP TSG-RAN WG2 Meeting #123bis** **R2-230xxxx**

Xiamen, China, 9 – 13 October 2023

**Agenda item: 7.5.1**

**Source: Huawei, HiSilicon**

**Title: Open issues for RRC CR of XR enhancements WI**

**Document for: Discussion and Decision**

# 1. Introduction

This document aims to facilitate the discussion on open issues related to RRC CR for XR enhancements, as per the following e-mail discussion:

* [POST123bis][023][XR] 38.331 Running CR (Huawei)

Scope:

- Review running CR

- Identify open issues

- Get inputs for subset of open issues (focus more detailed open issues that would help with CR finalisation.

 Deadline: long

The comments on the changes implemented in the updated RRC CR can be provided by the companies directly in the CR using comments. In this document, companies are requested to provide their input for some of the open issues, mainly related to detailed stage-3 signalling. Please provide your contact details in the table below.

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| --- | --- |
| **Company** | **Delegate’s e-mail and name** |
| Ericsson | Richard Tano, richard.tano@ericsson.com |
| CATT | Pierre Bertrand, pierrebertrand@catt.cn |
| LGE | SeungJune Yi, seungjune.yi@lge.com  |
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# 2. Input for the RRC open issues

Following implementation of the latest agreements, many of the editor’s notes could be removed from the RRC CR. Some small changes were also made by the CR rapporteur, even though they were not agreed directly. For these, the companies are requested to provide their comments directly in the CR document. The remaining ones are discussed in the following subsections.

## 2.1 UAI triggering

There is a following EN in the running RRC CR:

“Editor’s note: The UE may not have UL traffic information available immediately after being configured to provide it by the gNB. RAN2 may need to discuss whether this should be handled somehow, e.g. specifying that the UE may delay the first transmission of this information until the relevant information is available at the UE.”

A number of contributions suggested to add a NOTE in specifications clarifying that the information should be provided by the UE only when it is available. There were also suggestions that UE could report that no satisfactory value of a certain parameter is available. The rapporteur believes that a NOTE would be sufficient, aiming to clarify that the UE is not required to report immediately, but may delay sending the information until it is available. The following note is then proposed:

“NOTE: The UE should only initiate transmission of the *UEAssistanceInformation* message to provide UL traffic information once the UE gathers sufficient information, i.e. it is not required to do so immediately after being configured to provide UL traffic information.”

**Question 1: Do you agree to add the following note in TS 38.331? Do you have any comment/suggestion on the wording of the note?**

**NOTE: The UE should only initiate transmission of the *UEAssistanceInformation* message to provide UL traffic information once the UE gathers sufficient information, i.e. it is not required to do so immediately after being configured to provide UL traffic information.**

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| **Company** | **Comments** |
| Ericsson | The note could be ok but it is questionable. The no satisfactory value may not only be an occurrence in the beginning, but also because of changes in the application.As for reporting the “no satisfactory value …” a simple option would be to simply use the lack of a reported value as such indication. Another option would be to explicitly report an empty value. Nothing more complicated than either of those options would be needed. |
| CATT | We agree with Ericsson: the note is only for the first UAI after configuration, and is not needed because there is no problem in that case. Indeed, RRC models the UAI reporting as follows:1) 5.7.4.2 Initiation1> if configured to provide UL traffic information:2> if the UE did not transmit a *UEAssistanceInformation* message with *ul-TrafficInfo* since it was configured to provide UL traffic information; or2> […]3> initiate transmission of the *UEAssistanceInformation* message in accordance with 5.7.4.3 to provide UL traffic information.2) 5.7.4.3 Actions…1> if transmission of the *UEAssistanceInformation* message is initiated to provide UL traffic information according to 5.7.4.2:2> for each PDU session for which the UE intends to provide UL traffic information in this *UEAssistanceInformation* message:3> […]4> if the jitter range measurement is available; and4> […]5> set *jitterRange* to the latest measured value of the jitter range;The above model does not mean that the UE will send an empty UAI in 5.7.4.3 if no measurement is available. For us, it is clear that the UE implementation will wait for the measurements to be available to send the UAI.However, we don’t share the Rapporteur’s view that the usecase we discussed in R2-2309704 suggesting UE could report that no satisfactory value of a certain parameter is available, falls in the same usecase, as it extends it after UE has already reported some measurements. The scenario is as follows:1) UE first reports converged measurements on BAT, jitter and periodicity2) In tethering case due to XR user motion, the above measurements which were once stable may not end-up being nicely converging anymore, for a period of time. That is, the previous reported value(s) is/are no longer valid, but no new value could be obtained with satisfactory accuracy to be reported.In such case, we believe it is important that UE informs the gNB about it rather than reporting inaccurate values or not reporting anything. In such case, gNB may then prefer to address the traffic with baseline dynamic scheduling rather than configured grants. One can argue, as for the above case, that when no value is seen satisfactory for the UE, even the previous values are no longer valid (hence have changed) the new measurement will not be considered as “available” in clause 5.7.4.3 and the UE will just not report anything waiting for some available results. True, however during this time gNB still believes that the previous reported values are valid and CG configs will not match the XR traffic anymore.One way to report that the UE did not converge to an accurate value for a given parameter can be via a special value in the value range.  |
| LGE | Ok with the Note. |
| Futurewei | General OK with the Note, except some editorial change as the following:**NOTE: The UE should initiate transmission of the *UEAssistanceInformation* message to provide UL traffic information only when the UE gathers sufficient information, i.e. it is not required to do so immediately after being configured to provide UL traffic information.** |

## 2.2 Supported frame rates and DRX periodicities

According to TR 38.835 [2]: “Most XR frame rates (15, 30, 45, 60, 72, 90 and 120fps) correspond to periodicities which are not an integer (66.66, 33.33, 22.22, 16.66, 13.88, 11.11 and 8.33ms respectively).”

When expressing these periodicities with rational numbers, they would correspond to:

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| --- | --- | --- |
| Frame rate [fps] | Periodicity in decimal number [ms] | Periodicity in rational number [ms] |
| 15 | 66.6(6) | 200/3 |
| 30 | 33.3(3) | 100/3 |
| 45 | 22.2(2) | 200/9 |
| 60 | 16.6(6) | 50/3 |
| 72 | 13.8(8) | 125/9 |
| 90 | 11.1(1) | 100/9 |
| 120 | 8.3(3) | 25/3 |

For both short and long DRX, cycles corresponding to the above frame rates were added in the running RRC CR. After this, there were already some long DRX cycles which were multiple of short DRX cycles, but some had to be added specifically:

For ms125over9, double and triple were added, i.e. ms250over9 and ms125over3

For ms200over9, double was added, i.e. ms400over3 (only one was added, since larger value may not be able to meet XR traffic’s PSDB requirement)

The resulting DRX configuration is as follows in the updated RRC CR:

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| DRX-ConfigExt2-v18xx ::= SEQUENCE { drx-NonIntegerLongCycleStartOffset-r18 CHOICE { ms25over3 INTEGER(0..8), ms100over9 INTEGER(0..11), ms125over9 INTEGER(0..13), ms50over3 INTEGER(0..16), ms200over9 INTEGER(0..22), ms250over9 INTEGER(0..27), ms100over3 INTEGER(0..33), ms125over3 INTEGER(0..41), ms200over3 INTEGER(0..66), ms400over3 INTEGER(0..133) }, shortDRX-r18 SEQUENCE { drx-NonIntegerShortCycle-r18 ENUMERATED {ms25over3, ms100over9, ms125over9, ms50over3, ms200over9, ms100over3, ms200over3, spare1 }, drx-ShortCycleTimer-r18 INTEGER (1..16) } OPTIONAL, -- Need R  drx-TimeReferenceSFN-r18 ENUMERATED {sfn512} OPTIONAL -- Need S} |

**Question 2: Companies are requested to provide comments on the current values of short and long DRX cycles, e.g. are any additional values needed etc.**

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| **Company** | **Comments** |
| Ericsson | The proposed numbers are quite limiting and likely not future proof (an inherent problem with the CHOICE solution). Some additional numbers that may be relevant to capture are (Based on SA4 [TR 26.949, "Video formats for 3GPP services"]):1001/120 = 8.34 ms (119.88 fps)1001/60 = 16.68 ms (59.94 fps)1001/30 = 33.36 ms (29.97 fps)1001/24 = 41.70 ms (23.97 fps)Furthermore it is questionable if the proposed numbers are capturing the agreement that “long DRX cycle shall be an **integer multiple** of the short DRX cycle”. The proposed values doesn’t span any real range of the **integer multiples**. A point of adding non rational numbers for both is to have flexibility to do sparser configuration of the longer cycle, thus there need to be more multiple values (e.g. ms125). |
| CATT | We are OK with the additional values proposed by Ericsson.BTW, regarding “*For ms200over9, double was added, i.e. ms400over3*” , should it be 400over9 instead? |
| LGE | We are wondering whether all the video formats should be considered in XR. According to TR 38.835 [2]: “Most XR frame rates (15, 30, 45, 60, 72, 90 and 120fps) correspond to periodicities which are not an integer (66.66, 33.33, 22.22, 16.66, 13.88, 11.11 and 8.33ms respectively).” Supporting those frame rates would be sufficient for XR.The last value should be 400over9 instead of 400over3. |
| Futurewei | Agree with CATT and LGE that the last value should be 400over9, instead of 400over3. |

## 2.3 Jitter and periodicity signalling

**Jitter**

With respect to jitter signalling, RAN2 needs to decide on:

* Range of the signalling values, e.g. [-4, 4], [-8, 8]
* Granularity of the signalling, e.g. 0.5ms, 1ms.
* Whether the jitter is symmetrical, i.e. lower and upper limit have the same value but opposite sign, or lower limit and upper limit can be different and should be reported separately.

For the rapporteur to prepare the signalling accordingly, companies are then requested to provide their views on the aspects mentioned above.

**Question 3: Please provide your view on jitter signalling in the table below.**

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| **Company name** | **Value range, e.g. [-4, 4], [-8, 8]** | **Granularity, e.g. 0.5ms, 1ms etc.** | **Symmetrical or asymmetrical** | **Rationale/comments** |
| Ericsson | [-8,8] | 0.5ms | Symmetrical  | In our understanding no assumptions on asymmetrical jitter ranges have been under study in RAN. TR 38.838 models a jitter range as a symmetrical [-4,4] ms truncated gaussian. Sticking to those assumptions seems like the simplest choice at this point in time. |
| CATT | [-4, 4] | 0.5ms | Asymmetrical | In UL, the jitter depends on the encoding delay of different types of video frames, so the distribution of this variation should not be expected to be Gaussian, but rather a bounded peak-to-peak value as also characterized in Figure 3b of *M. Lecci, M. Drago, A. Zanella, M. Zorzi, An Open Framework for Analyzing and Modeling XR Network Traffic, IEEE Access, Sept 2021*.Note RAN1 selected a symmetrical approach in their simulation framework, for simplicity as this didn’t have much impact on the performance results. |
| LGE | [-4, 4] | 0.5ms | Symmetrical | We think this is the simplest approach. |
| Futurewei | [-4, 4] | 0.5ms | Symmetrical |  |

**Periodicity**

Similarly, traffic periodicity signalling needs to be decided. Proposals that were mentioned included:

* Reuse of TSCAI signalling. Periodicity in TSCAI is defined as follows in TS 38.413:

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| 9.3.1.132 PeriodicityThis IE indicates the Periodicity of the TSC QoS flow as defined in TS 23.501 [9].

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| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| Periodicity | M |  | INTEGER (0..640000, …) | Periodicity expressed in units of 1 us. |

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* Follow the definition of non-integer DRX cycles. Short DRX cycles would be most appropriate since they only have values corresponding to the XR frame rates, as clarified in section 2.2:

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| drx-NonIntegerShortCycle-r18 ENUMERATED {ms25over3, ms100over9, ms125over9, ms50over3, ms200over9, ms100over3, ms200over3, spare1 }, |

* Reuse CG-like signalling, which is currently defined in TS 38.331 as follows:

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| periodicity ENUMERATED {sym2, sym7, sym1x14, sym2x14, sym4x14, sym5x14, sym8x14, sym10x14, sym16x14, sym20x14, sym32x14, sym40x14, sym64x14, sym80x14, sym128x14, sym160x14, sym256x14, sym320x14, sym512x14, sym640x14, sym1024x14, sym1280x14, sym2560x14, sym5120x14, sym6, sym1x12, sym2x12, sym4x12, sym5x12, sym8x12, sym10x12, sym16x12, sym20x12, sym32x12, sym40x12, sym64x12, sym80x12, sym128x12, sym160x12, sym256x12, sym320x12, sym512x12, sym640x12, sym1280x12, sym2560x12 } |

In rapporteur’s view, it seems straightforward to reuse the agreed DRX-like signalling for signalling of non-integer periodicities of traffic. However, there is also pose/control traffic which can have integer periodicity. Also, periodicity as specified with TSCAI currently allows to express the periodicity with a very high accuracy which would allow to easily signal a value of e.g. 33.33 ms which seems to be a sufficient approximation of the real periodicity. Considering the above, the rapporteur would like to propose to focus on two options:

* Option 1: Signal the periodicity with integer value for both integer periodicities and non-integer periodicities (in which case the value closest to the real periodicity value is signalled by the UE, e.g. 33,33ms is signalled for 100/3 ms)
* Option 2: Signal the periodicity differently (choice structure) depending on whether it is integer or non-integer value:
	+ Integer periodicities are signalled with integer value
	+ Non-integer periodicities are signalled in the same way as signalled for non-integer DRX cycles, e.g. ms25over3, ms100over9 etc.

Companies are also requested to provide their view on the signalling range and granularity, e.g. current TSCAI supports periodicities in the range of 0-640 ms signalled with a granularity of 1us.

**Question 4: Companies are requested to provide their views in the table below.**

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| **Company name** | **Preferred option** | **Signalling range** | **Granularity** | **Other comments** |
| Ericsson | Option 1 | 0, 640000 | 1us | Seems like a simpler choice to mimic the format from the CN. As for reporting Non-integer periods the same way as for DRX cycles, it seems such format limits the reporting ranges, a good solution may also consider other use-cases than XR where periodicity information may be useful. With 1us granularity we may future proof the solutions to capture all necessary traffic periodicities including non-integer as well as integer periods. |
| CATT | Option 1 | Same as TSCAI  | Same as TSCAI | Considering the precision provided by TSCAI approach, it is sufficient for such measurement.  |
| LGE | Option 1 | Same as TSCAI  | Same as TSCAI |  |
| Futurewei | Option 2 | For integer values: ms10 and ms20;For rational values: similar to the rational DRX cycles except the values due to doubling or tripling. | precise | To avoid mismatch due to rounding.  |

## 2.4 Confirmation of other parameter values

The current running CR contains editor’s notes capturing the need to confirm the values of several parameters:

* Remaining time threshold

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| remainingTimeThreshold-r18 ENUMERATED {ms5, ms10, ms15, ms20, ms25, ms30, ms50, spare} |

* PSI discard timer

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| PSI-DiscardTimer-r18 ::= ENUMERATED {ms0, ms5, ms10, ms15, ms20, ms25, ms30, ms40, ms50, ms60, ms75, ms100, ms150, ms200, ms300, ms500 } |

* UAI prohibit timer for UL Traffic Information

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| ul-TrafficInfoProhibitTimer-r18 ENUMERATED {s0, s0dot5, s1, s2, s5, s10, s20, s30, s60, s90, s120, s300, s600, spare3, spare2, spare1} |

**Question 5: Companies are requested to provide their comments on the proposed values of the parameters mentioned above, e.g. are any more values needed, are some values inappropriate etc.**

* **Remaining time threshold**

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| **Company** | **Comments** |
| Ericsson | These value options are way too limiting. Network need to be able to configure threshold values that make sense for the scheduling, depending on the future traffic and network options. There is simply no chance that any company knows today which values are the best ones, since this will depend on the future development of the traffic and network features. Thus the values need to have much higher granularity.We suggest to add threshold values as a range of INTEGER(1..255). |
| CATT | Ok with current values of *PSI-DiscardTimer* and *ul-TrafficInfoProhibitTimer*.As for the *remainingTimeThreshold*, the current values seem to us well suited for XR, although we are also OK with Ericsson proposal to leave more flexibility, with larger values, to be used by various types of delay-aware schedulers, as well as addressing other traffic types. |
| LGE | We think remaining time threshold does not need to have long values. Maybe maximum 15ms is sufficient. In addition, we don’t think many values are needed. Our suggestion is {ms5, ms10, ms15, spare}. |
| Futurewei | We are OK to have finer granularity for the remaining time threshold, e.g., {ms2, ms4, ms6, ms8, ms10, ms12, ms14, ms16, ms18, ms20, ms22, ms24, ms26, ms28, ms30, spare}. |

* **PSI discard timer**

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| **Company** | **Comments** |
| Ericsson | The proposed value range doesn’t seem to make sense. Why is majority of the values high values when PSI discard is to be used for SHORTER timer values than normal PDU Set discard? UL PDU Set discard has always been discussed to likely be configured around the UL PSDB values, which normally is assumed around ~30ms. PSI timer values should thus be significantly lower than this. And in this lower range the values are too few/too low granularity. Thus we should remove the higher values and increase the number of low values. There should at least be as high granularity in the low range as in legacy PDCP SDU discard (including the extensions). However also the legacy PDCP discard values would benefit of being increased, since now we are talking about configuring the discard around PSDB it would benefit of more granularity in those intervals for PDU Set discarding. Similar to the remaining time threshold it would be beneficial if this was a value range to support all possibilities and to be consistent it could cover the same range i.e. INTEGER(1..255).Existing discard timer values should be updated to also support similar granularity. |
| CATT | Ok with the current values. We have different view from Ericsson regarding large timer values. Indeed, the congestion state typically reflects a situation where the UE buffer is full of PDU Sets waiting for being transmitted, the vast majority of which already exceeded the PSDB anyways; otherwise there would not be congestion. Indeed, when the PDCP discard timer is configured with the target delay budget value set by SMF to NG-RAN (i.e. PSDB), congestion (i.e. the input data rate is momentarily larger than the output data rate) is less likely to occur since the PDU Sets exceeding their delay budget are discarded by PDCP. In other words such congestion situation most often occurs when RAN configured the discard timer to a value (much) larger than PSDB in order to keep delivering late PDU Sets, i.e. even when they exceeded their CN-configured delay budget, PSDB. |
| LGE | We are generally ok with the current value, but not sure whether the values higher than ms100 are really needed. |
| Futurewei | We agree with Ericsson that the PSI discard timer value, which is to be applied to low importance PDUs, should be smaller, e.g., {ms0, ms2, ms4, ms6, ms8, ms10, ms12, ms14, ms16, ms18, ms20, ms22, ms24, ms26, ms28, spare}.If a larger discard timer value is desirable, it should be applied to the legacy discardTimer, not to discardTimerForLowImportance, and it should be applied to high importance PDUs, not low importance PDUs. That is a different behaviour than what the PSI based SDU discard is intended for.  |

* **UAI prohibit timer for UL Traffic Information**

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| **Company** | **Comments** |
| Ericsson | The purpose of the prohibition timer is to avoid excessive signalling in case of highly dynamic frame rate changes. If the frame rate changes between e.g 60 and 90 fps i.e. 16.667ms to 11.1ms several times a second it may not be possible for some gNB implementations to adapt the scheduling or configurations fast enough. For these implementations higher value in order of 1 seconds may be sufficient. However for faster implementations lower values may be usable, e.g. in the order of milliseconds.New proposed values to use are {0ms, 200ms, 400ms, 600ms, 800ms, s1, s2, s5, s10, s30, s60, s120, s300, spare3, spare2, spare1}. |
| CATT | No strong view. Lower-end values proposed by Ericsson seem quite fast for UAI, but Ok to follow majority. |
| Futurewei | Should we also consider the infinity value? |

## 2.5 Other issues

If companies see any other issues to discuss/solve for the XR RRC CR, companies are requested to raise them here.

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| Company | Issue description |
| Ericsson | The added A here “– UECapabilityEnquiryA” shall be removed |
| Ericsson | This field description***drx-T~~t~~imeReferenceSFN***Indicates SFN used for determination of the offset of DRX cycle. The UE uses the closest SFN with the indicated number preceding the reception of *DRX-Config*, see TS 38.321 [3], clause 5.7. If the field *timeReferenceSFN* is not present, the reference SFN is 0.~~Editor’s note: The definition of timeReferenceSFN field might need to be updated depending on the final formula used for DRX cycle in TS 38.321.~~ Shall say “If the field drx-*TimeReferenceSFN* is not present, the reference SFN is 0.” |
| Ericsson | For *jitterRange* it says “This field shall only be reported by the UE together with the *burstArrivalTime* or after the UE had already reported *burstArrivalTime* during the ongoing RRC connection” where “during the ongoing RRC connection” is unprecise and “by the UE” is redundant as RRC specifies exactly what the UE shall do, maybe replace with “This field shall only be reported together with *burstArrivalTime* or after *burstArrivalTime* has been reported.” |
| Ericsson | In case of RRC connection re-establishment and if the UE is not configured with *attemptCondReconfig.* The UE should release the *ul-TrafficInfoReportingConfig*  and stop the timer T346x. This behavior is in line with other UAI configurations. If agreed the following sentence “release *ul-TrafficInfoReportingConfig*, if configured and stop timer T346x, if running” can be added in the procedure in section ‘5.3.7.2 Initiation’ and if the UE is configured with *attempCondReconfig* add the sentence to the procedure in section ‘5.3.7.3 Action following cell selections while T311 is running’.  |
| CATT | With R18 enhancements introduced in RAN1 on configured grants in support of XR, we expect CGs to be extensively used for such traffic types in UL. However, the legacy CG periodicities do not match the XR traffic periodicities, and similar to DRX, we believe it would be worth allowing an alternate configuration of such periodicity in rational number. |
| LGE | The name of the PSI-discard timer needs to be aligned with PDCP specification. In PDCP, the name of the timer is DiscardTimerForLowImportance.In addition, we think configuration restriction should be specified in RRC that the *PSI-DiscardTimer* is shorter than the *discardTimer*. |

# 3. Summary

 TBD