**3GPP TSG RAN meeting #98-e RP-22xxxx**

**Electronic Meeting, December 12-16, 2022**

## Status Report to TSG

**Agenda item:** 9.2.10

|  |  |
| --- | --- |
| **WI / SI Name** | Study on XR Enhancements for NR |
| included in this status report | Study Item: Yes | Core part: No | Performance part:No | Testing part:No |
| **Acronym** | FS\_NR\_XR\_enh |
| **Unique ID** | 940087 |
| **TSG Tdoc of latest approved WI/SI description (if any)** | [RP-220285](http://3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_95e/Docs/RP-220285.zip) |
| **Target Completion Date****(indicate if changed)** | Study Item: 12/2022 | Core part: N/A | Performance part: N/A | Testing part: N/A |
| **Overall Completion level** | Study Item: 80% | Core part: N/A | Performance Part: N/A | Testing part: |

**Source:**

|  |  |
| --- | --- |
| **Leading WG** | RAN2 |
| **Rapporteur** | **Name** | Benoist Sébire |
| **Company** | Nokia |
| **Email** | benoist.sebire@nokia.com |

## 1 Work plan related evaluation

|  |  |
| --- | --- |
| **Do you want to modify the time budget for this WI/SI compared to what was endorsed at the last RAN meeting?** | Yes |

The TR is not complete and only version 1.0.0 is submitted for information to this meeting. Note this is the first version submitted to RAN as it could not be submitted last time since it was not 60% complete then.

Since both SA2 and SA4 extended their studies by one quarter, RAN2 also needs one more quarter to conclude the study on XR awarenes. The TR will be submitted for approval then.

## 2. Detailed progress in RAN WGs since last TSG meeting (for all involved WGs)

## 2.1 RAN1

#### 2.1.1 Agreements

**RAN1 #109-e (May 2022)**

**Agreement**

The TR skeleton (in R1-2205329) for TR 38.835 Study on XR enhancements for NR is endorsed from RAN1 perspective. Send LS to RAN2 to convey this agreement. The LS to RAN2 is endorsed in R1-2205443.

XR specific power saving techniques

**Agreement**

Rel-17 evaluation methodology for XR power saving captured in TR 38.838 is used as the baseline evaluation methodology for UE power evaluation of Rel-18 SI on XR enhancements

**Agreement**

Companies are encouraged to compare performance of the following Rel-15/16/17 features with the proposed enhancements for Rel-18 XR power saving evaluations. Power saving gain is calculated w.r.t. the AlwaysOn baseline.

* Rel-15/16 CDRX including long DRX cycle, short DRX cycle and DRX command MAC CE and DCP
* Rel-17 PDCCH adaptation including PDCCH skipping and SSSG switching

Note: up to companies to report the configuration of the Rel-15/16/17 features

**Agreement**

For power saving study of Rel-18 XR SI, CDRX enhancements to evaluate in this study item are to be selected from the following:

* High priority Issue 1-1: Alignment between CDRX and XR traffic for resolving the mismatch between CDRX cycle and XR traffic periodicity for each flow
* High priority Issue 1-2: C-DRX enhancements to handle jitter
* Medium priority Issue 1-3: CDRX enhancements for multiple XR traffic flows [Note 2]
* Low priority Issue 1-4: CDRX enhancements to adjust to variable burst sizes and frame rate
	+ Note: Some companies think the adjustment for variable burst sizes can be realized by existing spec already
* Low priority Issue 1-5: low latency handling
* Low priority Issue 1-6: SFN wraparound mismatch (if handled in RAN1)

FFS: how the solutions or the combination of the solutions can handle all the identified issues.

Note 1: Other considerations are not precluded

Note 2: It can also be adopted for addressing issue 1-1

Note 3: Companies are encouraged to clarify or provide more details of the proposed solutions, for addressing concerns from the group.

Additional details can be found in R1-2205411.

**Agreement**

For power saving study of Rel-18 XR SI, PDCCH monitoring enhancements to evaluate in this study item are to be selected from the following

* Low priority Issue 2-1: Alignment between PDCCH monitoring and XR traffic to resolve the mismatch between PDCCH monitoring periodicity and XR traffic periodicity.
	+ Note: some companies think Rel-17 PDCCH monitoring adaptation can solve issue 2-1 or achieve similar intended outcome
	+ Note: Solutions proposed for Issue 2-1 and those proposed for Issue 1-1 are motivated by the same issue, namely non-integer XR traffic periodicity. It is to be studied how they compare in in terms of power saving gain and capacity, (a) solutions proposed for Issue 1-1; (b) solutions proposed for Issue 2-1.
* Low priority Issue 2-2: XR-dedicated PDCCH monitoring window to supplement CDRX for multi-flow traffic.
	+ Note: some companies think Rel-17 PDCCH monitoring adaptation can solve issue 2-2 or achieve similar intended outcome
	+ Note: Solutions proposed for Issue 2-2 and those proposed for Issue 1-3 are motivated by the same issue, namely multiple XR traffic flows. It is to be studied how they compare in in terms of power saving gain and capacity, (a) solutions proposed for Issue 1-3; (b) solutions proposed for Issue 2-2.
* High priority Issue 2-3: Enhancements to Rel-17 PDCCH monitoring adaptation.
	+ Note: Discussion on some enhancements may depend on the outcome of Rel-17 PDCCH monitoring adaptation maintenance
	+ Note: The study on enhancement to R17 PDCCH monitoring adaptation should focus on the techniques that are used for addressing XR-specific issues, e.g., jitter

Note 1: Other considerations are not precluded

Note 2: Companies are encouraged to clarify or provide more details of the proposed solutions, for addressing concerns from the group.

**Agreement**

For Rel-18 XR power saving enhancements, RAN1 further discusses by RAN1 #110 whether the issues below are to be addressed, and if so, which solutions should be selected for evaluation in this study item. These issues are low priority.

* Issue 3-1: Misaligned UE transmission and reception.
* Issue 3-2: Power saving by XR-aware scheduling.
	+ Note 1b: XR SI objective has XR-awareness in RAN listed as a specific topic of RAN2 study
* Issue 3-3: Unnecessary data transmission in allocated resources.

Note 1: Rel-18 XR SI objective only has CDRX enhancements and PDCCH monitoring enhancements explicitly listed as focus of RAN1 study

Note 2: Other considerations are not precluded

**Conclusion**

* If no evaluation result is provided by any company for an issue, the issue is deprioritized. The issue and proposed enhancements for the issue will not be captured by RAN1 in TR 38.835.
* If no evaluation result is provided by the proponent company for a proposed enhancement, the proposed enhancement is deprioritized. The proposed enhancement will not be captured by RAN1 in TR 38.835.
* If multiple enhancement techniques are proposed for the same issue, there can be down selection among them for the consideration of candidate enhancement for study item recommendation by RAN1 at least based on performance (power saving and capacity), spec impact, signaling overhead and implementation complexity.
* Companies are encouraged to provide detailed information for both the proposed enhancement and the existing power saving features used as the performance reference so that the evaluation results for both can be reproduced by other companies.
* When using existing power saving features as the performance reference, companies are encouraged to configure the existing power saving features to achieve the best performance.
* For evaluation of a proposed enhancement and evaluation of the existing power saving features as performance reference, companies are encouraged to provide the high load case (as defined in TR 38.838, Section A.2) results. Results for low load case can also be reported optionally.

XR-specific capacity enhancements techniques

**Agreement**

Rel-17 evaluation methodology for XR capacity enhancement captured in TR 38.838 is used as the baseline evaluation methodology for XR capacity enhancement of Rel-18 SI on XR enhancements.

**Conclusion**

Study of network coding for capacity enhancements during Rel-18 XR SI is down prioritized in RAN1.

**Agreement**

* For each candidate capacity enhancement technique for XR traffic, companies are encouraged to consider the following *common principle for assessment of the candidate capacity enhancement technique*:
	+ Identify the XR-specific issue(s) that the enhancement technique is addressing
	+ Identify the necessity of the enhancement technique to address the issues
	+ Identify whether/how the enhancements provide benefit/performance capacity gain.
		- Consider at least feasibility, complexity, and system level performance evaluations in comparing the enhancement techniques. Power saving gains for a given enhancement technique can optionally be evaluated and considered in addition to these other aspects.
* The baseline scheduling scheme when comparing the proposed capacity enhancements techniques is:
	+ Dynamic scheduling and/or
	+ Semi-persistent scheduling / Configured grant scheduling
		- Note: Companies are encouraged to additionally use DG scheduling as the baseline scheduling scheme when showing the capacity performance gain

**Agreement**

* To support a candidate capacity enhancement technique for XR traffic, capacity performance gain by the technique as compared to baseline should be shown.
	+ Capacity performance gain by the candidate technique as compared to baseline is a necessary condition to consider supporting the candidate technique.

**Conclusion**

Companies are encouraged to use the capacity Excel sheet attached with TR 38.838 in RP-213652 for recording the simulation results that are provided in their contributions.

**Agreement**

To study whether/how to support a candidate capacity enhancement technique for XR traffic based SPS/CG transmissions, companies are encouraged to consider the following studies:

* Study enhancements related to ~~support of~~ multiple PDSCHs SPStransmission occasions in a period
* Study enhancements related to multiple PUSCHs CG transmission occasions in a period
* Study enhancements related to dynamic adaptation of SPS/CG parameters/configurations
* Study enhancements related to non-integer periodicity for SPS/CG transmissions.
* Note: Other studies are not precluded, as well as the combination of the above studies.

Follow the common principle for assessment of the candidate capacity enhancement technique

**Agreement**

To study whether/how to support a candidate capacity enhancement technique for XR traffic based dynamic scheduling/grant transmissions, companies are encouraged to consider the following studies:

* Study enhancements related to extending capability of single DCI scheduling multi-PDSCHs/PUSCHs for FR2-2 to FR1/FR2.
* Note: whether and how to discuss enhancements may depend on the outcome of Rel-17 B52.6G UE feature discussion
* Study enhancements related to HARQ-ACK and/or CBG transmissions for single DCI scheduling one or multi PDSCH(s).
* Study enhancements related to allowing different configurations per PDSCH/PUSCH
* Study enhancement related to scheduling request and/or BSR with the focus on L1 enhancements.
* Note: Other studies are not precluded as well as the combination of the above studies.
* Follow the *common principle for assessment of the candidate capacity enhancement technique.*

**Conclusion**

It is common understanding that studying of RAN2 proposed techniques for XR-awareness information to improve XR capacity can be studied in RAN1 upon request from RAN2.

**Agreement**

The following lists the candidate enhancements techniques for link adaptation to improve XR capacity that are proposed by companies RAN1#109-e.

* At least the proponents are encouraged to justify the corresponding capacity benefits for XR traffic for considering potential study of these candidate enhancements techniques.
	+ Delta MCS
	+ Soft HARQ-ACK feedback
	+ Cooperative MIMO scheme via precoding technique - bi-directional training
	+ Enhanced link adaptation for CBG-based transmission
	+ CSI report enhancements to address the different BLER requirements of different XR flows
* Follow the *common principle for assessment of the candidate capacity enhancement technique.*

**Agreement**

The following lists the candidate enhancements techniques based on measurement-gap link to improve XR capacity that are proposed by companies RAN1#109-e.

* At least the proponents are encouraged to justify the corresponding capacity benefits for XR traffic for considering potential study of these candidate enhancements techniques.
	+ Dynamic L1 based MG activation/deactivation.
	+ Reuse current R16/R17 RRM relaxation condition to allow scheduling in MG to transform the R16/R17 RRM power saving gain into capacity gain.
* Follow the *common principle for assessment of the candidate capacity enhancement technique.*

**Agreement**

The following lists the candidate enhancements techniques to improve XR capacity that are proposed by companies RAN1#109-e.

* At least the proponents are encouraged to justify the corresponding capacity benefits for XR traffic for considering potential study of these candidate enhancements techniques.
	+ Inter-UE/intra-UE multiplexing techniques, including e.g. finer granularity preemption indication
* Follow the *common principle for assessment of the candidate capacity enhancement technique.*

**RAN1 #110 (August 2022)**

XR specific power saving techniques

**Conclusion**

Conclude that “SFN wraparound mismatch” is a RAN2 issue. It can be left to RAN2 to address. RAN1 does not further study it.

**Agreement**

RAN1 recommends identifying a solution for enhancement of CDRX to align with XR traffic periodicity

**Conclusion**

RAN1 does not assume instantaneous jitter value for a frame is predictable for Rel-18 XR SI power saving study before further input is provided by SA.

**Conclusion**

All the proposed PDCCH monitoring adaptation/reduction schemes including those for jitter handling need to be compared against the Rel-17 PDCCH monitoring adaptation which is to be used as performance reference.

**Conclusion**

UE transmission and reception alignment for Issue 3-1 is deprioritized for power saving in Rel-18 XR SI.

**Conclusion**

RAN1 does not assume dynamic switch of different XR video data rates or frame rates for Rel-18 XR power saving study before further input is provided by SA.

**For future meetings**

Companies are encouraged to account the enhancement of CDRX to align with XR traffic periodicity in their further evaluations for XR power saving enhancements.

**Conclusion**:

* Companies are requested to use the Excel sheet attached with TR 38.838 in RP-213652 for recording the simulation results that are provided in their contributions.

XR-specific capacity enhancements techniques

**Agreement**

RAN1 to make decision on the following in RAN1#110bis-e

* Support single DCI scheduling multi-PDSCHs/PUSCHs which is currently supported for FR2-2 to other SCS in FR1/FR2

**Conclusion**

There is no consensus in RAN1 on the benefits of enhancing SPS for the purpose of XR capacity enhancement

**Agreement**

When DG is used as the baseline scheme, for the performance evaluation scheduling, after SR is triggered, both BSR and UL data can be transmitted using the UL grant after SR.

* Companies are encouraged to provide the size of resources by the first UL grant after SR

**Agreement**

Whether/how to enhance BSR to improve capacity performance of XR traffic is within RAN2 scope and is not handled by RAN1.

* Note that companies should indicate if and what BSR enhancement is assumed in their RAN1 proposals on CG and DG enhancements.
* RAN1 can evaluate BSR enhancement to improve capacity performance

**Agreement**

Deprioritize the study of CQI report for different BLER and/or different XR traffic to improve XR capacity performance.

**Agreement**

Deprioritize the study of intra/inter UE prioritization/multiplexing enhancements to improve XR capacity performance.

**For future meetings:**

Companies are **requested to follow** the following agreement and conclusion from RAN1#109-e. Check final FL summary for details.

* **Agreement**
	+ Rel-17 evaluation methodology for XR capacity enhancement captured in TR 38.838 is used as the baseline evaluation methodology for XR capacity enhancement of Rel-18 SI on XR enhancements.
* **Conclusion**
	+ Companies are encouraged to use the capacity Excel sheet attached with TR 38.838 in RP-213652 for recording the simulation results that are provided in their contributions.

**RAN1 #110bis-e (October 2022)**

XR specific power saving techniques

**Agreement**

For enhancement of CDRX to align with XR traffic periodicity (i.e., Issue 1-1)

* Prioritize semi-static solutions
	+ FFS: Whether dynamic solutions will be also needed

**Conclusion**

“Retransmission-less CG for UL pose transmission (Item 3.3-5)” is a RAN2 issue, leave the discussion to RAN2, RAN1 does not further investigate the issue.

* Note: how to capture evaluation results and findings will be separately discussed

**Conclusion**

RAN1 does not further study jitter handling by LP-WUS (Item 2.2-4) in Rel-18 XR SI

* Note: how to capture evaluation results and findings will be separately discussed

**Conclusion**

In addition to the values for jitter in Table 5.1-2 in TR 38.838, the following statistical parameters for jitter can also be optionally evaluated in Rel-18 XR SI.

* Note: This optional assumption is not applicable to the evaluation of 90 FPS and above

|  |  |  |
| --- | --- | --- |
| Parameter | unit | Optional value for evaluation |
| Mean | ms | 0 |
| STD | ms | 5 |
| Truncation range | ms | [-8, 8] |

**Conclusion**

RAN1 deprioritizes DCP indicated SSSG switching (Item 3.3-4)

* Note: how to capture evaluation results and findings will be separately discussed

XR-specific capacity enhancements techniques

**Agreement**

To study whether/how the enhanced CG candidate techniques are necessary and beneficial for improving XR capacity, focus at least on the following techniques:

* Dynamic indication of the unused CG PUSCH occasion(s) or resource(s) by the UE
* Increase CG PUSCH transmission occasions in a duration

**Conclusion**

No further discussion in RAN1 for Rel-18 XR to extend the support of legacy single DCI scheduling multi-PDSCHs for FR2-2, to other SCS in FR1/FR2-1*.*

**Conclusion**

The capacity gain performance results in R1-2208661, R1-2209658 and R1-2209198 corresponding to enhancements based on multi-PDSCH scheduling by a single DCI are captured in XR SI TR

**Conclusion**

Study on enhancement for CBG based HARQ-ACK feedback reporting is down-priorotized in RAN1 XR SI.

**Conclusion**

The following proposed enhancements techniques to improve XR capacity performance are down-priorotized in RAN1 XR SI:

* (P3-5-3) Study on PHR enhancement based on XR traffic arrival periodicity or UL pose periodicity.
* (P3-5-4) Study mechanism of packet dropping based on the PDB requirement, to avoid resource waste due to the out-of-date packets.

**Agreement**

* For further study the mechanisms to enable HARQ retransmission of a TB on a different cell than the cell of the initial TB transmission for CA operation on TDD cells, consider at least the following:
	+ Capacity performance evaluation results
	+ Complexity analysis and RAN2 impact

**Conclusion**

* Study of soft HARQ-ACK and Delta MCS in RAN1 XR SI for improving XR capacity is down-priortized.
* Note: The corresponding capacity gain performance results in R1-2210003, R1-2208377 and R1-2203607 are captured in XR SI TR.

**Conclusion**

* Study on enhanced CQI based on CBG transmission, and study on enhanced CQI based on DMRS for improving XR capacity are down-priortized in RAN1 XR SI.
* Note: The corresponding capacity gain performance results in R1-2208402 and R1-2209536 are captured in XR SI TR.

**Conclusion**

Study on *Cooperative MIMO via DL interference probing based on SRS* enhancement for improving XR capacity is down prioritized in RAN1 XR SI.

Note: The corresponding capacity gain performance results in R1-2208377 are captured in XR SI TR.

**Conclusion**

No consensus to continue study on differentiation of XR multiple flows based on CG enhancement in RAN1 XR SI.

**Conclusion**

No consensus to continue study of multi-bits SR mechanisms for capacity improvement of XR traffic in RAN1 XR SI.

**RAN1 #111 (November 2022)**

XR specific power saving techniques

**Conclusion**

There is no consensus on the following proposals in Table 1 for CDRX enhancements and Table 2 for PDCCH monitoring enhancements.

**Table 1: CDRX enhancements**

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| --- |
| **Proposal for CDRX enhancements** |
| **Proposal 2.2**: support dynamic periodicity alignment between CDRX and XR traffic |
| **Proposal 2.3-1:** support additional active time by UE extending DRX active time if UE does not receive XR data within current active time |
| **Proposal 2.3-2:** support additional active time by gNB using dynamic signaling such as a DCI to trigger additional On Duration if the data packet arrives after the On Duration expires |
| **Proposal 2.4**: support non-uniform PMOs within CDRX On Duration  |
| **Proposal 2.5**: support two-stage CDRX On Duration |
| **Proposal 2.6-1**: support early stopping of On-Duration timer by inactivity timer expiration |
| **Proposal 2.6-2**: support early stopping of On-Duration timer after a time window after the reception of XR data  |
| **Proposal 2.7**: support multiple active CDRX configurations |
| **Proposal 2.8**: support dynamic grant enhancement with XR-specific pre-scheduling |
| **Proposal 2.9**: support SPS+DG with UE power saving scheme |
| **Proposal 2.10**: Support XR-specific plyaoutDelayForMediaStartup for XR UE power saving enhancement  |

**Table 2: PDCCH monitoring adaptation enhancements**

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| --- |
| **Proposals for PDCCH monitoring adaptation enhancements** |
| **Proposal 3.1:** support PDCCH monitoring resume if UE transmits NACK after PDCCH skipping starts |
| **Proposal 3.2-1:** support PDCCH skipping duration enhancements by additional PDCCH skipping durations (>3) |
| **Proposal 3.2-2:** support PDCCH skipping duration enhancements by PDCCH skipping till the start of next potential data arrival |
| **Proposal 3.3-1**: support non-scheduling DCI based PDCCH skipping indication  |
| **Proposal 3.3-2**: support continuous PDCCH skipping, i.e., UE continuously skips the PDCCH MOs until the DCI is successfully decoded at the time of packet arrival |
| **Proposal 3.4**: support an implicit SSSG at the start of drx-OnDuration and another SSSG applies when a PDCCH for data traffic is received, with search space set monitoring pattern aligned with DRX cycle |

XR-specific capacity enhancements techniques

**Agreement**

TPs for XR TR in R1-2212732 is endorsed in principle.

**Conclusion**

* The capacity gain performance results in R1-2210907 (Huawei/HiSilicon) corresponding to enhancements based on UL delay aware scheduling are captured in XR SI TR.

**Conclusion**

* The capacity gain performance results in R1-2211906 (ZTE/Sanechips) and R1-2211175 (CATT) corresponding to BSR enhancements are captured in XR SI TR.

**Conclusion**

* The capacity gain performance results in R1-2211175 (CATT) corresponding to enhanced CG+DG scheme are captured in XR SI TR.
	+ Note: SU-MIMO is used for baseline and MU-MIMO for the proposed enhancement.

**Conclusion**

* The capacity gain performance results in R1-2211175 (CATT) corresponding to XR-specific *playoutDelayForMediaStartup* enhancement scheme are captured in XR SI TR.

**Agreement**

Support dynamic indication of the unused CG PUSCH occasion(s) based on UCI (e.g., CG-UCI or a new UCI) by the UE

**Agreement**

Support multiple CG PUSCH transmission occasions in a period of a single CG PUSCH configuration

**Conclusion**

No consensus on the following:

Support dynamic indication of the unused CG PUSCH resource(s) based on UCI (e.g., CG-UCI or a new UCI) by the UE

**Conclusion 3-1:**

* Deprioritize discussion on HARQ retransmission of a TB on a different cell than the cell of the initial TB transmission for CA operation on TDD cells in XR agenda.

**Conclusion 5-5:**

* Deprioritize in RAN1, the study of XR-specific *playoutDelayForMediaStartup* for XR awareness scheduling to improve XR capacity enhancement.

**Conclusion 4-1:**

* The capacity gain performance results in R1-2210907 and R1-2212254 corresponding to enhancements on RRM measurement are captured in XR SI TR.

**Conclusion**

No consensus on the following:

Enhancements on RRM to relax scheduling restriction for at least for intra-frequency RRM without MGs in FR2 and for inter-frequency RRM with MGs

**Agreement**

The following TP for section 5.3.1 is endorsed in principle for TR 38.835:

|  |
| --- |
| *The following enhancements for configured grant based transmission are recommended:** *Multiple CG PUSCH transmission occasions in a period of a single CG PUSCH configuration;*
* *Dynamic indication of unused CG PUSCH occasion(s) based on UCI (e.g., CG-UCI or a new UCI) by the UE.*

*The corresponding capacity performance evaluation results are available in Annex B.1.6.**The evaluation results for other proposed and studied capacity enhancement schemes are available in Annex B.1.* |

#### 2.1.2 Remaining Open issues

In accordance of the SID:

- There is no remaining open issue.

## 2.2 RAN2

#### 2.2.1 Agreements

Agreements from **RAN2#119-e** meeting:

- RAN2 does not intend to ask RAN1 to change their simulation assumptions;

- RAN2 should take SA2/SA4 work into account.

- RAN2 assumes that PDU Set based parameters and PDU Set related information may be used for better support of XR services. RAN2 can consider both UL and DL directions.

- RAN2 will study PDU Set based parameters and PDU Set related information handling in Network and UE.

- RAN2 to adopt the current SA2 definition of PDU Set as an application media unit as working assumption, subjected to further guidance from SA2 and SA4.

- XR awareness discussion in RAN2 should consider PDU set characteristics and how to use the information available on those (for UL and/or DL). Can also consider how to handle data bursts.

- RAN2 can study e.g. periodicity, arrival time, jitter and frame-size variations for XR awareness to enable power savings and capacity enhancements. Can study also how often such parameters change (i.e. how dynamic they are).

- RAN2 can consider how PDU sets can be mapped to DRBs (FFS if SA2 discussion on PDU set mapping to QoS (sub-)flows impacts this).

- RAN2 to focus on the following issues for power saving, as well necessary parameters XR-awareness to support such enhancements, i.e.:

- DRX enhancements to address the issues of DRX cycle mismatch and jitter;

- Identify necessary parameters from CN for XR-awareness for power saving.

- Enhancements to Rel-17 PDCCH adaptation can be discussed based on RAN1 feedback, if they have any RAN2 impact.

- RAN2-specific aspects can be studied based on contributions (e.g. multiple XR traffic flows with different periodicities, SFN wrap-around, RAN2-specific CDRX aspects, …).

- As starting point, RAN2 can further discuss the solutions in TR 38.838 that can impact on L2 operation (e.g., BSR, LCP, assistance information for scheduling, packet discarding, prioritization) for XR-specific capacity improvement. RAN2-specific solutions are not precluded (even if RAN1 hasn’t discussed them before).

- Enhancement to SPS/CG should be justified for XR scheduling and should be evaluated against dynamic grant (DG) scheduling which should be considered as baseline. Should justify why enhancements are needed.

- RAN2 considers SPS enhancements may not be needed in Rel-18 XR since PDCCH capacity is not assumed to be a problem for XR. FFS if SPS has some power consumption benefits.

Agreements from **RAN2#119bis-e** meeting:

- From RAN2 viewpoint, the following information would be useful for PDU set handling in UL and DL:

- Semi-static information (from CN to RAN): At least PSER and PSDB;

- Dynamic information: At least identifying which PDU belongs to which data burst/PDU set is also needed, including means to determine at least PDU set boundaries.

- Capture the models 1a/b, 2a/b (from [R2-2209777](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_119bis-e/Docs/R2-2209777.zip)) in TR and indicate what is possible in current specifications and how. FFS how LCH options work in each case

- SDAP maps each data packet in a PDU set to a single PDCP SDU, as in legacy (i.e. each PDU is only mapped to a single SDU).

- HARQ and RLC re-/transmissions for XR traffic are done as in legacy (i.e. they are not based on XR PDU sets).

- For UE transmitter, the PDCP discard should be performed per PDU set basis.

- For UE transmitter, the PDCP discard is managed per SDU for PDU set, the PDCP entity discards all PDCP SDUs associated with the PDU set.

- At least RRC pre-configuration and switching of configurations of DRX could be considered for enhancements of XR power saving. Other solutions are not precluded and can be further discussed.

- Introduce new BS table(s) to reduce the quantisation errors (e.g. for high bit rates). FFS how new BSR tables are created and how they impact BSR formats (can be discussed in WI phase).

- Delay information consists of at least “remaining time”.

- RAN2 considers a delay information is useful for XR. FFS if dynamic reporting from UE to network (e.g. via BSR) is needed, or whether PSDB is sufficient. If we have delay information, it needs to distinguish how much data is buffered for which delay value. Stage-3 details (e.g. what’s contained, how the triggering is done) can be discussed in the WI phase.

- If we have delay information reporting, RAN2 aims to define how the UE determines the “remaining time” in the delay information.

- Current CG configurations can be reused for UL XR traffic. FFS if enhancements are needed (RAN1 is already discussing something). RAN2 can discuss this in the next meeting.

- RAN2 can discuss potential enhancement to provide some assistant information on UL XR traffic for CG configurations at the gNB. FFS whether TSCAI can already provide all necessary information.

- RAN2 discuss whether additional traffic or QoS related information on downlink traffic beyond what has been agreed by SA2 needs to be provided to RAN for UE power savings.

- RAN2 study what traffic and QoS related information on uplink traffic (e.g. counterpart of what has been agreed by SA2) should be provided to RAN for UE power savings and how the information may be provided to RAN.

- Capture in TR that traffic parameters and Jitter are semi-static info.

- Can capture also SA2 agreements related to how they impact RAN2.

Agreements from **RAN2#120** meeting:

- N1N excluded.

- Splitting DRB into multiple LCH (DC like) FFS.

- Should try to understand why we would need to treat PDU sets differently over the radio and why different PDU sets are muxed over same flows. Also need to understand need for reordering. LS to SA2/SA4 sent in R2-2213351.

- Agree that UE identifies PDU Sets / Bursts.

- In-band marking not needed. Further information considered if BSR is not enough.

- Handling of discard FFS.

- Regarding making LCP delay aware:

- If delay-aware LCP is introduced, need the ability to turn it off;

- SRBs not impacted.

- Not considered further unless fundamental issues are identified.

- RAN2 to support timer-based discarding of UL transmit side of PDCP PDU/SDUs of a PDU set. FFS how this is modelled in PDCP specification, can be discussed in WI phase.

- RAN2 aims to allow XR frame rates that correspond to non-integer periodicities in at least semi-static manner (e.g. RRC). Details can be left to WI phase.

- RAN2 thinks we need one or more additional BSR table(s) for XR. FFS whether these are static (=specified) or dynamic (e.g. generated, differs according to some RRC parameter), can be discussed in WI phase.

- RAN2 will introduce data volume information associated with delay information (e.g. remaining time) in a MAC CE. FFS if this is extension of BSR or new format. FFS how to do that (e.g. what exactly is reported) and how to ensure this information is up-to-date e.g. considering UL scheduling delay.

- RAN2 needs to discuss additional BSR triggering conditions to allow timely availability of buffer status information at gNB. This can be discussed in WI phase.

- RAN2 sees some benefit from CG to XR services. RAN2 will address enhancements triggered by RAN1 work. - RAN2 agrees some assistance information can be beneficial (e.g. periodicity, packet size). RAN2 assumes baseline could be TSCAI (pending SA2 conclusions), can discuss during WI phase whether something additional is needed on top of that. If any assistance information is needed, its definition should be standardized.

- RAN2 thinks all information may not be always available at UE application.

#### 2.2.2 Open Issues

In accordance of the SID:

- Finish identifying mechanisms for XR-awareness.

## 3. Detailed progress in SA WGs since last TSG meeting (for all involved WGs)

## 3.1 SA2

The SA2 status report is available in S2-22xxxxx.

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