[94e-15-R18-XREnh] - Version 0.0.3
RAN

3GPP TSG RAN#94e RP-213544

Electronic Meeting, December 06 - 17, 2021

Source: Moderator of XR Enhancements (Nokia)

Title: Moderator's Final Summary on "[RAN94e-15-R18-XREnh]"

Document for: Endorsement

1 Initial Phase - now closed

1.1 Justification of the SID

Please add here if you have any suggestion for revision of the draft **Justification** text in RP-212711.

Feedback Form 1: Suggestions for revising the Justification

1 – Ericsson LM The proposed justification-section looks fine from our point of view.
2 – Futurewei Technologies We have 2 comments on the justification section: - The main conclusion from the Rel-17 XR evaluation SI ("Based on the study, it is recommended to further study and enhance at least the capacity and UE power consumption performance of 5G NR for XR and CG applications.") should be included as motivation for capacity and power saving study in Rel-18. - The statement that "**From the Release 17 Study item on "XR evaluations" it is clear that XR application awareness by UE and gNB would improve the user experience, improve the NR system capacity in supporting XR services, and reduce the UE power consumption**" is not accurate as we do not have such study or conclusion in the Rel-17 XR evaluation SI though we may agree this is the case. Suggest to revise.
3 – DOCOMO Communications Lab. The proposed justification-section looks fine to us.
4 – Spark NZ Ltd Proposed justification is also good from our point of view

5 – HuaWei Technologies Co.

Generally, we are fine with the justification of the SID in RP-212711. However, the justification for XR-awareness in RAN can be further improved by adding some examples, which are already identified in the approved SA2 study item S2-2109360. These example can help RAN WGs for better understanding the work of XR-awareness in RAN. Therefore, we propose the following modifications.

"The set of anticipated XR and CG services has a certain variety and characteristics of the data streams (i.e., video) may change "on-the-fly", while the services are running over NR. Therefore, additional information, ***e.g. the QoS flow association, frame-level QoS, ADU-based QoS, XR specific QoS etc,*** *on the running services from higher layers may be beneficial to facilitate informed choices of radio parameters.*

6 – Intel

The proposed justification section looks fine from our point of view.

7 – ZTE Corporation

Comment # 1

Many of the XR and CG use cases are characterised by quasi-periodic traffic (with possible jitter) with high data rate in DL (i.e., video steam) combined with the frequent UL (i.e., pose/control update) and/or UL video stream. Both DL and UL traffic are also characterized by relatively strict packet delay budget (PDB). Hence, there is a need to study and potentially specify possible solutions to better support such challenging services, ~~i.e., by better matching the non-integer periodicity of traffic, such as 60/90/120 frames per second to the NR signalling.~~

We don't think a particular scheduling scheme should be listed in the justification part. Potential enhancement should be dealt with under the objectives if needed at all.

Comment # 2

Many of the end user XR and CG devices are expected to be mobile and of small-scale, thus having limited battery power resources. Therefore, additional power enhancements may be needed to reduce the overall UE power consumption when running XR and CG services and thus extend the effective UE battery lifetime. From the Release 17 Study Item on "XR evaluations" it is identified that the current DRX configurations do not fit well for (i) the non-integer XR traffic periodicity, ~~(ii) variable XR data rate and (iii)~~ (ii) quasi-periodic XR periodicity, hence enhancements would be beneficial in this area.

According to the simulation in Rel-17 study item, variable XR data rate does not affect DRX configuration. Therefore, it is suggested to delete (ii)variable XR data rate.

Comment # 3

With HW's clarification, the term 'on the fly' seems to imply differentiated granularity of QoS switching during a given data stream, which unfortunately was not studied in the Rel-17 RAN1 study. We prefer to simply delete the relevant phrase.

The set of anticipated XR and CG services has a certain variety ~~and characteristics of the data streams (i.e., video) may change "on-the-fly vary, while the services are running over NR~~. Therefore, additional information on the running services from higher layers may be beneficial to facilitate informed choices of radio parameters. From the Release 17 Study item on "XR evaluations" it is clear that XR application awareness by UE and gNB would improve the user experience, improve the NR system capacity in supporting XR services, and reduce the UE power consumption. It is expected that SA Working Groups would lead the work on identifying necessary enhancements to improve XR awareness, and that RAN will be made aware of these enhanced parameters and can potentially tailor the radio processing of XR traffic.

8 – SHARP Corporation

We are fine with the proposed justification

9 – Guangdong OPPO Mobile Telecom.

We are generally fine with justification. However, the following bullets were not identified from R17 study item. So we suggest to remove them.

- "From the Release 17 Study Item on "XR evaluations" it is identified that the current DRX configurations do not fit well for (i) the non-integer XR traffic periodicity, (ii) variable XR data rate and (iii) quasi-periodic XR periodicity, hence enhancements would be beneficial in this area."
- "From the Release 17 Study item on "XR evaluations" it is clear that XR application awareness by UE and gNB would improve the user experience, improve the NR system capacity in supporting XR services, and reduce the UE power consumption"

10 – Apple GmbH

Overall the justification section of the draft SID looks good. We suggest the following addition:

"From the Release 17 Study Item on "XR evaluations" it is identified that the current DRX configurations do not fit well for (i) the non-integer XR traffic periodicity, (ii) variable XR data rate, ~~and~~ (iii) quasi-periodic XR periodicity, (iv) multiple data flows such as pose/control and video, hence enhancements would be beneficial in this area."

11 – NEC Corporation

We are fine with the proposed justification.

12 – Nokia Corporation

We are generally fine with the justification. Mentioning of the non-integer periodicity of the traffic would be good to retain as that is obviously one of the key motivations to take action and improve current solutions, and something we expect to face from difference codecs used in XR domain.

13 – LG Uplus

Fine with the justification now. Other point is to have "e.g bracket part" in Justification section instead of Objective section if many companies have strong concern for having it objective part.

14 – Motorola Mobility España SA

The justification looks fine to us.

15 – MediaTek Inc.

We support the justification as is.

16 – VODAFONE Group Plc

(in line with previous comments) As other tasks in the UE are highly power consuming for XR, I remain sceptical about "XR power saving". But it is necessary to adapt to the non-ms periodicity of the data streams. hence it would be much more accurate to just say:

Many of the end user XR and CG devices are expected to be mobile and of small-scale, thus having limited battery power resources. ~~Therefore, additional power enhancements may be needed to reduce the overall UE power consumption when running XR and CG services and thus extend the effective UE battery lifetime.~~ From the Release 17 Study Item on "XR evaluations" it is identified that the current DRX configurations do not fit well for (i) the non-integer XR traffic periodicity, (ii) variable XR data rate and (iii) quasi-periodic XR periodicity, hence enhancements would be beneficial in this area.

17 – InterDigital

We are fine with the proposed justification

18 – Sony Europe B.V.

The proposed justification section looks fine from our point of view.

19 – Facebook

The justification looks fine.

20 – Qualcomm Korea

We are fine with the proposed justification section.

21 – Philips International B.V.

We are generally fine with justification.

22 – China Mobile Com. Corporation

We are fine with the proposed justification.

23 – Samsung Electronics Co.

We are fine with the proposed justification.

24 – Spreadtrum Communications

We are fine with the proposed justification.

1.2 Objectives - XR Awareness

The Objectives in RP-212711 are assumed to be rather stable. Please add any suggestions here if you strongly believe some changes to the Objectives on **XR awareness** are needed.

Feedback Form 2: Comments on XR Awareness objectives

1 – Ericsson LM

We think the brackets with the examples should be removed. They are only related to "QoS metrics", but not to "application layer attributes" hence the list is not complete. But the list will never be complete anyway and we do not think that we should put restrictions to what attributes should be studied. The study itself should evaluate which metrics/attributes are beneficial for XR.

We think the simplest approach is to remove the text inside the brackets. After the study, there will of course be a concrete list on what to specify.

2 – CATT

We agree with Ericsson that the brackets with examples are not necessary to be included.

The objective of XR awareness is for gNB scheduling to optimize the resource allocation with awareness of the XR traffic characteristic, QoS metrics, and application attributes. Thus, the gNB scheduling with XR awareness should have RAN1 in the study of this objective.

The XR traffic characteristic would be from either XR server or XR device at the UE. Thus, the XR awareness should include the study of mechanism in retrieving the XR service, such as UE feedbacks and CORE network service request. This mechanism of retrieving XR characteristic from services request and bear establishment should include not only RAN2 but also RAN1 and RAN3.

3 – vivo Mobile Communication Co.

In addition to the QoS relevant information, other XR specific information for could be also considered during the study item phase, like XR characteristics or application layer attributes, as mentioned in the main bullet. For example, frame boundary, packet importance/priority, latency requirements, etc., may also beneficial for the XR specific traffic handling.

Besides, frame-level QoS and ADU-based QoS have the similar meaning, considering ADU could be defined as frame level. So there might be duplication here.

Thus, we think the ”example part” in the first bullet should be removed or updated as below:

Study and identify the XR traffic (both UL and DL) characteristics, QoS metrics, and application layer attributes beneficial for the gNB to be aware of, e.g. [the QoS flow association, frame-level QoS~~, ADU-based QoS~~, XR specific traffic attributes~~QoS~~, Jitter, etc.]

4 – T-Mobile USA Inc.

TR38.38 contains several traffic models, there is no need for RAN2 to duplicate this work. ”**Study and identify the XR traffic (both UL and DL) characteristics”** basically opens up the discussion to traffic models that go beyond what that RAN1 previously concluded in TR38.838.

Scope of this objective isn’t to reopen the discussion on traffic types. Change text to: ”

Using the traffic characteristics identified in TR 38.383 version 17.0.0 identify the XR specific traffic attributes that the gNB would benefit from being aware of. ”

5 – Futurewei Technologies

The brackets with the examples can be removed. They should be outcome of the studies, as joint efforts of RAN2 and SA2, based on the feasibility and benefit.

6 – DOCOMO Communications Lab.

We agree with Ericsson that the example part with the brackets should be removed.

7 – Spark NZ Ltd

We also agree with the proposal of Ericsson

8 – HuaWei Technologies Co.

We think the examples in XR-awareness in RAN (i.e., the QoS flow association, frame-level QoS, ADU-based QoS, XR specific QoS) should be kept, which is consistent with the way formulating power saving part and provide a good guidance on further study. These examples have been discussed and acknowledged widely, which is helpful for companies to understand what kind of aspects need to be studied and evaluated. In addition, these examples are consistent with what SA2 has been listed in their approved study item S2-2109360, and it is better to keep them for better understanding and coordination with SA2.

In addition, the study work on XR-awareness in RAN has potential effects on RAN3 as some information may need exchange between CN and RAN, thus we suggest to add RAN3 to the related WGs of "XR-awareness in RAN".

Therefore, we suggest to keep the examples and add RAN3 as the impacted group. We could also be fine with vivo's updated examples. Alternatively these examples can be reflected in the justification for better understanding.

*Objectives on XR-awareness in RAN (RAN2, **RAN3**):*

- *Study and identify the XR traffic (both UL and DL) characteristics, QoS metrics, and application layer attributes beneficial for the gNB to be aware of, e.g. ~~[~~the QoS flow association, frame-level QoS, ADU-based QoS, XR specific QoS~~]~~.*
- *Study how the above information aids XR-specific traffic handling.*

Cooperation is needed with the corresponding study work of SA2 ~~//add latest SA2 reference~~S2-2109360

9 – ZTE Corporation

RAN1 should be a working group for this objective.

Some enhancements endorsed in capacity section for TR38.838 are relevant for XR-awareness in RAN. Some are from multiple sources while others come from a single source. Cross-verification and consensus needs thus to be built as to which XR-awareness techniques can truly benefit from capacity perspective. This, in turn, shall impact aspects on the granularity of QoS refinement (listed in the first examples in the first bullet) as well as which concrete components in QoS should be made aware to RAN. Thus RAN1 should be involved in the XR-awareness in RAN objective.

10 – Intel

We are ok keeping the list of examples which is aligned to areas of interest highlighted by companies during previous plenary email discussions, as well as, in related SID agreed in SA side.

11 – China Unicom

We support ot keep the list of examples as in RP-212711 to align with SA2 discussion.

12 – Guangdong OPPO Mobile Telecom.

We suggest that the example part in the bracket and "e.g." should be removed. The definition of the term in the bracket is not clear and there maybe overlap between different terms. To avoid misleading, we suggest to remove the example part.

13 – LG Electronics Inc.

No strong view on the bracket parts. Either way is ok.. keep or remove.

14 – Deutsche Telekom AG

incl. text should be removed

15 – NEC Corporation

We prefer to remove the examples in the brackets.

16 – Apple GmbH

The content in backets is a key part well aligned with the evaluations and assumptions of the Rel-17 SI by RAN1 and other evaluations by SA4. The impact of XR awareness on RAN and respective QoS aspects has been one of the most widely identified areas raised by companies over the last 6 months. XR traffic often relies on a series of packets such as an ADU to perform an operation. RAN should study and evaluate if, and for how much, the unit of an ADU or a frame/slice can be considered as part of QoS for XR.

We therefore suggest to remove the backets in the first bullet in order to keep its content as part of the objective:

- *Study and identify the XR traffic (both UL and DL) characteristics, QoS metrics, and application layer attributes beneficial for the gNB to be aware of, e.g. ~~[~~the QoS flow association, frame-level QoS, ADU-based QoS, XR specific QoS~~]~~.*

17 – Nokia Corporation

We see the study for this part could be well handled in RAN2, then in WI phase RAN3 could have time allocation to accomodate getting the necessary info from 5G core. I see this approach used in the past SIs as well. We don't see here a role for RAN1 necessary for actually getting the parameters (from core) which are then considered by the scheduler.

18 – LG Uplus

Fine for now. One suggestion is to have "e.g bracket part" in Justification section instead of Objective section if many companies have strong concern for having in Objective and if we cannot reach to the consensus at the end of this week.

19 – Motorola Mobility España SA

We would prefer to remove the examples in the brackets. It is not necessary to limit the information the gNB should be aware of at the beginning. And we are wondering about the difference between 'frame' and 'ADU'. The concept of 'frame' or 'ADU' has not been clearly defined. In order to avoid any confusion, it would be better to remove them in the objectives. The QoS flow association also depends on end to end QoS framework which would require coordination with SA2.

We think not only RAN2 but also RAN3 should be involved e.g., to support the QoS flow association if agreeable.

20 – MediaTek Inc.

We fully agree with the view expressed by Ericsson the "[...]" should be removed.
The discussion and decision on introducing any QoS changes wrt frame-level QoS, ADU-based QoS, XR-specific QoS are not under RAN control, but under the responsibility of SA2 (and SA4). RAN will need to adapt to the decisions from SA2 and SA4. QoS flow association is also premature to discuss before SA2 have sufficiently progressed their work.

NOTE that with SA2 starting their work in Q1 2022 and RAN2 not earlier than Q3 2022, the RAN SID may be updated at a later stage if necessary once SA2 work has progressed sufficiently.

21 – InterDigital

We are fine with keeping the examples on XR-awareness in RAN as they serve to clarify the objective better

22 – Sony Europe B.V.

We are fine with the objectives, and to keep the XW awareness examples, but could potentially clarify that they are just examples and not a completer list of relevant attributes.

23 – Verizon UK Ltd

We are supportive of the objective. The goal is to help NB scheduling to optimize the resource allocation with awareness of the XR traffic characteristic, QoS metrics, and application attributes. We are fine with rewording, adding involved std groups and putting things to right places but we found the content in the bracket interesting.

24 – Facebook

We think the work need to align with SA2/SA4. On the first bullet, alignment with SA4 is critical on frame level and ADU processing as these are within the media processing/protocol under SA4.

25 – Qualcomm Korea

To better support XR service, RAN awareness is also necessary. We propose following modification.

- *Study and identify the XR traffic (both UL and DL) characteristics, QoS metrics, and application layer attributes beneficial for the gNB to be aware of, e.g. ~~[~~the QoS flow association, frame-level QoS, ADU-based QoS, XR specific QoS, Deadline-based Latency and Delay budget~~]~~.*
- *Study how this information aids XR-specific traffic handling*
- *Study the gains of potential XR-specific RAN-centric mechanisms, e.g., staggering of the UEs to improve capacity and power.*

26 – Philips International B.V.

Agree with Sony: We are fine with the objectives, and to keep the XR awareness examples, but could potentially clarify that they are just examples and not a completer list of relevant attributes.

27 – China Mobile Com. Corporation

- The bracket issue: As long as it is aligned with SA, we don't see it as a big problem. There is a "e.g." anyway.
- The second bullet: *"Study how the above information aids XR-specific traffic handling"*. It feels a bit blur. Because the first bullet aims to list all information that "*beneficial for the gNB*", so it is already known that these information is good. Maybe it is more accurate to say "*Study how the above information* <u>*is applied in RAN*</u> ~~*aids XR-specific traffic handling*~~"?

28 – Samsung Electronics Co.

We are fine to keep the listed examples as they provide better understanding of the objective (but agree that it should not be restrictive to the example, so that we could add e.g. ", etc." at the end of the example). In addition, as pointed out by many companies, the availability of the required information for XR-awareness in RAN would be determined by both SA2 and SA4 sides, so the NOTE in the objective should also explicitly mention SA4 as well.

29 – Spreadtrum Communications

We think the traffic aware enhancement depends on how to acquire and indicate the assistance information to gNB, so RAN3 shall be involved.

30 – MediaTek Inc.

On "e.g. [the QoS flow association, frame-level QoS, ADU-based QoS, XR specific QoS]" - for alignment with SA2 (since that seems to be the argument, we propose instead then to refer to SA2 terminology and definition i.e. "Media Unit" where a Media Unit consists of PDUs that have the same QoS requirements.

- Study and identify the XR traffic (both UL and DL) characteristics, QoS metrics, and application layer attributes beneficial for the gNB to be aware of e.g. ***Media Units (see //add latest SA2 reference)***

We also interpret this objective is to enable **mutual awareness** i.e. not only awareness in the gNB of application related information, but importantly as well the ability for the gNB to swiftly trigger codec/rate adaptation at the application e.g. based on load, in line with SA2's planned objective to "*Study exposure of 5GS QoS information (e.g., QoS capabilities) and network conditions to the Application to enable quick codec/rate adaptation help to provide desired QoE (e.g. such as assist in alleviating 5GS congestion). NOTE1: Parameters for exposure may coordinate with RAN and SA4.*"

We are therefore proposing the following ***changes***:

- Cooperation is needed with the corresponding study work of SA2, ***including on exposure of network conditions to the Application to enable quick codec/rate adaption (see*** //add latest SA2 reference***)***

1.3 Objectives - XR Power Saving

The Objectives in RP-212711 are assumed to be rather stable. Please add any suggestions here if you strongly believe some changes to the Objectives on **XR Power Saving** are needed.

Feedback Form 3: Comments on XR Power Saving objectives

1 – Ericsson LM

We think the objective is well-defined as it is and provides the WGs a direction as to what should be studied. Hence, we don't think any "further candidate techniques" needs to be added.

2 – CATT

The power saving objective contains two general aspects in enhancement of CDRX and PDCCH monitoring for XR and should be sufficient for the study.

3 – vivo Mobile Communication Co.

We also think the current objective for power saving is sufficient for the study. A minor suggestion is to change ”PDCCH monitoring” -> ”PDCCH monitoring adaptation”.

4 – DOCOMO Communications Lab.

We think the current objective is sufficient for the study. Therefore, we don’t think any further candidate techniques are needed.

5 – T-Mobile USA Inc.

Scope is too broad, first bullet doesn’t restrict the study to the features identified in the sub bullets. It appears to be the intent therefore T-Mobile suggests adding the underlined text to”- Study the following XR specific power saving techniques to accommodate XR service characteristics (periodicity, jitter, latency, reliability, etc...):”

6 – Spark NZ Ltd

The current objective is appropriate to study. There is no ned to add further candidate techniques.

7 – HuaWei Technologies Co.

we also don’t think any ”further candidate techniques” are needed.

8 – ZTE Corporation

OK with the current objectives. It should be clarified that several techniques captured in TR38.838 demonstrated promising power saving benefit in conjunction with capacity compared with the two objectives listed, thus we believe the brackets should be there.

9 – Intel

On XR-specific Power Saving, we suggested to add in “multiple flows” in the list of potential characteristics as shown in ”service characteristics (periodicity, **multiple flows**, jitter, latency, reliability, etc...)”.

We are also OK to remove the reference to ”PDCCH monitoring enhancements” understanding that Rel-17 PS WI is specifying PDCCH monitoring adaptation techniques which include both Search Space Set Group (SSSG) switching and PDCCH skipping, and it seems flexible enough to accommodate different traffic characteristics by suitable configuration from gNB. In addition, we do not see strong need to add any other objectives in connection to power saving.

10 – SHARP Corporation

We think further candidate techniques are not needed

11 – Guangdong OPPO Mobile Telecom.

The objectives for XR power saving should be sufficient for study. And we do not need to add further candidate techniques.

12 – LG Electronics Inc.

We also think further candidate techniques can be removed.

13 – Deutsche Telekom AG

Scope is ok, but the last bullet on ”further candidate techniques” should be removed

14 – NEC Corporation

We are fine with the objectives.

15 – Apple GmbH

XR applications typically involve multiple data flows which is clearly shown in the SA4 traffic models and RAN1 traffic models developed in Rel-17 SI on XR. Moreover, single periodic data flows have already been studied and considered in Rel-16. Multiple data flows with different periodicities, packet size distributions, reliability requirements and latency requirements are the key to drive enhancements which can be actually useful to XR applications in the field. Otherwise, the study item runs the risk to give too broad a scope, and WGs still need to figure out/guess the use cases allowed by the SI. Hence our proposal is to explicitly enumerate the key characteristics of XR traffic in the objectives part.

In Rel-16/17, PDCCH monitoring is adapted according to the current traffic need through newly introduced mechanisms such as wake-up signal, which can be a rather effective approach to save power if the XR traffic consists of a single flow, and the periodicity of the traffic arrival is not too small. With multiple data flows, adaptation to traffic becomes more challenging as those data flows may have non-commensurate periodicities. As pointed by many companies, some control channel enhancements may be useful for XR applications in terms of UE power saving. Whether they can be all formulated as PDCCH enhancements is not clear at this time yet. From that we propose to modify “PDCCH monitoring enhancement” to a more generic term as “control channel enhancement”.

As such, we propose the following changes to the objectives on XR Power Saving.

Objectives on XR-specific Power Saving (RAN1, RAN2):

- *Study XR specific power saving techniques to accommodate XR service characteristics* ***including*** *~~(~~periodicity,* ***multiple data flows, variable packet size,*** *jitter, latency, reliability, etc...~~)~~:*

o *C-DRX enhancement.*

o *~~PDCCH monitoring~~* ***Control channel*** *enhancement.*

16 – Nokia Corporation

We are fine with the objectives, and making them more focused with the addition as proposed by T-Mobile

17 – LG Uplus

We also don’t think any further candidate techniques are needed.

18 – Motorola Mobility España SA

We are fine with the objectives.

19 – MediaTek Inc.

We support the objective, with the removal of ”[Further candidate techniques can be added here, if consensus is found to add it]”

20 – InterDigital

We think adding multiple data flows to the objective, as proposed by Intel and Apple, is reasonable and provides better focus to the objective. Multiple data flows is also aligned with the traffic models adopted during Rel-17 SI

21 – VODAFONE Group Plc

The modifications suggested by Intel and Apple seem necessary.

22 – Sony Europe B.V.

We are fine with the objectives

23 – Verizon UK Ltd

In general fine with the objectives but also have some interest in the suggestions from Intel and Apple.

24 – Facebook

We support Intel and Apple’s modifications.

25 – Qualcomm Korea

We think SPS/CG should be also considered in XR UE power saving. Current SPS/CG mechanism was designed with low-rate periodic traffic in mind. Thus, enhancements are necessary to support XR traffic with high bit rate, variable packet size, and low latency requirement. Especially, current CG mechanism for frequent UL pose/control tx could have a high impact on UE power consumption due to too frequent triggering of retransmission DRX timer.

Thus, we propose following modification.

- ***XR-specific Power Saving (RAN1, RAN2)***
  - *Study XR specific power saving techniques to accommodate XR service characteristics (periodicity, jitter, latency, reliability, etc...)*
    - *C-DRX enhancement*
    - *PDCCH monitoring enhancement*
    - *Enhancements to SPS and CG*

26 – Philips International B.V.

We are fine with the objectives as is.

27 – China Mobile Com. Corporation

We are fine with the objectives.

We also agree with Qualcomm’s remark on how enhancement in SPS/CG can help power saving. But since they are included in capacity enhancement anyway, we are fine with including them under either objective.

28 – Samsung Electronics Co.

We are fine with the proposed objectives, as they are.

29 – Spreadtrum Communications

We think some RAN scheduling inforamtion shall be provided to upper layers in order to align the data of multiple flows, if possible.

1.4 Objectives - XR Capacity

The Objectives in RP-212711 are assumed to be rather stable. Please add any suggestions here if you strongly believe some changes to the Objectives on **XR Capacity** are needed.

Feedback Form 4: Comments on XR Capacity objectives

1 – Ericsson LM

We think the objective is well-defined as it is and provides the WGs a direction as to what should be studied. Hence, we don't think any "further candidate techniques" needs to be added.

2 – CATT

The objective of NR capacity enhancement for XR relies on the XR-awareness scheduling in resource allocation. Thus, the mechanism in retrieving XR characteristics, such as UE feedbacks, should be included in the objectives.

3 – Futurewei Technologies

Overall, we do not think adding examples is a good approach to move forward. If specific schemes are to be added, the starting point should be the TR of the R17 XR SI where a number of schemes for capacity improvement were proposed though no conclusion can be reached due to limited time and study. The current objective seems to be general enough but is not without problems:

- On "Study mechanisms that provide more efficient resource allocation and scheduling for XR services", what does it mean by "more efficient resource allocation and scheduling". Is it simply another way to say "capacity improvement"? Suggest to change to "**Study mechanisms that provide capacity improvement for XR services**"
- On "Enhancement to SPS and CG", as we and other companies pointed out in previous round of discussions, SPS and CG cannot provide better capacity than dynamic scheduling but rather to reduce power consumption. Then our understanding is that this is actually trying to mitigate the capacity loss due to SPS and CG. Therefore, this is effective for power saving and should be included in the second objective.
- On "Enhancement for dynamic grants", since "for" is used here, is it the right understanding that this includes all mechanism to enhance the capacity when dynamic grants/scheduling is used? If not, what is intended here?

4 – vivo Mobile Communication Co.

We think the current objective is sufficient for the study. So any further candidate technique is not needed.

5 – DOCOMO Communications Lab.

We think the current objective is sufficient for the study. Therefore, we don't think any further candidate techniques are needed.

6 – Spark NZ Ltd

Agree with Ericsson

7 – HuaWei Technologies Co.

We think the examples in XR-awareness in RAN (i.e., the QoS flow association, frame-level QoS, ADU-based QoS, XR specific QoS) should be kept, which is consistent with the way formulating power saving part and provide a good guidance on further study. These examples have been discussed and acknowledged widely, which is helpful for companies to understand what kind of aspects need to be studied and evaluated. In addition, these examples are consistent with what SA2 has been listed in their approved study item S2-2109360, and it is better to keep them for better understanding and coordination with SA2.

In addition, the study work on XR-awareness in RAN has potential effects on RAN3 as some information may need exchange between CN and RAN, thus we suggest to add RAN3 to the related WGs of "XR-awareness in RAN".

Therefore, we suggest to keep the examples and add RAN3 as the impacted group. We could also be fine with vivo's updated examples. Alternatively these examples can be reflected in the justification for better understanding.

*Objectives on XR-awareness in RAN (RAN2, **RAN3**):*

- *Study and identify the XR traffic (both UL and DL) characteristics, QoS metrics, and application layer attributes beneficial for the gNB to be aware of, e.g. ~~[~~the QoS flow association, frame-level QoS, ADU-based QoS, XR specific QoS~~]~~.*
- *Study how the above information aids XR-specific traffic handling.*

Cooperation is needed with the corresponding study work of SA2 ~~//add latest SA2 reference~~S2-2109360

8 – HuaWei Technologies Co.

Sorry, please ignore the above.

For capacity, we also don't think any "further candidate techniques" are needed.

9 – ZTE Corporation

Okay with the current objectives.

10 – Intel

On XR-specific capacity considerations, we suggest to add reference to the traffic characteristics included exemplary list as shown in "Study mechanisms that provide more efficient resource allocation and scheduling for XR services to handle XR specific **traffic characteristics, such as periodicity and jitter, multiple flows, latency, reliability** (RAN1, RAN2)". It can be further clarified whether HARQ-ACK enhancement is included as part of considerations on SPS and dynamic grants enhancements.

11 – SHARP Corporation

We think further candidate techniques are not needed

12 – Guangdong OPPO Mobile Telecom.

The objectives for XR capacity should be sufficient for study. And we do not need to add further candidate techniques.

13 – LG Electronics Inc.

We also think further candidate techniques can be removed.

14 – Deutsche Telekom AG

Scope is ok, but the last bullet on ”further candidate techniques” should be removed

15 – NEC Corporation

We are fine with the objectives.

16 – Apple GmbH

We consider both CSI and HARQ feedback enhancements key to enhance system capacity.

XR traffic streams come with rather stringent latency requirements, and in some cases, the 2nd transmission is the only opportunity for the gNB to provide more coded bits to the UE. As such, if a UE does not decode PDSCH successfully for the first transmission or for a retransmission when the latency bound is in danger of being exceeded, the more relevant information for the UE to provide is not merely the fact the UE fails to decode the transport block, rather how much more redundancy is needed from the gNB to allow the UE to decode the transport block in the next attempt. From that, it is reasonable to allow the UE to indicate how much redundancy is needed further for the UE to decode the transport block. Also the UE can consider the current status of the soft buffer in its feedback to the gNB.

It has been shown that CSI enhancements can achieve both low latency and decent system capacity.

Staggered transmission may avoid simultaneous traffic arrivals from multiple UEs in a cell. Considering quasi-periodic traffic arrival and additionally staggered transmission, interference can fluctuate substantially between slots depending on traffic from neighboring cells. Interference measurement which faithfully reflects the interference experienced by PDSCH carrying XR traffic should be supported, hence enhancement in CSI measurement can be motivated. Periodic and semi-persistent CSI measurement resources matched with XR traffic arrival are important as well. Also for CSI reporting, while it is possible to use aperiodic CSI reporting to match the reporting occasions with XR traffic arrival, it can be beneficial for periodic and semi-persistent CSI reporting’s occasions to be matched with XR traffic arrival, for faithful CSI measurements.

With multiple DL SPS for a UE, some transmit occasions carry no actual data and the alignment latency in DL transmission can be controlled. However, for the transmission occasions not associated with any actual transmission, the UE still needs to generate HARQ feedback. More importantly, as the UE does not have the a priori knowledge on whether there is actual DL transmission in a slot or not, some UE processing is still needed to make a determination, e.g., for DMRS correlation and LDPC decoding. With over-provision, the UE is still required to send HARQ feedback over PUCCH for non-existent SPS PDSCH transmission, which wastes system resources; and leads to UL interference. The UE may be allowed to skip the HARQ feedback for non-existent data transmission.

In summary, we propose the following changes to the objectives on XR Capacity:

Objectives on XR-specific capacity considerations (RAN1, RAN2):

- *Study mechanisms that provide more efficient resource allocation and scheduling for XR services* ***characteristics including periodicity, multiple data flows, variable packet size, jitter, latency, reliability, etc:***
  - *Enhancement to SPS and CG;*
  - *Enhancement for dynamic grants.*
  - ***Enhancements for CSI/HARQ to meet stringent latency requirement***

17 – Nokia Corporation

We are fine with the current objectives

18 – LG Uplus

We also don't think any further candidate techniques are needed.

19 – Motorola Mobility España SA

We are fine with the objectives.

20 – MediaTek Inc.

We support the objective with the removal of "[Further candidate techniques can be added here, if consensus is found to add it]"

21 – InterDigital

We agree with Intel and Apple to include multiple data flows to the objective as it clarifies the potential traffic characteristics that RAN may take into account for performing more efficient resource allocation and scheduling for XR services

22 – Sony Europe B.V.

We are fine with the current objetives.

23 – Verizon UK Ltd

Fine with the current proposal.

24 – Qualcomm Korea

We think following additional techniques for meeting tight XR latency and PER requirements could be further studied.

We propose following modification.

- **XR-specific capacity considerations (RAN1, RAN2)**
  - Study mechanisms that provide more efficient resource allocation and scheduling for XR services:
    - Enhancement to SPS and CG
    - Enhancement for dynamic grants and HARQ ACK feedback
    - Outer coding/Network coding

25 – Philips International B.V.

Scope is ok, but if majority wishes to remove the last bullet on ”further candidate techniques” then that is ok with us.

26 – China Mobile Com. Corporation

Current objective is good and agree to remove *”further candidate xxx”*.

But just saying: *”further candidate xxx”* is just a place holder, it will automatically disappear if we don’t mention it, right?

27 – Samsung Electronics Co.

We are fine with the proposed objectives as they are, and are fine to remove ’further candidate ...’ to not open the discussion too wide.

28 – Spreadtrum Communications

We are fine with the proposed objectives.

1.5 Any further general comments on the SID

Please add here if you have any **further comments** on any other parts of the SID in RP-212711.

Feedback Form 5: Further general comments on the draft SID

1 – Ericsson LM

We see that some companies are proposing to add their favourite solution as an ”example”. To open that door (adding each companies’ favourite solution as an ”example”) is an approach which only will complicate this discussion and as it is just about providing examples, it does not help the WGs anyway.

These lists of ”examples” shall of course not limit the WGs from looking into solutions which are really beneficial. Companies should instead bring their favourite solution to the WGs when the study actually starts. We should not try to have a mini-study here at plenary during this SID drafting-exercise.

2 – CATT

Since the objectives have been identified in broad aspect for capacity enhancement and power saving, we don’t see any examples or details sub-categories being listed in the objectives. The detail solution could be discussed in working groups.

3 – DOCOMO Communications Lab.

We share similar view with Ericsson and CATT that examples of exact candidate techniques are not needed to be added in the SID since they are just examples. Exact enhancement techniques can be brought by companies and studied in the study phase.

4 – Spark NZ Ltd

Agree with Ericsson and DoCoMo

5 – Guangdong OPPO Mobile Telecom.

Share view as above companies

6 – Deutsche Telekom AG

Same view.

7 – Apple GmbH

1) During the earlier email discussions, multiple data flow aspects were identified as a key aspect and included in the summary, however they are not explicitly included in the SI objectives. In our view, it is important to bring back multiple data flows aspects for all objectives. Moreover, the QoS aspects on ADU awareness in the RAN are important to study.

2) Assuming the time budget for a Rel-18 study item on XR will be approved at RAN#94-e, to ensure there is time to generate specifications for XR with high quality, an adequate time budget for the Rel-18 WI on XR should be decided or planned now rather than later. Of course, given the outcome of the Rel-18 SI on XR, some fine tuning on the time budget may be needed later on. However, not taking a tentative time budget now may have the undesirable consequence the XR WI needs to be squeezed in later.

8 – MediaTek Inc.

It is important that:

- Strong dependencies with SA2/SA4 be acknowledged and documented in this SID
- The objectives of the SID do not refer to QoS concepts that have yet to be concluded let alone discussed in SA2 and SA4
- The objectives of the SID be close-ended i.e. no statement such as ”further techniques [blah] can be studied”

9 – VODAFONE Group Plc

We believe that the ’multiple data flow’ aspects need to be considered.

10 – CHTTL

We are supportive of the current SID, and in general agree with Mediatek.

2 Final round - now closed

As per the comments at the GTW session on Wednesday the Moderator proposal is to go forward with the formulation below for the Objective section:

”The study is to be based on Release 17 TR 38.838, on corresponding Release 17 work from SA4 (as per SP-200054) and on Release 18 work from SA2 (as per SP-211166).

Objectives on XR-awareness in RAN (RAN2):

- *Study and identify the XR traffic (both UL and DL) characteristics, QoS metrics, and application layer*

attributes beneficial for the gNB to be aware of.

- *Study how the above information aids XR-specific traffic handling.*

Objectives on XR-specific Power Saving (RAN1, RAN2):

- *Study XR specific power saving techniques to accommodate XR service characteristics (periodicity, multiple flows, jitter, latency, reliability, etc...). Focus is on the following techniques:*
  - *C-DRX enhancement.*
  - *PDCCH monitoring enhancement.*

Objectives on XR-specific capacity considerations (RAN1, RAN2):

- *Study mechanisms that provide more efficient resource allocation and scheduling for XR service characteristics (periodicity, multiple flows, jitter, latency, reliability, etc…). Focus is on the following mechanisms:*
  - *SPS and CG enhancements;*
  - *Dynamic grant enhancements."*

Please indicate if you have any final comments on the formulation above in the feedback form below:

Feedback Form 6: Final comments on Objectives

1 – Nokia Corporation This seems generally fine, while our original preference was to limit the scope more tightly. With the focus wording then in RAN1/2 we assume there are then 3 agenda items for XR power saving (and for capacity also) with 3rd of them being "other", but the focus then meaning that from time point of view most attention given to the topics mentioned. This should allow then addressing also power saving related issues of SPS/CG as well as commented earlier.
2 – HuaWei Technologies Co. The updated version looks good and we are fine with it. Regarding how to organize agenda items, we understand this is up to the WG discussion and there is no need to discuss here.
3 – Guangdong OPPO Mobile Telecom. We are fine with the latest version. With respect to "SPS and CG enhancements" and "Dynamic grant enhancements", we think these terms cover the whole data transmission procedure, at least including resource allocation and HARQ-ACK feedback. Detailed spec impact depends on output from study stage.

4 – LG Uplus

Thanks for leading the discussion nicely. We are fine with the current version.

5 – vivo Mobile Communication Co.

Thanks for the updating. We are fine with this version.

With the added wording "*Focus is on the following techniques*", we assume others which are not mentioned here could also be considered during study if accepted by companies, but with low priority.

6 – CATT

Thanks for the updated objectives. We are general fine with the updating proposal. As we commented during GTW session, XR-awareness is the key in achieving NR system capacity enhancement and UE power saving. The XR traffic characteristic and application attribute could be incorporated in XR-awareness scheduling and resource allocation semi-statically. RAN1 should be included in the first objective of XR-awareness study.

7 – Tejas Networks Ltd.

The updated version is fine.

8 – MediaTek Inc.

We think the text on awareness can be misinterpreted as restricted to gNB awareness only, which in our view is not going to deliver the changes required to make XR work properly in 5G. Mutual awareness as explained above is vital to this work (in line with SA discussions). The reference to SA WID. To this end we recommend adding a NOTE:

- NOTE: the work is not intended to prevent work on application awareness potentially resulting from (See // Ref to SA SID)

9 – Futurewei Technologies

We think the current version addressed some of the concerns raised before. On the objective for capacity, we have the following suggestions to improve the wording:

- *The objective should not be on "capacity considerations" but on "capacity improvements" per R17 XR TR conclusion. Suggest to change "Objectives on XR-specific capacity considerations (RAN1, RAN2)" to "Objectives on XR-specific capacity* ***improvements*** *(RAN1, RAN2)" to be clear about the goal of study and to be at the same level of the power saving objective.*

- *About "Dynamic grant enhancements", "grant" is almost always used for uplink, as in the case of TS 38.300 and 38.212 which is not the case here. Suggest to change it to "Dynamic* ***scheduling/****grant enhancements". This is also then more align with the sub-bullet of "SPS and CG enhancements" where both "scheduling" and "grant" are included.*

Overall, we have similar understanding as other companies that the current scope is not limited to DCI or scheduling aspect but rather open ended. The study itself will conclude the scope of proper enhancements for capacity improvements.

10 – Verizon UK Ltd

The revision looks good to us. Thanks moderator.

11 – Facebook

In general, we agree with the comments made by QCOM online that given it is a study phase, the objectives should not be too limiting. We suggest making the following changes:

...Focus is on the following mechanisms (but not limited to):

12 – VODAFONE Group Plc

seems OK, thanks

13 – InterDigital

Thank you for updating the objectives. We are fine with this version of the SID

14 – ZTE Corporation

One remaining thing is on the "Other related Work Items and dependencies" (Chapter 2.3) in RP-212711. It seems that the titles of SA2 and SA4 report for XR should be corrected. We are okay with other parts. We would like to add ZTE and Sanechips as supporting companies.

15 – Apple GmbH

We are fine with the proposed revision of the objectives. Thanks to the moderator for putting this together.

Just a small comment the SA4 SID (FS_XRTraffic in SP-200054) has been revised to SP-210043 in SA#91e, it would be better to use the latest version.