3GPP TSG-RAN #93-e RP-21xxxx
Online, 13-17 September 2021

Agenda Item: 9.8, 14

Source: RAN2 Chair (Moderator)

Title: Report of Offline Discussion [93e-29-UECapability]

Document for: Discussion

# Introduction

This discussion includes RP-212108 [1], RP-212109 [2], RP-212206 [3], RP-212207 [4].

v0xx – Initial Round

v1xx – Intermediate Round

# Contacts

Please provide a company contact that the email discussion moderator can contact if required.

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| --- | --- |
| **Company** | **Contact name and email** |
| Moderator | Johan.Johansson@mediatek.com |
| Qualcomm | pgaal@qti.qualcomm.com |
| Ericsson | mattias.a.bergstrom@ericsson.com |
| Apple | naveen.palle@apple.com |
| T-Mobile USA | John.humbert2@t-mobile.com |
| Huawei,HiSilicon | zhaoyang@huawei.com |
| Futurewei | hao.bi@futurewei.com |
| Vivo | Chenli5g@vivo.com |
| DOCOMO | shinya.kumagai@docomo-lab.com |
| Intel | seunghee.han@intel.com |
| SoftBank | Yosuke.akimoto@g.softbank.co.jp |
| ZTE | wei.xingguang@zte.com.cn |
| OPPO | Duzhongda@oppo.comLuqianxi@oppo.com |
| Nokia, NSB | Cássio Ribeiro, cassio.ribeiro@nokia.com |
| Vodafone  | Manook.soghomonian@vodafone.com  |
| Samsung | sj100.park@samsung.com, hyoungju.ji@samsung.com |
| China Unicom | gaos30@chinaunicom.cn |
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# NR URLLC UE categories/profiles

RP-212109 [2] and RP-212207 [4] (with CR in RP-212206 [3]), discusses NR URLLC UE categories/profiles or improved description of features for NR URLLC.

The topic was discussed also at previous TSG RAN meeting.

Status, TSG RAN 92e:

*There is no consensus at current meeting. Accurate status of discussion:*

*a) There seems to be full agreement that defining URLLC profiles / UE categories will consume a lot of time and is not easy, e.g. it is commented that there are different diverse URLLC applications with different requirements.*

*b) The proponents seems to be in agreement that the purpose of defining URLLC profiles / UE categories is to bring clarity to the market as to which features are relevant for URLLC, and to avoid market fragmentation. Also some companies opposing to do this in 3GPP acknowledges that there would be value to have this.*

*c) It is questioned that 3GPP is not the right place to address issues such as market fragmentation. To do this work, involvement of industry players not in 3GPP may be needed. It is pointed out that in 3GPP it may be particularly difficult to converge as companies are likely to push for their own solutions.*

*d) The need is questioned by some companies. From technical perspective UE capabilities are unambiguous, now also the TR38.822 has been updated for easier navigation.*

*e) A majority of companies think such effort is not worthwhile in 3GPP, while several major operators support this.*

*f) There is some support among proponents to attempt to simplify the work by having limitations, e.g. limiting to Rel-15 only in a first step, and treating features for latency and reliability separately. It is also commented that it would be valuable to define a basic feature set that meets certain requirements in basic scenario, to be used as baseline.*

RP-212109 [2] suggests that mainly c) above need to be further discussed and addressed in addition to more exactly decide what to specify, in order to have NR URLLC UE categories/profiles.

RP-212109 [2] further suggests that in order to make the work feasible, not full NR URLLC UE categories/profiles can be specified, e.g. according to examples below (Alt 1, Alt 2) or other way.

* **(Alt. 1)** Even though so many kind of categories (e.g. reliability only, low latency only, reliability + latency) may be needed to cover the potential URLLC use cases, RAN can focus on defining only one category/profile for now.
* **(Alt. 2)** Do not define any categories/profiles, but introduce new categorization for URLLC related UE features in TS38.822 based on their characteristics to give more detailed technical analyses to outside 3GPP, for example:
	+ Features related to achieve 99.9999% reliability:
		- 5-34b, 5-34a …
	+ Features related to achieve 1ms latency in radio interface:
		- 5-5a, 5-5b, 5-5c …
	+ Features related to capacity enhancement for URLLC
		- Xxx
	+ [Other dimensions can be discussed]
	+ [Target release (i.e. Rel-15 only or also include Rel-16) needs to be clarified]

RP-212207 [4] (with CR in RP-212206 [3]) Observes that which Rel-15 features are relevant to URLLC type of services is not currently visible externally, as all Rel-15 features are listed together in [TR38.822](https://www.3gpp.org/DynaReport/38822.htm) and suggest to capture the Rel-15 UE capabilities relevant for URLLC operation as an informative annex in TS38.306 (e.g. as illustrated in [RP-212206](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_93e/Docs/RP-212206.zip)) **(Alt. 3)**

## Initial Round

Q: Moderator asks companies to provide initial feedback on the observations and proposals in RP-212109 [2] and RP-212207 [4], e.g. on Alt 1 Alt 2 Alt 3, to what extent they are acceptable, and whether other details need to be considered.

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| **Company** | **Acceptable Alt** | **Comment / Justification / Explanation** |
| Qualcomm | Alt 3 | Alt 1 and Alt 2 are already precluded as per the previous conclusions. None of the alternatives are strictly speaking necessary but we can accept Alt 3 in order to close this issue.  |
| Ericsson | - | We believe that the conclusions from the last RAN plenary meeting still hold and that 3GPP is not the fora to define these categories. As discussed earlier, it is better if this type of exercise is handled outside of 3GPP and it is already ongoing in some industry fora, e.g. 5G-ACIA. |
| Apple | No, but see comments. |

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| As discussed earlier the existing UE capabilities have been defined in a generic way to support a wide range of requirements for a variety of use-cases, products, and applications. Thus Alt 1 and Alt 2 may end up with many many combinations. At the same time, adding all these variants into a specification may not be so essential.We still do not think any of the alternatives is necessary. **But if it helps, we can accept Alt 3 with some modification. Our preference would be to use the table proposed by Nokia in Alt 3, but ideally the table would be more suitable to be placed into 38.822** (e.g., section 4), since the TR already provides additional information for other features including a grouping, and this could be extended with a view to URLLC specifically. |

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| T-Mobile USA | - | Trying to define profiles for URLLC will be as unproductive as the FGI bit discussion that RAN had for early releases of LTE and subsequently for Mandatory with Capability bit indication for NR.Implementors will tailer their solutions to market needs. With the large number of use cases for URLLC we don’t see a need to define profiles or groups of features  |
| Huawei,HiSilicon | Need further discussionSort of combined Alt 2 and Alt3 | We are in general positive on figuring out a way forward on defining URLLC UE type/category. Alt 2 makes sense as URLLC services could differ on different E2E latency and reliability classification, but as several companies pointed out already in RAN#92e, these detailed requirements may need inputs from the industry players. We observed that 5G-ACIA is having relevant activities, and it would be good to coordinate with the industry, to make the URLLC UE type/category definition useful and consistent with the real marketing requirements. Thus we suggest to send an LS to 5G-ACIA, informing that 3GPP is discussing how to define the URLLC UE type/categories, and ask 5G-ACIA to provide necessary inputs to help such definition.In parallel with coordination with 5G-ACIA, Alt 3 can first be discussed in 3GPP to at least identify those capabilities which are specific to URLLC. It would be better if the capabilities can be grouped into low-latency specific and reliability specific. This may help future discussion once the latency and reliability requirements classification becomes clearer. |
| Samsung | Alt. 3 | We think that alt. 1 is to define basic feature group for URLLC and alt. 2 is to define details of URLLC categories for all UE capability. These are already discussed in last meeting and any consensus wasn’t achieved. With minimum 3GPP efforts, we can accept alt. 3. |
| Futurewei | - | We are also concerned that more exercises to specify URLLC profiles/categories in RAN without industry input may not be very productive, and we would be open to work on this issue jointly with industrial fora.If there happens to be agreement to capture something for URLLC feature, we’d prefer Alt. 2 to keep it consistent with other efforts of updating UE features. |
| vivo | - | We share the same views with Ericsson. Although Alt.3 may reduce the workload on defining which features are for low latency, which are for reliability, still it is debatable which features should be viewed as related to URLLC, which ones should not be listed. For example, it is not clear that rateMatchingResrcSetSemi-Static and rateMatchingResrcSetDynamic are related to URLLC; while mux-SR-HARQ-ACK-CSI-PUCCH-MultiPerSlot is not related to URLLC. |
| DOCOMO | Alt.3 | We think Alt.1 and Alt.2 should be precluded for further discussion based on the previous conclusion. On the other hand, we can accept Alt.3 if it is not so controversial. |
| Intel | - | We prefer industry to select features for the purpose of URLLC. For instance, mini-slot may be considered for URLLC, but at the same time it could be useful for DSS. In general, even if a feature was introduced for certain WI, the features can be used for other purpose. We feel to need long exercise to sort them out to reach agreements.  |
| SoftBank | OK to choose the least controversial one. | In our understanding, only moderator’s summary was provided in the last meeting, and nothing is precluded. On the other hand, we are fine to focus on less controversial option, which is Alt 3 with possible modification, in the next round given the situation.<Comment to Ericsson>If 5G-ACIA can understand the intention of RAN related features, I think, yes, it can be perfectly done in 5G-ACIA. However, we don’t think it is the case. We believe that’s the reason why Nokia proposes to capture the list. <Comment to vivo>We can understand the concern. However, if the categorization of some features is controversial in 3GPP, nobody outside 3GPP can understand the intention of the features at all … |
| ZTE | Alt.1/Alt.2/Alt.3 | Defining UE feature profile/category for URLLC is beneficial to make the URLLC UE features (including Rel-15 features) clear and avoid market fragmentation. Thus, we are supportive to define UE feature profile/category for URLLC. If it is agreed, we can also try to define UE feature profile/category for other WI, e.g., Redcap. Regarding Alt.1, although we think that defining just one UE category/profile is similar to the existing “basic UE feature group”, which could be too restrictive for URLLC. But we can accept this alternative as it can serve as a starting point for future discussion if necessary.Regarding Alt.2, we think the basic idea of it is similar to Alt.3. Both of Alt.2 and Alt.3 are trying to introduce categorization for URLLC related UE features. In general, we are fine with both alternatives. |
| OPPO(Zhongda) | No | In general we also think 3GPP is not the right place to discuss such URLLC profile. The main concern is that once a CR to TR or TS is approved, company will try to refine it again and again. 3GPP spec is kind of toolkit and it is up to industry to interpret based on their understanding. If they have some doubt, they can send LS to 3GPP for confirmation which will help both.  |
| Nokia, NSB | Alt.3 | Indeed we have proposed Alt.3 as a compromise based on the previous discussions. We strongly believe it is something that does not require substantial effort from WGs or RAN, as it is only informative and not mandating any behavior. In response to some specific comments:<Ericsson, OPPO> We agree with Softbank that 5G-ACIA is not really looking into detailed 3GPP radio specifications, and in this respect this work is complementary to their activity. In fact, this type of list provides a good starting point for any non-3GPP organization to progress on this type of discussions, as the UE capabilities can be very obscure for those outside the corresponding WGs in the first place. <vivo> We are open for discussion on where to draw the line between the relevance of the feature to URLLC or not. This should not be an extensive discussion anyway, because the list is not mandating any behavior.<Intel> We are in agreement here, and Alt.3 allows full freedom for the industry, and to use features freely. <T-Mobile> This is understood, and that is the reason we have proposed Alt.3. It doesn’t require any grouping of features for implementation or definition of any profiles. Chipset and network vendors would be still free to make whatever combination of features they see fit for their products.<Apple> We acknowledge that TR38.822 is also a possible place for such a list. The main reason we proposed it to 38.306 is because the feature definitions are in that same spec, especially considering that Rel-15 features have never been updated in 38.822 since the first snapshot was taken.  |
| Vodafone | ---- | Defining a specific use-case or profiles may be counter-productive and restrictive in terms of its industrial application |
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## Intermediate Round

### Initial Round Conclusions

**Observation:** A number of companies oppose the introduction of specific use cases or specific profiles, and a number of companies state that such work is done and/or should be done outside 3GPP. A number of companies indicate Alt 3 as acceptable. Proponent of Alt 3 also confirm that an intention is that Alt 3 can be complementary to other outside 3GPP efforts. It was also commented that TS 38.822 could be considered for capturing Alt 3.

**Comment:** This topic still seems contentious (as last meeting). Understand that Alt 3 can be acceptable. There are also proposals to make Alt 3 more specific by splitting capabilities according to reliability and latency. Based on the comments this seems not currently acceptable (but not explicitly clear, see point 2 below).

**Proposed way forward (After Initial Round):** Capture the Rel-15 UE capabilities relevant for URLLC operation

Points to address further:

1. Whether to capture as an informative annex in TS38.306 or in TR38.822 (or other).
2. Confirm whether acceptable or not to further describe whether a feature/UE capability is for reliability or latency.
3. How to progress the CR, by TSG RAN or by WGs (RAN1, RAN2). If by TSG RAN attempt approval now or postpone.

Q: Please feedback on the Initial Round Conclusions above. Confirm whether the proposed way forward can be acceptable. Provide opinions on points to address further. Can also provide comments on the Company CR in RP-212206 [3].

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| **Company** | **Acceptable** | **Comments**  |
| Nokia, NSB | Yes | 1. Our preference is TS38.306 since it is the most up-to-date reference on Rel-15 capabilities, and the most natural place for external organizations to look for such information.
2. This is acceptable from our point of view if not controversial, but we acknowledge it does require more debate for some of the features. It is not essential though, and it can be done later, if needed.
3. Our preference is to approve the CR now, if possible. In any case we don’t see a need to offload this task to WGs.
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| Qualcomm | Yes | 1. Our preference is TS38.822 since this is an informative Annex.
2. Not sure what the target of the question is. The first column in the CR already includes very similar info. Is the question about whether to delete this column, or whether to add a new column? We are ok with deleting the column but not ok with adding a new column or to introduce further split/categorization of the rows.
3. No strong preference, ok with approval now, with the assumption that companies can submit later CRs to add potentially missing capabilities.
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| Ericsson | - | The input in the initial phase seems to be more pointing in the direction of not continuing this exercise, i.e. same conclusion as in the last plenary. The arguments for **not** capturing the URLLC UE types brought up in the last RAN plenary meeting seem to also still hold, or even have become stronger (similar exercises ongoing in other fora). |
| Apple | - | We tend to agree a bit with Ericsson’s views. And that we do not need to pursue anything in this meeting.1. If RAN agrees to do something, then to us 38.822 is preferred.
2. We think that nothing needs to be done, and we should not further split the features into reliability or latency category. Note that there is some interaction between latency and reliability, and there is no clear categorization for many features.
3. We don’t have a strong view, as long as this is meant for 38.822
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| Samsung | - | We think that the proposal can be confirmed with details on how/what to capture in 3GPP.1. No strong views. However, we slightly prefer TR38.822.
2. We do not support to do split the feature into reliability and latency as we commented before in last RAN plenary. We can only accept high-level definition for progress.
3. RAN level CR is preferred because it may need interworking between RAN1 and RAN2 if it moves to WG level CR.
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| SoftBank | Yes | 1. Our preference is TS38.306, but we can be flexible.
2. Similar view as Nokia. We can go step by step, and it can be done at later stage, if necessary.
3. Fine to approve the CR now, and further updated can be done later based on the companies’ contributions.
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| vivo | - | We could accept Alt3 as a compromise with the following details:1. Our preference is to capture as an informative part in TR 38.822.
2. We don’t think further split features/capabilities between reliability and latency is a good idea. It would be a long debating to categorize/split these features. The category provided in CR is clear enough.
3. Approval and discussion in RAN level is more preferable, which could offload the work in WGs and avoid interworking between WGs. The FGs provided in CR RP-212206 can be a starting point.
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| Huawei,HiSilicon | Yes | 1. We prefer 38.306.
2. We think it is useful to be specific on which capabilities are for latency and which are for reliability, but we can also go step by step as long as this can be discussed in future meetings.
3. We are fine to approve the CR, while we think further update should be allowed in future meetings if needed. If the CR is approved, we think Rel-16 URLLC specific features should also be captured at the same place to keep the consistency.
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| OPPO | No | We still prefer not to discuss this profile in 3GPP. |
| DOCOMO |  | We can accept the way forward only if all of the work is finished in this meeting. We don’t see any value to continue this discussion in 3GPP for multiple meetings.1. No strong preference but it seems TR38.822 is proper place as it is an informative annex.
2. Such categorization needs further discussion and hence, we don’t think it is necessary.
3. It should be done within this meeting. No additional work should be expected in other TSG/WG meetings.
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| CATT | Yes | 1. We prefer TS38.822
2. We prefer not to further split low latency and high reliability since the discussions are expected to be quite controversial.
3. No strong view.
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| China Unicom | Yes | 1. We prefer TS38.306 since it’s more suitable to place this annex in a specification for information.2. We are open to this, but maybe we can go step by step if necessary.3. No strong views, but suggest further discussion shall not be precluded if it is needed in the future. |
| ZTE  | Yes  | 1. Our preference is TS38.306 since 38.822 somehow is outdated. But we can go with majority view.2. We are ok to further describe whether a feature/UE capability is for reliability or latency as it gives more information to the verticals.3. No strong view on this. |
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## Final Round

### Intermediate Round Conclusions

**Comment:** Alt 3 seems still quite agreeable. No further split of capabilities beyond what is proposed in RP-212206 seems agreeable. Concerns have been expressed that this should not evolve by continued updating, and that a CR is acceptable only if it can be agreed at current meeting with no further RP discussions. Opinions expressed for 38822 (vs 38306) seems stronger and with justification that informational text is better in this TR and more aligned with contents there. The information added in the CR in RP-212206 didn’t receive any negative comments and seems to be a good baseline.

**Proposed way forward (After Intermediate Round):**

* Capture the Rel-15 UE capabilities relevant for URLLC operation
* CR is to be approved at current TSG RAN
* Change is captured in TR 38.822 (based on the proposal in RP-212206).

Point to address further:

Whether we need to capture limitations or conditions in order to make this way forward fully acceptable, e.g. whether we expect no further modifications, for URLLC or for other use cases.

Q: For final round address Whether we need to capture limitations or conditions in order to make this way forward fully acceptable, e.g. whether we expect no further modifications, for URLLC (or for other use cases).

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| **Company** | **Condition Required?** | **Comment / Justification / Explanation** |
| Huawei,HiSilicon | No | Although we prefer 38306, we can accept capturing in 38.822. As usual we think 3GPP discussion is always contribution driven, and there should be nothing prevented for any future discussion if needed. Please also note that this is the first time that companies bring the list of URLLC specific features, and it should allow companies to have more time to check. We don’t see any specific limitation is required and appropriate. |
| Qualcomm | Yes | To be clear, we agree with Huawei that in practice it is difficult to declare any text or specification unalterable. But we think there is value in clarifying that agreeing to this CR is not meant in any way to alter the status captured in RAN #92e. This can be captured, e.g. as follows: **Proposed way forward (After Intermediate Round):** * Capture the Rel-15 UE capabilities relevant for URLLC operation and reconfirm the status captured in RAN #92e about not introducing UE profiles or any further UE feature categorization
* CR is to be approved at current TSG RAN
* Change is captured in TR 38.822 (based on the proposal in RP-212206).

We are equally ok with not introducing the CR and not making any changes if the above is not acceptable.  |
| Apple | No need for conditions. | We are okay to capture the text in 38.822 and the proposed CR is acceptable to us. A further split or categorization is not required, we see no reason to limit the application areas. |
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# UL MIMO coherence capabilities

RP-212108 [1] proposes to address LS from RAN4 to RAN1 and RAN2 in R4-2107765 (R1-2106431) due to lack of progress in WGs. Moderator observes that in RAN2 the topic was postponed awaiting outcome from RAN1. The following proposals are made:

Proposal 1: A new UE capability indicating UL MIMO coherence per band per band combination is introduced (regardless of UL Tx switching)

Proposal 2: Solve this issue at the RAN#93-emeeting.

## Initial Round

Q: Moderator asks companies to provide initial feedback on the proposals and discussion in RP-212108 [1], i.e. whether to have the discussion at TSG RAN 93e, and/or whether the proposed technical way forward or other way forward can be acceptable.

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| **Company** | **Acceptable?** | **Comment / Justification / Explanation** |
| Qualcomm | Yes | We support discussing and solving this issue in RAN#93e.The UE MIMO coherence capability is strongly coupled with the number of Tx chains / layers. For example, the UE may be coherent capable with 2 Tx but not coherent (not even partial coherent) with 4 Tx. Since the number of layers is already signaled per band per band combination, the coherence capability needs to be signaled in the same structure per band per band combination to maintain consistency and avoid under reporting by the UE.  |
| Ericsson | No | The UL TX switching issue for coherent MIMO operation that was identified in the RAN4 LS R1-2106431 is already solved in our view by the CR made to 38.101, and it so does not drive the need for the UE capability changes suggested in RP-212108. |
| Apple | Yes, but | We are ok to introduce a per-band-per-BC capability, but regarding the topic getting this discussed/resolved in RAN-93e, we are not sure if this is needed. Can be done at WG level. |
| Huawei,HiSilicon | No | We had similar views as Ericsson. |
| Samsung | No | We also think gNB can manage this issue based on R4-2109583 for 38.101 but we think this discussion can be done in WG discussion. |
| Futurewei |  | This should be resolved at WG level. |
| Vivo | Yes | We are fine to solve this issue in RAN#93e to facilitate the progress in WG. Currently UL MIMO coherence capability is reported per band, and number of layers is signaled per band per band combination, which may lead to under reporting in the cases where one UE supports 4Tx is configured with 2Tx in a BWP, and the coherence capability is different. |
| DOCOMO |  | This proposal can be discussed at WG level. |
| ZTE |  | Before sharing our view, we would like to understand the proposal better. The RAN4 LS (R4-2107765) proposed to introduce a new UE feature to differentiate the coherence capability between transmission directly after the Tx switching gap and other regular transmission. While the proposal from RP-212108 seems to introduce a new coherence capability (per band per BC), which can be used to differentiate coherence capability between Tx switching case and non-Tx switching case. It seems the proposal from RP-212108 is not directly in line with the RAN4 LS and can’t address the issue raised by the RAN 4 LS. Is this the correct understanding?If yes, then it seems that even if we adopt the proposal from RP-212108, we may still need to introduce another UE capability to differentiate the coherence capability between transmission directly after the Tx switching gap and other regular transmission. |
| OPPO (Qianxi) | Yes | We are open to this since it brings more flexibility to UE implementation.Similar view as Apple, we are fine to leave this to further discussion at WG level. |
| Nokia, NSB | Maybe | We do not have strong concerns on the proposal, but we prefer to have this discussion in WG level first. |
| MediaTek |  | We also suggest to leave this for WG discussion |
| Vodafone  | No  | no need for further work nor categorization. We agree with Ericsson. |
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### Initial Round Conclusion

Moderator: Suggest no further discussion beyond initial Rnd.

Observation: Some confusion as to the relation with the Referenced RAN4 LS. Most companies prefer that this is discussed at WG level.

**Conclusion** No Conclusion at TSG RAN 93e. Expect that this can be discussed at WG level (based on company contributions there).

# Conclusions

RP-212109 NR UE categories/profiles for URLLC SoftBank Discussion

RP-212207 Discussion on introduction of list of Rel-15 features relevant to URLLC
 Nokia, Nokia Shanghai Bell Discussion

RP-212206 Introduction of informative annex on list of Rel-15 features relevant to
 URLLC Nokia, Nokia Shanghai Bell CR Rel-16 38.306
 16.5.0 0644 - F NR\_newRAT-Core

*Conclusions after intermediate or final rounds*

**RP-212108 UL MIMO coherence capabilities Qualcomm Incorporated**

Observation: Some confusion as to the relation with the Referenced RAN4 LS. Most companies prefer that this is discussed at WG level.

**Conclusion** No Conclusion at TSG RAN 93e. Expect that this can be discussed at WG level (based on company contributions there).

# References

[1] RP-212108 UL MIMO coherence capabilities Qualcomm Incorporated
 Discussion

[2] RP-212109 NR UE categories/profiles for URLLC SoftBank Discussion

[3] RP-212206 Introduction of informative annex on list of Rel-15 features relevant to
 URLLC Nokia, Nokia Shanghai Bell CR Rel-16 38.306
 16.5.0 0644 - F NR\_newRAT-Core

[4] RP-212207 Discussion on introduction of list of Rel-15 features relevant to URLLC
 Nokia, Nokia Shanghai Bell Discussion