3GPP TSG-RAN WG2 Meeting #116 Electronic R2-21xxxxx

Online, November 1 –12, 2021

**Agenda item: 8.7.2.4**

**Source: Apple**

**Title: Draft-Summary of [Post115-e][604][Relay] Relay QoS (Apple)**

**Document for: Discussion and Decision**

# 1 Introduction

This document is a report on the following email discussion:

* [Post115-e][604][Relay] Relay QoS (Apple)

      Scope: Address remaining proposals on QoS for L2 relay:

* PDB and PER split between Uu and PC5 (P3/P4 of R2-2109018)
* Configuration of remote and relay UE with PC5 QoS parameters (P3/P4/P5/P6/P9/P10/P11 of R2-2109018)
* Granularity of QoS configuration for remote UE, per PC5 RLC bearer or per Uu QoS flow (P12/P13 of R2-2109018)
* Multiplexing of QoS flows of different PDU sessions and separation of relay traffic and relay UE’s own traffic (P14 of R2-2109018)
* RLC channel mapping in relation to QoS parameters (P15 of R2-2109018)
* Measurement reports on PC5 link conditions (P16 of R2-2109018)

      Intended outcome: Report to next meeting

      Deadline:  Long

Please note that the proposals above from R2-2109018 [19] were part of the summary of Agenda 8.7.2.4, which are based on the company contributions [1-18] submitted to RAN2#115-e. All those contributions are listed in section 5 for your reference.

Please also note that P11 is added in the above scope because it was discussed and included in R2-2109018 [19] but accidently left out in the summary section due to a copy/paste error. P11 is also related to whether a certain QoS metric shall be configured for remote UE, so it is proper to discuss it here, along with P9/P10.

The email discussion is planned as having two phases:

* **Phase I**: During this phase, a questionnaire is provided, and companies are invited to share feedback on the questions by 10:00 UTC, 14th October, 2021.
* **Phase II:** Rapporteur submits a summary based on phase I’s inputs, and companies can comment on the summary by the submission deadline of RAN2#116-e.

# 2 Contact Points

Respondents to this email discussion are kindly asked to fill in the following table.

|  |  |  |
| --- | --- | --- |
| Company | Name | Email Address |
| Apple(rapporteur) | Zhibin Wu | zhibin\_wu@apple.com |
| OPPO | Boyuan Zhang | zhangboyuan@oppo.com |
| Qualcomm | Peng Cheng | chengp@qti.qualcomm.com |
| Ericsson | Wang Min | min.w.wang@ericsson.com |
| InterDigital | Martino Freda | martino.freda@interdigital.com |
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# 3 Discussion

## 3.1 PDB and PER split between Uu and PC5

[1] has discussed the issue that when E2E QoS corresponding to a certain standardized 5QI is split, the PER and PDB values may no longer match the values represented in standardized PQI. For example, “If gNB determines the end-to-end PDB (100ms) should be split between Uu and PC5, Uu uses 60ms and PC5 uses 40ms. For Uu backhaul link, it should use non-standardized 5QI which with priority level equals to 20 and PDB equals to 60ms. Similarly, non-standardized PDB should also be used in PC5.” The analysis on PDB and PER is similar on this aspect. The following proposals has been included in [19], but not yet discussed:

**Proposal 3: [Need Discuss]When gNB performing PDB split between Uu and PC5, non-standardized PDB parameters can be used.**

**Proposal 4: [Need Discuss]When gNB performing PER split between Uu and PC5, non-standardized PER parameters can be used.**

Thus, the rapporteur asks the company views about the above two proposals:

**Question 1: Do companies agree with proposal 3?**

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| --- | --- | --- |
| Company | Yes or No | Comments |
| OPPO | Yes |  |
| Qualcomm | See comments | We agree with the intention of this proposal because standardized PDB parameters are not quite likely to be split, as analysed in [1]. However, we are not sure what is the spec impact. RAN2 has agreed that it is up to gNB implementation to split the QoS between Uu link and PC5 link. Thus, it is straight forward to leave it to gNB how to configure the split PC5 QoS to remote UE. Generally, RAN2 don’t specify to restrict gNB behaviour or configuration. |
| Ericsson | see comments | One thing to clarify: the PDB which the gNB splits is not E2E PDB, which is AN PDB (i.e., E2E PDB minus – PDB reserved for CN).  We also share the same view as Qualcomm. It will be up to the gNB implementation on how to split the PDB. This would not affect the spec. the PDB value is mostly probably to be used by remote UE or relay UE for Mode 2 scheduling. Therefore, the intention is ok, however, the proposal itself is not clear.  Suggest to reword the proposal  **When gNB performing PDB split between Uu and PC5, non-standardized PDB parameters can be used. No spec impact is foreseen.** |
| InterDigital | Yes | We agree with the comments from Qualcomm and Ericsson, that there is no spec impact here. |
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**Question 2: Do companies agree with proposal 4?**

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| Company | Yes or No | Comments |
| OPPO | No | Since now the specification does not make use of PER for any UE behaviours. Thus, we do not see a need for “PER split” |
| Qualcomm | No | First, PER split is not agreed yet. This question should be discussed only if Q9 and Q10 can be agreed.  Even if Q9 and Q10 can be agreed, we have similar comments to Q1. We agree with the intention, but it can be left to gNB implementation without spec change because RAN2 generally don’t specify to restrict gNB behaviour or configuration. |
| Ericsson | No | Agree with OPPO. PER is no need to split, at least RAN2 shall avoid discussion on this before there is clear use case on how to utilize split PER. |
| InterDigital | No | Agree with Qualcomm. |
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## 3.2 Configuration of remote and relay UE with PC5 QoS parameters

In this section, we first discuss the general signaling aspects of QoS configuration. Whatever gNB decides regarding he E2E QoS breakdown, it need to inform the relay UE about the related QoS configurations. Details of the contents of QoS configuration can be discussed later. Similarly, gNB also can deliver the QoS-related configuration directly to RRC\_CONNECTED remote UE, as proposed or suggested in [3]. There is no obvious benefit to deliver this configuration to relay UE first and then let relay UE to forward that to remote UE. There is no need to let relay UE to make any changes of this configuration for the remote UE, either. So, the rapporteur has provided the following proposal in [19] and would like to ask the company view on this.

**Proposal 5: [Need discuss] gNB directly configures relay UE for PC5 QoS configuration via Uu RRC signalling. And gNB also directly configures remote UE for PC5 QoS configuration via Uu RRC signalling. FFS signaling details and when they are triggered.**

**Question 3: Do companies agree with proposal 5?**

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| Company | Yes or No | Comments |
| OPPO | Yes |  |
| Qualcomm | Yes | This proposal is to fill the below 2 gaps from Rel-16 legacy PC5 QoS configuration:   1. In Rel-16 framework, PC5 RLC bearer ID is allocated by UE self, and thereby gNB does not know the PC5 RLC bearer ID. 2. PQI in Rel-16 *SL-SDAP-config (*as part of SLRB config*)*can’t be used by relay UE because SDAP layer is absent in relay UE.   The details of signalling and its trigger can be further discussed. |
| Ericsson | Yes |  |
| InterDigital | Yes |  |
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Then, we focused on individual QoS metric instead of the overall QoS configuration or bearer configurations.

In RAN2#115, it has been agreed that PDB value, as a QoS metric, needed to be known by remote UE and relay UE respectively:

Agreements on QoS:

Proposal 7 (modified): [Easy] gNB should configure the [mode 2] L2 remote UE with the PC5 PDB for PC5 hop of relay traffic.

Proposal 8 (modified): [Easy] gNB should configure the mode 2 L2 relay UE with the PC5 PDB for PC5 hop of relay traffic.

Regarding other QoS metrics, it is suggested that PC5 priority (i.e., PQI priority) is definitely needed for PC5 QoS enforcement because this must be included in SCI for NR SL transmission. Whether this information is explicitly conveyed or as part of SL RLC bearer configuration can be further discussed (e.g., in stage 3). The following proposal is given in R2-2109018[19], but not yet discussed in RAN2#115-e.

**Proposal 6: [Need Discuss] gNB should configure remote UE and relay UE about the PC5 Priority information for PC5 hop of relay traffic.**

Company views are solicited about the above proposal in the following question:

**Question 4: Do companies agree with proposal 6?**

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| Company | Yes or No | Comments |
| OPPO | Yes but no spec impact | As in legacy behaviour, gNB will configure per-PC5 LCH priority for each UE, so there should be no delta part. |
| Qualcomm | See comments | We have same understanding as Rapporteur that PC5 priority is needed for relay and remote UE because it is required to be included in SCI.  However, we prefer that PC5 priority information can be as part of SL RLC bearer configuration. We are not convinced that a new explicit PC5 priority for relay hop needs to be introduced and conveyed to remote/relay UE (besides the legacy PQI priority). As we mentioned before, PC5 priority can be reflected via gNB configured PC5 RLC bearers, but it is not necessary to have a new split value for PC5 hop of relay traffic. |
| Ericsson | Yes | As indicated by OPPO, it is LCH priority which is used in the SCI. the current signalling interface is already able to carry the priority information. Therefore, no need to spend time to discuss. |
| InterDigital | Yes | We agree with the statement. As for how it is conveyed/configured, we agree with rapporteur that this can be left to stage-3 discussion. |
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It is worth noting that the configuration of the split PDB has been agreed as captured in the RAN2#115 agreements. However, the split of PER requirements may need some further discussion, so, we have the following proposals for remote UE and relay UE, respectively in R2-2109018[19].

**Proposal 9: [Need Discuss] gNB should configure the mode 2 remote UE about the PC5 PER for PC5 hop of rely traffic.**

**Proposal 10: [Need Discuss] gNB should configure the mode 2 relay UE about the PC5 PER for PC5 hop of rely traffic. FFS mode 1 relay UE.**

Company views are solicited about the above proposals in the following questions:

**Question 5: Do companies agree with proposal 9?**

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| --- | --- | --- |
| Company | Yes or No | Comments |
| OPPO | No | As mentioned in Q2, current spec does not make use of PER. So we do not see the need to configure PC5 PER. |
| Qualcomm | No | We are not convinced why PC5 PER needs split. gNB can split PER via its implementation and configure PC5 RLC bearers accordingly. It is our understanding that the split PER is reflected via gNB configured PC5 RLC bearers, but its explicit value is not necessary to be provided to relay or remote UE. |
| Ericsson | No | As OPPO and Qualcomm commented, there is no usage of PER in the Mode 2 resource allocation. |
| InterDigital |  | We are not sure that the argument that “because PER is not used currently in SL, it is not needed for relayed” is valid, since now the split is between a Uu PER and a SL PER. This can be left open for now. |
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**Question 6: Do companies agree with proposal 10?**

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| Company | Yes or No | Comments |
| OPPO | No | See above comment |
| Qualcomm | No | Same comments as Q5. We don’t agree to convey explicit split PER value to relay UE. The split PER has been reflected in gNB configured PC5 RLC bearers. |
| Ericsson | No | there is no usage of PER in the Mode 2 resource allocation. |
| InterDigital |  | Same as Q5. |
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There is a similar proposal in R2-2109018[19] based on analysis in [1] that the PC5 Link-AMBR is also needed for mode 2 remote UE.

**Proposal 11: [Need Discuss] gNB should configure the mode 2 remote UE about the PC5 LINK-AMBR for PC5 hop of rely traffic.**

Company views are solicited about the above proposal in the following question:

**Question 7: Do companies agree with proposal 11?**

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| --- | --- | --- |
| Company | Yes or No | Comments |
| OPPO | No | LINK-AMBR is used for V2X, but not used for ProSe L2 Relay so no need to consider here. |
| Qualcomm | No | First, we understand PC5 Link-AMBR is for Mode 1 only, which can’t work for remote UE connecting to relay.  Secondly, PC5 Link-AMBR is more of an optimization aspect. It can always be enforced on the gNB (as it is a Mode 1 operation parameter only). In the Relay case, it could help for Relay to avoid forwarding too much data from Remote UE, but it is not part of the QoS Model to enforce on Relay or Remote UE in SA2 design. So, even if majority prefer it, we think RAN2 need to check with SA2 first. |
| Ericsson | No | The PC5 link-AMBR is enforced at RAN based on Mode 1 resource allocation. In the relay scenario, Remote UE will or only base on Mode 2 resource allocation in this release. Therefore, in order to enforce PC5 link-AMBR, RAN2 has to spend efforts to study other enhancement features, which are not possible considering limited time in Rel-17. |
| InterDigital | No | Agree with previous comments – this is only for mode 1. |
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## 3.3 Granularity of QoS configuration for remote UE, per PC5 RLC bearer or per Uu QoS flow

It is fair to assume gNB’s QoS split could be done per QOS profile and QOS profile can be provided on a per QoS flow basis, at least for DL traffic from gNB. However, the related QoS configuration is not necessarily be conveyed at the same granularity, especially considering the fact that SDAP/PDCP layer is not available in relay UE. Regarding how QoS metric is configured in which granularity, we have some proposals from [14] regarding PDB metric, which can be discussed. Note that [14] has actually proposed Alt 3 ( a ratio of E2E PDB per Uu QoS flow), but the rapporteur think this is just an optimization of Alt 2. So, RAN2 may only need to down-select from the above two options. Therefore, it was proposed as below in R2-2109018[19]:

Proposal 12: [Need Discuss] RAN2 down-select the options for QoS configuration for remote UE for its operation on PC5 hop (UL).

Alt1: remote UE is configured per PC5 RLC bearer

Alt2: remote UE is configured per Uu QoS flow

For the purpose of resolving the issue raised in P12, the rapporteur asks the company views on the following question.

**Question 8: Regarding the options for QoS configuration for remote UE for its operation on PC5 hop (UL), which option do you prefer?**

* **Option A: remote UE is configured per PC5 RLC bearer**
* **Option B: remote UE is configured per Uu QoS flow**
* **Option C: Other, please specify.**

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| --- | --- | --- |
| Company | Option | Comments |
| OPPO | Option A | Consider relay UE is blind to remote UE’s Uu QoS flow, PDB should be configured per PC5 RLC bearer. |
| Qualcomm | Option A | We should discuss DL case first. In DL, as we comment in Q9, Option A is the only feasible way because QoS flow info of remote UE (or SDAP layer) is not available in relay.  For UL, in principle, both Option A and Option B can work. But Option B may need some clarification whether the Uu QoS flow info from NAS is split or E2E. Thus, we prefer aligned configuration in DL and UL, i.e., Option A |
| Ericsson | Option A | There is no SL SDAP, and SL PDCP at the PC5 hop for remote UE, it is straightforward to base on PC5 RLC bearer. While Uu QoS flow is across two hops, which is not feasible. |
| InterDigital | Option A | Even in normal sidelink, QoS configuration is per RLC bearer and the QoS flows are only visible in the SDAP layer. |
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Then, regarding the relay UE, as there is no SDAP layer in relay UE for relay traffic, it is proposed in [14] and duplicated in [19] as P13:

**Proposal 13: [Need Discuss] Regarding mode 2 Relay UE for its operation on PC5 hop (DL), PDB should be configured per PC5 RLC bearer.**

Company views are solicited about the above proposal in the following question:

**Question 9: Do companies agree with proposal 13?**

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| Company | Yes or No | Comments |
| OPPO | Yes |  |
| Qualcomm | Yes | In DL, this is the only feasible way because Uu QoS flow is not available in relay and SDAP layer is absent in relay. |
| Ericsson | Yes |  |
| InterDigital | Yes |  |
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## 3.4 Multiplexing of QoS flows of different PDU sessions and separation of relay traffic and relay UE’s own traffic

In Rel-15 NR, Multiplexing QoS flows of different PDU sessions into the same Uu DRB is not allowed due to the security policy issue, as pointed out in [3].

However, [5] has argued that security policy is an end-to-end PDCP layer issue and “that this is one of the key reasons that the adaptation is done below the PDCP wherein the end-to-end bearer security is still maintained between the Remote UE and the gNB”. Hence, each bearer belonging to different PDU session is still able to apply the corresponding security algorithms as dictated by the policy. Therefore, the traffic from relay UE and remote UE can still be multiplexed in the same Uu bearer in SL relay case. P14 was proposed in RAN2#115, but not yet discussed due to time limit.

Proposal 14 [Need Discuss] RAN2 to discuss whether to follow NR Rel-15 principle that gNB can’t configure to multiplex QoS flows of different PDU sessions target from remote/relay UE into a single Uu DRB in L2 U2N relay, or there is no need to enforce separation of Remote UE traffic and Relay UE’s own traffic in a single Uu bearer.

The rapporteur think Rel-15 principle is applicable to end-to-end Uu DRB and does not prevent traffic multiplexing by the relay UE into the same Uu RLC bearer. For the purpose of resolving the issue raised in P14, companies are invited to answer the following more straightforward question:

**Question 10: Is there a need to enforce separation of Remote UE traffic and Relay UE’s own traffic in different Uu RLC bearers?**

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| Company | Yes or No | Comments |
| OPPO | See comment | Here we can directly follow the UP discussion result in adaptation layer, so no need to discuss here in QoS AI.  Our preference is that for Uu hop, differentiate the traffic for remote and relay UE via LCID, i.e., in different RLC bearers. |
| Qualcomm | Yes | First, the principle was agreed in NR Rel-15 because they may have different security policy, which is per PDU session coming to gNB from the SMF [5]. Clearly, the same principle should be followed in L2 U2N relay.  Secondly, because remote UE’s traffic has PC5/Uu adaptation layer header, we don’t think it technically can be multiplexed with Relay UE’s own traffic. |
| Ericsson | Yes | As Qualcomm indicated that, multiplexing SDUs with the adaptation layer and SDUs without adaptation layer in the same Uu RLC channel, is infeasible since the gNB will not be able to parse the SDUs correctly. |
| InterDigital | No | We agree with Rapporteur and [5] that there is no security issue for multiplexing the traffics on the same RLC bearer. |
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## 3.5 RLC channel mapping in relation to QoS parameters

Regarding the N-to-1 mapping issue left in WI stage: “Details of handling in case PC5 RLC channels with different end-to-end QoS are mapped to the same Uu RLC channel can be discussed in WI phase”. In submission[1][2][3][5][6], companies are fine to allow PC5 RLC channels with different end-to-end QoS to be mapped to the same Uu RLC channel. While several companies think this is up to proper gNB implementation, one company [2] think “The mapping between the ingress PC5 RLC channel and the egress Uu RLC channel is handled by the adaptation layer of the relay UE, and the relay UE is not aware of the E2E QoS. Therefore, no special handling is needed to differentiate whether PC5 RLC channels with the same or different E2E QoS are mapped to the same Uu RLC channel.” Hence P15 was proposed in R2-2109018[19]:

**Proposal 15 [Need Discuss] PC5 RLC channels with different end-to-end QoS can be mapped to the same Uu RLC channel, which is up to gNB implementation.**

Company views are solicited about the above proposal in the following question:

**Question 11: Do companies agree with proposal 15?**

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| Company | Yes or No | Comments |
| OPPO | Yes |  |
| Qualcomm | Yes but… | We are wondering whether the following can be agreed as a RAN2 common understanding:  “gNB is expected to multiplex PC5 RLC channels with similar E2E QoS into same Uu RLC channel. Otherwise, remote UE’s QoS performance may be degraded or even can’t be satisfied.” |
| Ericsson | Yes | In our understanding, this can be resolved by proper gNB implementation, e.g. gNB may only map PC5 RLC channels with different E2E QoS to the same Uu RLC channel if the QoS breakdown over Uu is the same for these PC5 RLC channels so that they can be treated equally over Uu.  Regarding Qualcomm suggested understanding, we don’t agree. The key point it that,  QoS breakdown over Uu of different remote UEs are similar, regardless if E2E QoS are same or different. Anyway, this can be just up to gNB implementation. RAN2 shall not agree on or introduce any unnecessary restriction or agreement or common understanding towards the gNB. |
| InterDigital | Yes | This is upto gNB implementation, so it is possible. |
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## 3.6 Measurement reports on PC5 link conditions

Based on the proposals in [2][5][7][8][10][13], it is a common understanding that the existing mechanism (SL measurement report and CBR reporting) at least can be utilized by gNB to make proper QoS split decisions and adjust QoS configurations. It has also been argued in [8][10] that the measurements directly related to QoS guarantee (e.g., latency, PER) are not included in the current UE measurement and reporting mechanisms. In current L2 measurement, gNB will perform some QoS related measurements and reporting, e.g. packet delay and loss rate in Uu link, but it does not has those measurements or statics of the relay link. Thus, whether some enhancements are needed for measurement report can be further discussed.

**Proposal 16 [Need Discuss] The existing SL measurement report and CBR measurement reports can be used by gNB to understand PC5 link conditions and determine QoS configuration. FFS whether enhancements on measurements reporting for PC5 link (e.g., on packet delay and loss rate ) are needed.**

Company views are solicited about the above proposal in the following question:

**Question 12: Do companies agree with proposal 16?**

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| Company | Yes or No | Comments |
| OPPO | Yes to the first part but No to the FFS part | We share the view that the legacy SL CBR measurement report can be applied in sidelink relay.  But there is no need for additional enhancement since gNB can control the QoS split strategy based on remote UE’s end-to-end QoS and relay UE’s Uu QoS, which are able to be aware by gNB naturally, |
| Qualcomm | Yes | We think this proposal is straight forward. Furthermore, we don’t think it is necessary to enhance the measurement for PC5. The current SL-RSRP/SD-RSRP and CBR are sufficient for gNB to determine QoS configuration. |
| Ericsson | Yes to the first part, but No to the FFS part | Share the same view as OPPO. RAN2 shall avoid discussing any optimization feature, there is limited time left in Rel-17. |
| InterDigital | Yes | We are fine to agree to the proposal as is. We don’t need to discuss the FFS point as part of this question and stick with the conclusion proposed in the last meeting for now. |
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# 4 Conclusion

TBD

# 5 References

[1] R2-2106993 End-to-end QoS Management for L2 Sidelink Relay CATT discussion Rel-17 NR\_SL\_relay-Core

[2] R2-2107040 Discussion on resource allocation and QoS management for L2 U2N relay OPPO discussion Rel-17 NR\_SL\_relay-Core

[3] R2-2107107 Discussion on E2E QoS enforcement in L2 U2N relay Qualcomm Incorporated discussion NR\_SL\_relay-Core

[4] R2-2107278 Discussion on QoS for L2 UE to NW Relays InterDigital discussion Rel-17 FS\_NR\_SL\_relay

[5] R2-2107308 E2E QoS management considerations for L2 U2N relaying Intel Corporation discussion Rel-17 NR\_SL\_relay-Core

[6] R2-2107471 Aspects for QoS management with SL relay Ericsson discussion Rel-17 NR\_SL\_relay-Core

[7] R2-2107497 E2E QoS Provisioning with L2 Sidelink Relay Fraunhofer IIS, Fraunhofer HHI discussion Rel-17

[8] R2-2107624 QoS enhancements for UE-to-NW relay Apple discussion Rel-17 NR\_SL\_relay-Core

[9] R2-2107712 QoS management aspects for L2 U2N Relay Samsung discussion Rel-17 NR\_SL\_relay-Core

[10] R2-2107758 Mechanisms for E2E QoS management vivo discussion

[11] R2-2107833 Considerations on voice and video support for Relays Philips International B.V., MediaTek, Vivo, FirstNet discussion Rel-17 NR\_SL\_relay-Core

[12] R2-2108149 Discussion on QoS of SL relay ZTE, Sanechips discussion Rel-17

[13] R2-2108512 Mechanisms for E2E QoS management CMCC discussion Rel-17 NR\_SL\_relay-Core

[14] R2-2108624 QoS management of L2 U2N relay Huawei, HiSilicon discussion Rel-17 NR\_SL\_relay-Core

[15] R2-2108821 On recommended bit rate MediaTek Inc. discussion Rel-17 NR\_SL\_relay-Core

[16] TR38.836 Study on NR sidelink relay(Release 17)

[17] RP-210904 WID on NR SL Relay

[18] R2-2108148 Discussion on adaptation layer design ZTE Corporation, Sanechips discussion Rel-17

[19] R2-2109018 [Pre115-e][605][Relay] Summary of AI 8.7.2.4 QoS (Apple)