**3GPP TSG RAN WG2 Meeting #114-e R2-2106587  
Electronic Meeting, 19th - 27th May 2021**

**Agenda item: 8.7.3**

**Source: CATT**

**Title: [AT114-e][618][Relay] Remaining issues on (re)selection**

**Document for: Discussion and Decision**

# Introduction

This is email discussion for below offline discussion:

 [AT114-e][618][Relay] Remaining issues on (re)selection (CATT)

      Scope: Resolve remaining open issues on relay (re)selection:

         Discuss the case of no data for evaluating the relay (re)selection trigger criterion, and determine whether a specified UE behaviour is needed, and if so what to specify

         Discuss P2 and P5 of R2-2106470

      Intended outcome: Report to CB session, in R2-2106587

      Deadline:  Tuesday 2021-05-25 1000 UTC (can extend if needed)

The above email discussion is divided in two phases:

* **Phase I:** Companies are invited to provide feedback on the questionnaire of this email discussion by 2021-05-24 1000 UTC.
* **Phase II :** Rapporteur submits a summary and proposals based on the feedback and companies can comments on the summary and proposals by 2021-05-25 0700 UTC, to allow time for final proposals reshaping and Tdoc submission.

# Discussion

## PC5 measurement in case of no data transmission

During the online discussion, the following agreements regarding to PC5 measurements were reached:

Agreements:

Use only SL-RSRP if available; discuss the no data case by email.

The reaming issue is that how to performs the PC5 measurement in case of no data. There are mainly two options:

* Option 1: still use SL-RSRP;
* Option 2: use SD-RSRP.

For Option 1, it should further discuss how to acquire the SL-RSRP when there is no data available. For Option 2, as mentioned by Apple, if both SL-RSRP and SD-RSRP are used, the reselection threshold may be different, which would be problematic. Hence, in order to make progress, it should first discuss which PC5 measurement should be used in case of no data.

**Question 1: When a Remote UE is connected with a Relay UE and when there is no data transmission, which PC5 measurement should be used for relay reselection evaluation? Please give your comments.**

* **Option 1: SL-RSRP;**
* **Option 2: SD-RSRP.**
* **Option-3: Up to UE implementation to adopt SL-RSRP or SD-RSRP**

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| **Companies** | **Option** | **Comments** |
| OPPO | Option 1 or Option-3 | During Rel-16, it has been discussed on how to perform SL-RSRP under the case that when unicast link has been established but no data transmission. Therefore, there is nothing new if we keep using SL-RSRP.  Or, if this issue becomes too controversial, we see one way-out as leave the selection of option-1/2 to UE implementation. |
| Qualcomm | Option 1 | RAN2 has agreed to only use SL-RSRP when there is data transmission. Then if SD-RSRP still can be used, it means remote UE has to perform two different measurements (i.e. both SD-RSRP and SL-RSRP) for one single PC5 link. We have below concern:   * It increases remote UE unnecessary power consumption and complexity to maintain two measurements * It implies relay has to continue broadcasting discovery message just for PC5 measurement even if it is already overloaded (i.e. it can just maintain current remote UEs but can’t get more) * It will bring some potential tricky spec impacts, e.g.   + How a remote UE can decide it is “no data transmission”? Do we need to specify a duration threshold of IDLE time for remote UE to determine when to start using SD-RSRP? Can RAN2 decide without RAN4 involvement?   + For service continuity, whether both SL-RSRP and SD-RSRP or one of them need to be reported for one single relay with PC5 connection.   In order to simplify UE behavior and avoid risking of incompletion of relay reselection, we prefer to only rely on SL-RSRP for relay with PC5 connection. |
| vivo | Option 2 | Using SD-RSRP for relay reselection can to some extent reuse the design in LTE.  On the other hand, if SL-RSRP is used, the relay reselection can be triggered by SL-RSRP but anyway if the remote UE would like to select another UE without PC5-RRC connection with, it still needs to measure SD-RSRP.  And there are cases that no data transmission is ongoing and then we have to need more work on how we acquire the SL-RSRP in all cases, and it may be even more complicated as different options brought by companies (e.g. based on keep alive message, CSI message) and may also involve SA2 for upper layer message related aspects. |
| Ericsson | Option 1 | On top of Qualcomm’s comments, if there is no timely discovery message transmission (with Model A) from relay UE, remote UE may need to transmit discovery message with Model B. this sounds like to introduce a new trigger for discovery, which may bring spec impact. Therefore, considering RAN2 has to complete the work this meeting, RAN2 needs to select the simplest solution (i.e., option 1) to avoid spec change. |
| InterDigital | Option 2 | We think option 1 is not preferred because either 1) it introduces new signaling (e.g. transmission of CSI request/CSI report) which adds overhead, or 2) relies on the transmission of keep alive signaling, which from experience in Rel16 V2X (for RLM/RLF) is not frequent enough for AS layer operations.  Seeing that the relay is anyways transmitting discovery (i.e. for other remote UEs), discovery can be used in the case of no data. And since the UE is aware whether it uses SL-RSRP or SD-RSRP for the reselection trigger, it knows which threshold to use, so we don’t see the use of both SL-RSRP and SD-RSRP as problematic. |
| Samsung | Option 1 | We share the concern to use two different measurements. |
| ZTE | Option 1 | If remote UE is PC5 connected with relay, we think SL-RSRP should be used. If no data transmission is available, AS layer may trigger the upper layer to initiate the keep alive procedure. As shown below, the keep alive procedure may be triggered by the lower layer based on UE implementation.  TS 24.587  The initiating UE shall initiate the PC5 unicast link keep-alive procedure when:  a) timer T5003 for this link expires;  b) optionally, a request from the lower layers to check the viability of the PC5 unicast link is received; or  NOTE 1: Whether the lower layers can request the initiation of the PC5 unicast link keep-alive procedure, and what the triggers for the lower layers are to request the initiation of the PC5 unicast link keep-alive procedure, are UE implementation specific. |
| CMCC | Option1 | We have the same concern as Qualcomm for Option2 and option 1 seems acceptable for us. |
| Lenovo&MM | Option 2 | If the discovery message is available, the UE can avoid triggering the keep alive message, which is not needed at that time. |
| Nokia | Option 1 | Even we say that it is up-to UE implementation to use SD-RSRP as well, RAN2 need to do some additional specification work to enable it; e.g. to provide thresholds for SD-RSRP. Therefore, we think that it is simpler to use SL-RSRP only.  We think that SL-RSRP is good enough (can provide acceptable level evaluation of PC5 quality). Note that SL-RSRP covers the case when keep-alive messages are sent, as they are "data" from AS perspective. |
| Kyocera | Option 2 | We think the UE should have the option to use either SL-RSRP or SD-RSRP and one doesn’t need to be prioritized over another. We also agree with Vivo that the UE will anyway need to perform SD-RSRP for selecting relay UE candidates. |
| CATTCATT | Option1 | We share the same concern as QC, considering the time limitation; we prefer to reuse Rel-16 V2X’s solution to solve this issue. |
| Huawei, HiSilicon | Option 1 | We share the same concern as QC for option2. It is not desirable to require remote UE to trigger discovery procedure only for evaluation on the established PC5 link. And considering the legacy procedure of keep-alive could be reused to address the no data case as in R16, we prefer option 1. |
| Sharp | Option2 | Agree with vivo that the measurement of SD-RSRP is inevitable. And if there is a method to solve how to compare SL-RSRP and SD-RSRP from different relay UEs, the same method can be used for SL-RSRP and SD-RSRP from the same relay UE, including leave it to UE’s implementation. |
| Spreadtrum | Option 2 | If discovery message is available, SD-RSRP can be measured. |
| Convida | Option 1 | We had a similar discussion in R16 NR V2X for SL RLM/RLF determination. In the end, as long as the remote UE can trigger sidelink “data” transmissions from the relay UE, the SL RSRP measurements can be made. In our view, the Relay UE could be configured to send “data” transmissions to support SL RSRP measurements, or the remote UE could request the relay UE to send “data” transmissions.  In addition, it is not clear to us that there will be enough discovery signaling from the relay UE to properly measure SD-RSRP. If the remote UE needs to trigger these transmissions, we do not see the gain over triggering a keep-alive or CSI report. |
| Apple | Option 2 | We think there is a potential issue to use SL-RSRP due to the SL-based pathloss is not compatible with DL-path loss based SD-RSRP measurements. So, it is preferrable to use SD-RSRP as much as possible. |
| Intel | Option 2 | We agree with the comments from Vivo and Interdigital. To address concerns raised by other companies, we think that a) remote UE anyways checks for SD-RSRP while measuring other relay UEs, so there is no issue in measuring SD-RSRP in addition to SL-RSRP when there is no data b) for service continuity, we think that for direct to indirect access, it will be SD-RSRP that will be reported to the gNB; and since indirect to indirect access is not supported, we are not exactly sure about the concern. Furthermore, relying on keep-alive signalling to measure SL-RSRP seems unreliable as we cannot be sure of the periodicity of the message since it is controlled by higher layer. |
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If company selected Option 1, it should further discuss how to acquire the SL-RSRP in case of there is no data. According to the contributions on this RAN2 meeting, [1][6][7] suggested to use keep-alive message. [5][7] suggested to send SCI to peer UE to trigger CSI reporting.

**Question 2: When a Remote UE is connected with a Relay UE, if only SL-RSRP is used for relay reselection evaluation, in case of there is no sidelink data, which option should be selected for determining the SL-RSRP?** **Please give your comments.**

* **Option 1: Based on keep-alive message;**
* **Option 2: Based on CSI reporting triggered by SCI;**
* **Option 3: Depends on UE implementation (e.g., based on keep-alive message or CSI reporting).**

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| **Companies** | **Option** | **Comments** |
| OPPO | Option 3 | Both option 1 and option 2 can solve the no data issue, but it is not necessary to pursue spec effort on this issue. Thus, it is more preferable to leave the issue to UE implementation. |
| Qualcomm | Option 3 | Same view as OPPO |
| vivo | Option 3 | If option-1 in Q1 is agreed, we prefer option-3 for this question which is simple. |
| Ericsson | Option 3 |  |
| InterDigital | None | We don’t think either of these options is feasible, based on the comments we made in the previous question. |
| Samsung | Option 3 | Same view as OPPO |
| ZTE | Option 3 | Whether keep-alive or CSI reporting shall be used can be up to implementation. It is not necessary to specify it. |
| CMCC | Option 3 |  |
| Lenovo&MM | Option 3 with comments | We suggest the following description.  Depends on UE implementation (e.g., based on keep-alive message, CSI reporting or discovery message). |
| Nokia | Option 3 | Note that from AS perspective keep-alive is SL data. |
| CATT | Option 3 | We don’t think further down selection is needed. |
| Huawei, HiSilicon | Option 3 |  |
| Sharp | Option 3 | If only SL-RSRP is agreed. |
| Spreadtrum | Option 3 |  |
| Convida | Option 3 |  |
| Apple | Option 3 |  |
| Intel | See comment | We do not prefer this scenario, however, we are fine to go with majority if an option has to be chosen based on decision from Q1. |
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In addition, if company selected Option 2, it should further discuss whether different relay reselection thresholds should be configured for SL-RSRP and SD-RSRP.

**Question 4:** **Whether different relay reselection thresholds should be configured for SL-RSRP and SD-RSRP? Please give your comments.**

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| **Companies** | **Yes/No** | **Comments** |
| OPPO | up to network implementation | From our understanding, it is up to network implementation on whether to configure different threshold for SL-RSRP and SD-RSRP. In detail, e.g., when remote UE detecting its SL-RSRP is below the configured threshold (if SL-RSRP is adopted), it will start to perform relay reselection, then it can refer to SD-RSRP to reselect other relay UEs which have no unicast link with the remote UE. |
| Qualcomm | No strong view if option 2 agreed | If agreed, we need to define below cases:   * SL-RSRP satisfies threshold but SD-RSRP doesn’t * SD-RSRP satisfies threshold but SL-RSRP doesn’t |
| vivo | See comments | This issue may be related to power control mechanism for transmission of discovery messages. E.g. if the same power control mechanism is applied to discovery message and sidelink data, and as they are both transmitted on PSSCH, then one threshold can be possible.  Or, to simplify the design, we can also just configure two different thresholds for SD-RSRP and SL-RSRP to avoid potential problems.  It is acceptable that it is left to network implementation, but it may still need to be clarified what the UE would do in case of one threshold and two respective thresholds. |
| Ericsson | No | Considering limited time, perhaps it is sufficient to support one threshold, although performance may be not optimum. |
| InterDigital | This can be upto NW implementation | In our understanding, if different thresholds are configured, the remote UE performs reselection when SL-RSRP is below the first threshold when data is available, and performs reselection when SD-RSRP is below the second threshold when data is not available. |
| Samsung | Up to NW implementation |  |
| ZTE | No | If different relay reselection thresholds should be configured for SL-RSRP and SD-RSRP, it means we need to enhance the baseline reselection mechanism and capture the potential specification impact. Considering limited time left and we haven’t fully discussed the impacts of two thresholds, it is suggested to leave this enhancement to next release. |
| CMCC | Network implementation | More discussion is needed for the case that SD-RSRP and SL-RSRP threshold can not be reached during Relay selection, respectively. |
| Lenovo&MM | Up to network implementation | The network can decide whether the different thresholds are configured. |
| Nokia | Yes | It should depend on the network deployment/implementation if different thresholds are configured. |
| Kyocera | Yes | In case fixed power is used for discovery under separate resource pools, separate thresholds are needed. |
| CATT | No | We agree the threshold configuration is under the control of the network. If option 2 is selected, we share the same view as Ericsson to close it promptly. |
| Huawei, HiSilicon | Yes | From signaling point of view, two separate thresholds would be safer, and network can decide if the same value to be configured. |
| Sharp |  | Can leave it to network’s implementation. |
| Spreadtrum | Up to network implementation |  |
| Convida | Yes | In our view the thresholds may need to be different, and it should be possible to configure different relay reselection thresholds |
| Apple | Yes | At least we think the RRC specification shall support configure two thresholds given the different pathloss used in OLPC. NW can still decide to configure a single one or both. |
| Intel | Yes with comment | For initial relay selection case, the threshold for SD-RSRP should already be defined. Similarly, the threshold for SL-RSRP to be used during relay connection should also be defined already. It is up to network implementation to choose the corresponding thresholds. In our understanding, the scenario is always to use SL-RSRP first and only if it is not available, to check for SD-RSRP for relay reselection. |
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## Transmit power imbalance issue

For the power control of sidelink discovery message, the following agreement was reached during the online discussion:

Proposal 6: RAN2 agrees to reuse Rel-16 power control mechanism for transmission of discovery messages.

Since it was agreed that sidelink OLPC should be applied to discovery message, SD-RSRP also have the transmission power imbalance issue similar as SL-RSRP. In LTE Prose relay, the power imbalance issue was left to implementation. In NR, whether this can be left to implementation needs further discuss. [1] proposed to reuse LTE Prose relay scheme, rely on Network / UE implementation to resolve the transmit power imbalance issue on PC5 measurement for relay (re)selection trigger and candidate relay evaluation. [4] suggested Relay UE carry TX power information in SL model A discovery message and SD-RSRP measurement result in SL model B discovery message.

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| Tdoc# | Source | Summary of their proposals |
| R2-2104745 | Qualcomm Incorporated | P4: Same as LTE Prose relay, rely on Network / UE implementation to resolve the transmit power imbalance issue on PC5 measurement for relay (re)selection trigger and candidate relay evaluation |
| R2-2105127 | Apple | P1: Relay UE carry TX power information in its SL discovery message in model A relay discovery.  P2:Relay UE carry radio signal strength measurement of SL discovery message transmitted by remote UE in model B relay discovery. |

**Question 5: Whether the power imbalance issue can be left to UE implementation? Please give your comments.**

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| **Companies** | **Yes/No** | **Comments** |
| OPPO | Yes | We do not think there will be any impact on relay reselection caused by power imbalance issue. |
| Qualcomm | Yes | We agree there is transmit power imbalance issue. However, similar issue exists in LTE Prose relay for a long time because LTE discovery also applies to OLPC as captured in Section 23.11.1 of 36.330:  *There are three range classes. Upper layer authorisation provides applicable range class of the UE. Maximum allowed transmission power for each range class is signalled in SIB19. UE uses the applicable maximum allowed transmission power corresponding to its authorised range class. This puts an upper limit on the determined transmit power based on open loop power control parameters.*  Since no LTE CR was agreed to resolve this issue, we think it means either it is not an essential issue, or it can be resolved by Network/UE implementation. |
| vivo | Yes | Other solutions can be considered in future release. |
| Ericsson | Yes | We shall avoid the solution suggested by Apple, which causes more spec changes (i.e., discovery message content, or even RAN1 impact). The issue may be valid; however, it can be categorized as optimization, therefore shall be left for future release. |
| InterDigital | No | We think in LTE, the power imbalance issue was not resolved because it could be handled by NW implementation and authorization. In NR, the transmit power is limited by OLPC and it may be difficult to solve this by UE implementation. If time permits, we should consider this issue in this release. Otherwise, it can be left for next release as mentioned by Ericsson. |
| Samsung | Yes | We think this issue can be left to implementation. |
| ZTE | Yes | If SD-RSRP or SL-RSRP is higher enough, the PC5 link quality can be regarded as good for relay re-selection or maintaining the established PC5 connection between relay and remote UE. Even power imbalance exists, nothing is broken. It is not necessary to further consider the optimization to ensure fairness. |
| CMCC | Yes |  |
| Lenovo&MM | Yes | The power imbalance issue can be left to UE implementation |
| Nokia | Yes |  |
| Kyocera | No |  |
| CATT | Yes | We share the same view as OPPO and QC. |
| Huawei, HiSilicon | Yes |  |
| Sharp | Yes |  |
| Spreadtrum | Yes |  |
| Convida | See comment | The impact of the transmit power imbalance on relay (re)selection trigger and candidate relay evaluation is not clear to us. Our recommendation is to deprioritize for now. |
| Apple | NO | We understand the companies prefer simple solutions, but from the technical perspective, using an absolute value of RSRP threshold is not suitable for all the cases, given that different relays may either use fixed transmit power, or dynamic power based on OLPC. For relays with fixed transmit power, the transmit power may be different. For relay UEs using OLPC, it may or may not reach the cap of the transmit power range. Hence, it is unfair to judge the relays simply based on RSRP measurements, especially for an OOC remote UE whose RSRP threshold is preconfigured. Hence, we still hope RAN2 can consider a solution for this. Given the concern of work load, we are fine to only consider it after other high-priority items are completed.  Regarding the proposal of “left to UE implementation”. We think so far the UE behavior is clearly defined (Comparing RSRP measurements with a RSRP threshold). A remote UE cannot arbitrary change a measurement based on its hypothesis of TX UE OLPC. Relay UE cannot change its transmit power algorithms, either. So, there is no “UE implementation” solution here. It is only up to NW implementation. |
| Intel | Yes |  |
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If the answer of Question 5 is No, it should further discuss how to solve the power imbalance issue in case of OLPC is used.

**Question 6: Please add your solutions for solving the power imbalance issue in the following table.**

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| **Companies** | **Solutions** |
| InterDigital | The solution in R2-2105127 can be considered as the baseline if we agree to solve this issue. |
| Kyocera | We think fixed power should be defined and used for discovery, at least for separate discovery pool. |
| Apple | Please See R2-2105127 |
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## L2/L3 relay support

In RAN2#113bis-e meeting, the agreements on AS criteria for relay (re)selection were made:

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| Agreements:  Proposal 3-1 [easy]: Besides serving cell ID, PLMN ID, L2/L3 relay support (if agreed in discovery session) and relay load, other additional AS criteria are not considered in this release. |

We tried to solve the question that whether L2/L3 relay support is used as additional AS criteria for relay (re-)selection. Before we start, we would like to review the proposals from submitted contributions for this topic.

[3] indicated that according to SA2’s progress, the relay service code included in discovery message can indicate if the UE-to-Network Relay is a Layer-3 or Layer-2 UE-to-Network Relay. [1] suggested up to SA2 to decide whether to include L2/L3 relay support in discovery message.

[2] observed SA2 has agreed that UE may indicate the 5G ProSe capability which may indicate whether the UE is capable of one or more of the following 5G ProSe capabilities: ProSe Direct Discovery, ProSe Direct Communication, Layer-2 and/or Layer-3 ProSe UE-to-Network Relay and Layer-2 and/or Layer-3 Remote UE. Hence, it proposed that capability of L2/L3 relay can be used as additional AS criteria for relay (re)selection.

**Question 7: Whether L2/L3 relay support can be used as additional AS criteria for relay (re-)selection？Please give your comments.**

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| **Companies** | **Yes/No** | **Comments** |
| OPPO | Rely on SA2, no need to define AS criteria | Since SA2 is working on this, we can rely on SA2 for this, and thus no RAN2 impact is expected. |
| Qualcomm | Rely on SA2, no need to define AS criteria | Same view as OPPO, especially considering L3 relay support is more SA2 task as agreed in SI phase  In addition, assume this agreement is made in RAN2. Then if the relay and remote UE can support both L2 and L3 relay, do we need to specify a rule that remote UE prioritize to use L2 or L3 relay? Obviously, it will not be an easy agreement (as extensively discussed in SI phase) and the involvement of SA2 can be avoided anyway if it is agreed. |
| vivo | Yes | In our understanding the L2/L3 relay support should be considered as criteria for relay (re)selection, the only question is whether we should specify it in RAN2 or SA2. As relay (re)selection is mainly discussed in RAN2 we understand this L2/L3 relay support can be specified with small spec impact. But we are fine to leave the details to SA2 if this is the majority’s view.  On the other hand, we don’t necessarily need to specify a rule that remote UE prioritize to use L2 or L3 relay. The rule can be simple e.g. L2(L3)-only remote UE may not select L3(L2)-only relay UE. |
| Ericsson | Rely on SA2, no need to define AS criteria | As OPPO and Qualcomm pointed out, we can rely on SA2. |
| InterDigital | Yes | We think RAN2 should discuss the selection criteria because it is not clear how upper layers will know the UE capability. |
| Samsung | Rely on SA2, no need to define AS criteria | Agree with OPPO and Qualcomm |
| ZTE | Relay on SA2 | The RSC in discovery message has been agreed by SA2 to indicate if the UE-to-Network Relay is a Layer-3 or Layer-2 UE-to-Network Relay. And it is natural to use it for the relay (re)selection. Whether it is AS criteria and higher layer criteria is not so important to distinguish. |
| CMCC | Rely on SA2, no need to define AS criteria | Same view as OPPO. |
| Lenovo&MM | Yes | RAN2 can discuss and decide what AS information should be provided as the criteria, which is not controversial. |
| Nokia | Rely on SA2 | If SA2 solves the issue, then no need to have an AS criterion. |
| Kyocera | Rely on SA2 |  |
| CATT | Rely on SA2, no need to define AS criteria | The same view as OPPO and QC. |
| Huawei, HiSilicon | Rely on SA2, no need to define AS criteria | Same view as OPPO and Qualcomm. |
| Sharp | Relay on SA2 | We think choosing L2 or L3 architecture can be seen as upper layer criteria. |
| Spreadtrum | Rely on SA2, no need to define AS criteria |  |
| Convida | Yes | We think that the L2/L3 relay support should be used as an additional AS criteria for relay (re-)selection. In our view, the specification impact is low. |
| Apple | Up to SA2 | As L2/L3 indication is part of RSC code, this can be un upper-layer relay selection criterion. For interaction between AS layer and ProSe layer for sharing UE capability, we do not think it has to be detailed in the specification. |
| Intel | Leave it to SA2 handling | We are fine to go with majority view to rely on SA2 where the supported relay type is interpreted as part of RSC reported in discovery message; if there is any further impact to AS layer, we can discuss once we have response from SA2. |
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# Conclusion

# References

1. R2-2104745 Remaining issues on relay (re)selection Qualcomm Incorporated
2. R2-2104959 Remaining issues on Relay (re)selection vivo
3. R2-2104977 Discussion on Relay selection in Sidelink Relay ZTE, Sanechips
4. R2-2105127 Discussion on remaining issues of relay (re)selection and discovery Apple
5. R2-2105492 Aspects for SL relay selection and reselection Ericsson
6. R2-2106160 Remaining issues on relay selection and reselection Huawei, HiSilicon
7. R2-2106344 Other remaining issues on (re)selection MediaTek Inc.