3GPP TSG-RAN WG2 Meeting #119bis-e R2-2210914

Electronic Meeting, October, 2022

Agenda: 8.9.2

Source: InterDigital

Title: Summary of [AT119bis-e][427][Relay] Remaining proposals on UE-to-UE relay (InterDigital)

Document for: Discussion, Decision

# 1 Introduction

* [AT119bis-e][427][Relay] Remaining proposals on UE-to-UE relay (InterDigital)

Scope: Discuss P4.2/P6.1/P8.2/P9.1 of R2-2210893.

Intended outcome: Report to CB session

Deadline: Monday 2022-10-17 1700 UTC

The following document summarizes the discussion.

# 2 Discussion

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### 2.1 P4.2

The original P4.2 from R2-2210893 is as follows.

*Proposal 4.2: RAN2 discuss whether the dedicated discovery resource pool introduced in Rel-17 for U2N relay discovery is used for U2U relay discovery as well.*

**Q1.1) Do you agree that the dedicated discovery resource pool introduced in Rel-17 for U2N relay discovery is used for U2U relay discovery as well?**

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| --- | --- | --- |
| Company | Response (Y/N) | Comments |
| InterDigital | Yes | No need to deviate from Rel17. Furthermore, to avoid resource fragmentation, the same pool can be used for U2N and U2U. |
| Apple | Yes | Same view as InterDigital. There is no need to introduce a new type of discovery pool for U2U only. |
| OPPO | Yes |  |
| Kyocera | Yes | We agree with InterDigital that same pools may be used for U2N and U2U. |
| CATT | Yes |  |
| Qualcomm | Yes |  |
| CMCC | Yes |  |
| Ericsson | No | We don’t agree with this proposal, RAN2 shall first discuss whether the coexistence between U2N and U2U is to be studied in R18. Given limited time in R18, we suggest to down-prioritize the coexistence between U2N and U2U. otherwise, RAN2 needs to spend efforts to answer the following questions e.g.,   1. How to distinguish between a UE requesting resources for U2N discovery and a UE requesting resources for U2U discovery? 2. For a UE supporting both U2N and U2U, during the relay selection and reselection procedure, whether the UE selects the U2N relay or U2U relay? |
| vivo | Yes | We understand if separate dedicated pools are used for U2N and U2U discovery, the resource segmentation may lead to worse resource utilization so we can agree a same pool as the baseline. |
| Xiaomi | Yes | Agree with comments expressed by InterDigital |
| Intel | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Spreadtrum | Yes |  |
| Lenovo | Yes |  |
| ZTE | Yes | A shared discovery pool for U2N and U2U is resource efficiency and powering saving (no need to monitor separate pools). The motivation to introduce separate discovery pool for U2U only is not clear. |

### 2.2 P6.1

The original P6.1 from R2-2210893 is as follows.

*Proposal 6.1: RAN2 discusses the conditions at the relay and remote UE for transmission of discovery message among among 1) upper layer trigger; 2) channel quality between remote and relay UE; 3) conditions on the nieghbour list at the relay UE; 4) conditions on the contents of discovery received by another relay UE; 5) detection of RLF; 6) notification message received from a remote UE.*

For the different conditions mentioned by company papers in section 8.9.2, it would be best to discuss which triggers are applicable to the relay UE and which are applicable to the remote UE. Rapporteur notices that some conditions are clearly related to the relay or remote UE, while other conditions could be applicable to both and company inputs are needed.

**Q2.1) Which of the following conditions should be used to allow transmission of the discovery message at the relay UE?**

1. **Upper layer**
2. **Channel quality between remote and relay UE**
3. **Conditions on the neighbor list at the relay UE**
4. **Conditions on the contents of discovery received by another relay UE**
5. **Others (please specify)**
6. **The achievable UE list is not empty**

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| --- | --- | --- |
| Company | Response | Comments |
| InterDigital | A, B, C, D | B is needed as a condition for forwarding the discovery message by the relay. For C, it is useful to avoid a UE configured as a relay to transmit discovery when it has no remote UEs it is serving, or it cannot serve the remote Ues adequately (e.g. low RSRP). For D, it is useful to avoid two relays serving the same set of Ues to both occupy sidelink discovery resources when only one can do the job. |
| Apple | A, B | For C, we do not understand the concept of “neighbor list” here. Does it mean the relay UE need to first build a list of remote UE before announcing discovery message? What if all the remote UE(s) are also waiting for relay UE to announce first? Thus, we think U2U relay shall be allowed to announce its presence even if does not detect any remote UE (or neighbor) yet. We do not support list C as a criterion for “allowing”.  For D, even if this is considered, it is completely up to UE implementation and there is no need to capture anything in the spec. Also, it can also be categorized as upper layer because only the upper layer can process the PC5 discovery message. |
| OPPO | A,B,F | For A and B, we assume to reuse the principle in U2N Relay, that either upper layer can trigger the NR sidelink discovery message transmission, or the channel quality for U2N relay UE should under an upper bound Uu RSRP threshold and above a lower bound Uu RSRP threshold.  For F, our intention is try to be align with SA2 progress, since almost in all of the potential solutions in SA2 TR, the U2U Relay UE needs to maintain an achievable UE list, we think the U2U Relay UE can only act as a Relay UE as long as its maintained list is not empty. |
| Kyocera | a), b), c), f) | For c) and f), it is necessary for the relay UE to inform remote UE of a list of reachable Ues. Additionally, b) allows channel quality to be also included in the list of reachable Ues, which could allow remote Ues to decide which relay UE has better channel condition towards its target UE.  We don’t think d) is needed to prevent relay Ues from transmitting discovery (e.g., Model A discovery) as the relay UE know may not which remote UE is monitoring the discovery message. |
| CATT | A,B as baseline | A and B are inherited from U2N relay and should be set as baseline, further options can also discussed in stage-3. |
| Qualcomm | A | B is not needed, this is different with U2N. in U2U, if the Relay UE can decode the discovery message, then the Relay UE can transmit the discovery message. This should be same as existing PC5 connection setup, in which the UE can establish PC5 connection with the peer UE as long as the UE receives discovery message from the peer UE.  C,D,E,F are SA2 scope. |
| CMCC | A,B,C,F | For C, we think the eighbor list of the Relay UE should not be empty. What’s more, the channel quality between the candidate Relay UE and the Ues in the eighbor list should be above the threshold if the Relay UE wants to forward discovery message to the Target remote UE.  Explanation for “neighbout list”, as described in Solution#9 in TR23.700-33: A 5G ProSe-enabled UE decides if it can be connected via a 5G ProSe UE-to-UE relay by sending a message to the relay, so that the relay can add the UE into its eighbor list. The 5G ProSe UE-to-UE Relay sends out a Relay Announcement message periodically, announcing its availability for serving other Ues in the area (including the eighbor list).  For D, it can be up to UE implementation. |
| Ericsson | A, B | We share the same view as CATT, A and B can be agreed as the baseline, whether additional conditions can be adopted, need further discussions in RAN2 or waiting for progress in SA2. |
| Vivo | A | For B, we share the same view with Qualcomm, the PC5 channel quality may be used for relay (re)selection but there seems no strong motivation to use it to control discovery message transmission and this is not some reusing for U2N case (where we only have Uu RSRP used).  For C/D/E/F, we think it may not be possible to reach agreements in RAN2 for now as they are coupled with SA2 discussion/design. |
| Xiaomi | A, B, C, F | We note that the Relay UE transmission of a discovery message may be triggered by the reception of a Discovery message from a Source UE which we assume is considered as included in condition A (as processed by the upper layer), along with other upper layer triggers (unspecified/ specified by SA2).  B is useful to ensure link quality in the case of successful Relay link establishment. We believe that different thresholds can be used for the different discovery models.  C we see as useful in establishing that the neighbor list has potential for links to Remote Ues, in particular Remote Ues of good link qualities and support proposals including the link quality for the respective links in the neighbor list. We agree with the understanding indicated by CMCC regarding the population of the list, and this causing a trigger for discovery transmission.  For F in addition we also see a configurable minimum number of Ues in a neighbor list as a possible mechanism to control too frequent Discovery announcements. |
| Intel | A | We share the view with Qualcomm and vivo. The onus of checking the PC5 link quality towards the U2U Relay UE for relay (re)selection is on the remote UE.  We agree that we cannot converge on options C and D as they are in SA2 realm. We can also wait on SA2 guidance for how model B is supported at the Relay UE (e.g. does it respond to the Remote UE based on reachability towards the destination Remote UE?) |
| Huawei, HiSilicon | A, B | We understand before the resource UE find the target UE, there should be PC5 unicast link established between sources remote UE and relay UE, and also between relay UE and target remote UE. So it is possible the link quality can be used for relay to determine whether to transmit discovery message, i.e. to act as a relay UE for the source and target. |
| Spreadtrum | A, B, F | A and B should be the baseline. For F, according to SA2 discussion, we think a UE can only be a relay if the neighboring list is not empty. |
| Lenovo | A | Regarding B: if the Channel quality between remote and relay UE is ‘bad’, remote UE should be triggered to discover a new relay UE. Why is the relay UE triggered to transmit the discovery message? Our understanding is that B can be used at remote UE side rather than relay UE side.  Regarding C: It is not clear how the neighbor UE will trigger relay UE to transmit the discovery message based on the neighbor UE list. |
| ZTE | A, B, C | B may be used in discovery Model B. In specific, upon receiving U2U discovery solicitation message from source remote UE, relay UE can decide whether to broadcast a new discovery solicitation message associated with the source remote UE according to the channel quality with the source remote UE.  C may be used in discovery Model A. When relay UE discovers and determines neighbour UE list, it is useful that each neighbour UE has good PC5 link quality with the relay UE (e.g.each discovered UE has PC5 link quality above a threshold can be regarded as a neighbour). Otherwise, the relay UE may be not a appropriate relay UE for the neighbour/remote UE and it is not necessary for relay UE to broadcast such neighbour UEs.  D can be categorized as upper layer case. |

**Q2.2) Which of the following conditions should be used to allow transmission of the discovery message at the remote UE?**

1. **Upper layer**
2. **Channel quality between remote and relay UE**
3. **Detection of RLF**
4. **PC5 link release from relay to remote**
5. **Conditions on the contents of discovery received by another relay UE**
6. **Others (please specify)**
7. **Channel quality between Source Remote and Target Remote**

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| Company | Response | Comments |
| InterDigital | A, B, C, D | B, C, and D are all needed to help the remote UE search for another relay when the relay is no longer adequate and should be considered. |
| Apple | A, FFS B | B (e.g., SL-RSRP) is not even available in most of the cases except there is an existing PC5 link between two (remote) UEs, but we also wonder if L2 address in “direct” case and “U2U relay” case are supposed to be different or not. If address is different, then the SL RSRP value of this PC5 link cannot be recognized as a legit input for examining the channel condition between U2U remote and U2U relay.  For C and D, we are confused as the question seems mixing the “triggers of relay reselection” and “allowing/thresholding conditions of discovery” together. We think once a discovery transmission is allowed, the remote UE can always be allowed to transmit (i.e. model B) in regardless of selecting a relay or not.  For E, we have the same comment as in Q2.1 |
| OPPO | A, B, C(with comment),G | For C: we would like to clarify whether the detected RLF is with U2U Relay UE or Target Remote UE. From our understanding, it is reasonable that Remote UE should be triggered to transmit discovery message when the RLF happens in the direct link with Peer Remote UE(either Source or Target).  For g:The purpose of U2U Relay is to achieve the sidelink communication between source and target remote UE. In case there was originally a direct link between Source and Target Remote of which the channel quality is good, then there is no need to adopt U2U Relay only when the channel quality tends to be worse. |
| Kyocera | a), b), c), d), g) | We assume the discovery message transmission can be considered as a result of relay reselection in Q2.3), i.e., the remote UE may send discovery message as a result of relay reselection.  b), c) and d) are all useful conditions for relay reselection, so they should all be considered as triggers for discovery message transmission. |
| CATT | A,C,D,G | A,C,D,G are inherited from U2N relay and should be supported for U2U case. |
| Qualcomm | Only A from AS layer point of view. | This question is about discovery transmission, not relay reselection. There is no discovery message from AS layer, B,C,D, G are conditions to trigger relay reselection, whether to transmit discovery message is up to upper layer. If upper layer determines to transmit discovery message, will indicate to AS layer.  E is SA2 scope, AS layer does not know discovery content. |
| CMCC | A,D,G  Others see comments | For B, as for remote UE, we think Model A and Model B should be discussed separately. For Model A, it is okay to use channel quality (e.g.SD-RSRP). But for Model B, since it is the Remote UE to trigger the Discovery ransmission procedure. We are just wondering where the channel quality measurement result is from. Unless there is a ongoing/past Sidelink communication between the Remote UE and the Relay UE. Otherwise, the Remote UE can not use channel quality for the condition of Discovery message ransmission.  For C, we think C can be merged into A (e.g. *a)Upper layer(including RLF detected by the Remote UE)*). Because the detection of RLF is also sent to the upper layer which means the uppler layer triggers the discovery transmission of Remote UE.  For E, it can be up to UE implementation. |
| Ericsson | A, b, c, d and g | It is more correct to say what are conditions for triggering relay selection and reselection instead of discovery transmission. |
| vivo | A, FFS for G | Agree with Apple and Qualcomm that we should not mix the discussion for relay (re)selection with discovery transmission. So we don’t need to discuss B/C/D/E/F here.  For G, it is similar to the U2N design but it should be further evaluated because there may be no available Channel quality between Source Remote and Target Remote especially in mode-A discovery at source remote UE. |
| Xiaomi | A, B, C, D, E, F, G | Generally for B, C, D, E, F, we agree the AS triggering of reselection subsequently causing the triggering of discovery muddies the discussion, but want to ensure it is clear from the pov of the original question that these are all clearly considered.  Specifically for F in the same way that pre-emption of T400 expiry is already considered as a reselection mechanism to avoid delay associated with waiting for RLF, pre-emption of T400 expiry may trigger the transmission of discovery to facilitate timely reselection.  G clearly fits with the narrative of loss of existing link and need to establish Relaying link. |
| Intel | A for discovery message  A, B, C, D, G for relay reselection | Even in U2N, discovery message is initiated at the Remote UE based on configuration from upper layer. So, we can follow similar principle here. Then, assuming these are the Relay (re)selection triggers at the AS layer, B, C, D and potentially G can be considered.  For C, upon detection of RLF, it can be upto Remote UE to maintain the PC5-RRC connection, so a relay reselection is warranted if connection is released.  For D, upon release, Remote UE has to initiate relay (re)selection. |
| Huawei, HiSilicon | A with comments on B  Others for relay reselection | For Model B, a source remote UE transmits discovery message to find candidate relay and target UE, the relay can forward the discovery message (maybe AS condition can be applied here, could be discovery condition), and target remote UE responses some of the discovery message (maybe AS condition can be applied here, but should be the scope of relay selection), then relay UE forwards the discovery response message to the source remote UE. |
| Spreadtrum | A, B, G | C and D are used to trigger relay selection/reslection. |
| Lenovo | ABCD |  |
| ZTE | A, B, C, G | D and E can be categorized as upper layer case.  For C, it is not clear the RLF is between source remote UE and relay UE or between source remote UE and target remote UE. In our understanding, both are ok.  For G, It is possible the source UE and target UE has direct link originally, in this case, the PC5 link quality of the direct link could be considered, which is the same logic as the Uu threshold for U2N remote UE.  More accurately, B and C (RLF between source UE and relay UE) are triggers for relay reselection. |

### 2.3 P8.2

The original P9.1 from R2-2210893 is as follows.

*Proposal 8.2: RAN2 discusses the relay (re)selection criteria for U2U relay among 1) channel quality between remote and relay UE (first and/or second hop); 2) relay load; 3) Whether the PC5 link of the second hop is already established 4) PLMN ID; 5) Cell ID/gNB; 6) Prioritization of the direct link over a relayed link.*

Different to triggers which were discussed online, the above proposal addresses criteria to be used to determine which relay(s) can be selected by the remote UE once (re)selection is triggered.

**Q2.3) Which of the following criteria can be used by the remote UE to select a relay once relay (re)selection is triggered?**

1. **Channel quality between the remote UE and the relay**
2. **Channel quality between the relay and the destination (second hop)**
3. **Relay load**
4. **Whether PC5 link of the second hop is already established or not**
5. **PLMN ID**
6. **Cell ID/gNB**
7. **Prioritization of the direct link over the relayed link**
8. **Others (please specify)**

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| Company | Response | Comments |
| InterDigital | A, B, C, D | For A and B, although the relay selection can be upto UE implementation (as in Rel17), the remote UE should be able to have access to the channel quality of both hops.  It is not clear whether E and F are needed for U2U relay. As for G, this can be taken into account by the reselection triggering. |
| Apple | A,B,C,D | Same view as InterDigital. We think E,F are not needed for U2U relay as gNB is not involved. For G, this should be based on link quality comparison, we do not think this can be counted as an independent trigger. |
| OPPO | A B | For C, we do not see a strong motivation have the differentiation between U2U and U2N Relay (re)selection criteria, since in U2N, the Relay load is not considered. |
| Kyocera | a), b), c), g)  h) SL-RLF | a), b) and/or h) for both links should be applicable, since the target UE would not be reachable.  g) should be supported, although it’s FFS if channel conditions between the two links is applicable. |
| CATT | A,B,F | In U2N relay, besides AS criteria, serving Cell ID, PLMN ID and L2/L3 relay support is also supported. For U2U relay, A and B are related to AS criteria, F is related to NAS creiteria(can be further confirmed by SA2). |
| Qualcomm | A from AS layer point of view | From AS layer point of view, only A.  Other conditions are being discussed in SA2, should wait SA2 progress. |
| CMCC | A,D  Others see comments | For B, if the Remote UE wants to know the second hop’s channel quality, the Relay UE need to send the additional message/information in Discovery procedure which may be related to SA2 work. We are wondering whether RAN2 should communicate with SA2 first if RAN2 agrees with B and decides to add the info.  For C, 1)same with the comment for B, it may be related to SA2 work;.  2)The conception of Relay UE load needs to be defined first.  For E and F, same view as InterDigital. According to the last aggrement, it is still not clear whether some gNB control is needed for the IC scenario.  For G, our understanding for G is when the link qualities of both direck link and relayed link are above the threshold, the direct link has a higher priority. However, it should belong to Relay (re)selection trigger events, not for remote UE to select a suitable relay UE. |
| Ericsson | A | Agree with Qualcomm, only A can be agreed for the moment. B is not needed, since the relay UE can check the second hop quality by itself, before determining itself is able to be a relay UE. C is unclear, there is no relay load in U2N, same reason is applicable here. D can be left to remote UE implementation. E and F is not needed, as Interdigital said. G can be left to remote UE implementation.  It needs to be clear for RAN2, it is important to not make hurry decision in the beginning of R18, it is sufficient to agree on the minimum set of trigger conditions as the baseline. Other conditions need further study. |
| vivo | A, B  FFS for E/F | A should be the simplest one.  For B, we think in general it should also be considered by remote UE, because now in U2U there are two hops, so link quality only on the first link is sure not enough. As for B to be considered by source remote UE or target remote UE, it can be FFS (please note that target remote UE may also perform relay selection according to SA2 TR)  For E/F, agree with companies it should be decided after discussion of whether some gNB control is needed for the IC scenario. |
| Xiaomi | A, b, c, g, h  Ffs – e, f, d | For B, we see this as useful in establishing a best e2e link to the benefit of both parties, else the remote UE (using only option A) may choose a Relay UE resulting in the second (unknown signal strength) link being poor and compromised.  For D, it may need to be clarified that in the scenario where the Relay UE already has a PC5 connection to the target UE, as to whether the target UE would respond to secondary discovery messages from other Relay UEs having received the same message from the source UE via the already connected Relay UE? The need to connect to a second Relay UE at the target UE is unnecessary (when one already exists and which can provide connectivity to the source UE) and adds additional complexity to the Target UE implementation unnecessary in this release. Generally such a decision could be considered implementation or operator policy and fall under choice h) (see below).  We agree for E/F this can be a part of the general IC, scope of gNB control discussion.  H) and g), upper layer factors will also play a part, and generally g) can be considered to fall into this category along with other considerations mentioned by SA2. |
| Intel | A and FFS for B | If multiple candidate Relay UEs are available, we assume that D, E and F are already taken into consideration during discovery or by implementation and then at the AS layer, only the PC5 link quality between the Remote and Relay UE can be considered. C is not needed to be considered as the Relay UE can decide by implementation to not act as a Relay if it is overloaded.  Availability of B is reliant on the discovery message content/how the second hop link quality becomes available to the Remote UE. It can also be taken into consideration by the Relay UE during its own discovery of the destination Remote UE. |
| Huawei, HiSilicon | a) d) g) | For d) it also includes whether the unicast with the candidate relay (first hop) is established. |
| Spreadtrum | A |  |
| Lenovo | A | Regarding B, if B is agreed, the channel quality of second hop should be included in the discovery message. It is not a suitable way. |
| ZTE | A, B, FFS for F | For B, in U2U relay, the link quality of the second hop should be also considered when selecting relay UE. For C), similarly as discussed for U2N relay, relay load may not be considered. For e), it may be upper layer criteria. For F, it may be helpful for IC UEs for gNB control. |

### 2.4 P9.1

The original P9.1 from R2-2210893 is as follows.

Proposal 9.1: RAN2 to discuss whether the indication is needed for whether the gNB is capable of U2U relay discovery

**Q4.1) Is the indication for whether the gNB is capable of U2U relay discovery needed?**

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| Company | Response (Y/N) | Comments |
| InterDigital | No, with comments | Considering the agreement to strive for simplified gNB involvement, we think an indication is not needed. However, we are fine to leave this discussion to later when we have further defined U2U relay and the required gNB involvement. |
| Apple | No | No new SIB indication is needed. We can reuse the indication of ProSe discovery for this. |
| OPPO | Yes | Even the simplified gNB involvement may be applied, there is still a need of gNB capability to give either resource or SL-RB configuration towards U2U Relay/Remote, and we are not sure whether the indication of ProSe discovery can be reused for U2U since there are some delta part configuration, such as what we discussed in Q2.1 and Q2.2 |
| Kyocera | Yes | We assume IDLE/INACTIVE relay UEs would use Mode 2 discovery resources which should be controllable by the gNB. |
| CATT | See comment | It is too premature to discuss this question. Postpone is preferred. |
| Qualcomm |  | Postpone to discuss. |
| CMCC | No | Same view with InterDigital. We should first discuss whether the simplified gNB involvement is needed. And then focus on what simplified gNB involvement is included and how to simplify the specific gNB involvement. |
| Eicsson |  | Postpone the decision. Until RAN2 has clear conclusion on how to simplify gNB involvement. |
| vivo | See comments | Agree to postpone it after the gNB control related issues have been discussed. |
| Xiaomi | See comment | Also agree this can be deferred until after gNB control issue has been finalized. |
| Intel | Yes with comment. | We think that it is preferable to have such indication if some form of resource configuration support may be needed from the gNB even with minimal gNB involvement. But we are ok to postpone this discussion until the U2U relay functionality is further defined. |
| Huawei, HiSilicon | Yes | At least for discovery, the UE needs to know whether the RP in SIB is any can be used for U2U or not. But ok to postpone. |
| Spreadtrum | Yes |  |
| Lenovo | Yes | Some U2U configuration e.g resource should be considered in gNB side. Therefore, we slightly prefer to have it. But, we are fine to postpone this discussion. |
| ZTE | Yes | Even with simplified gNB involvement, such indication is needed if gNB providing discovery configuration for U2U relay is supported. Also ok to postpone. |

# 4 Conclusion

Rapporteur suggests the following proposals

# 4 References

1. R2-2210893 Summary of AI 8.9.2 – UE to UE Relay (InterDigital) – InterDigital