**3GPP TSG-RAN WG2 #117-e *R2-21xxxxx***

Electronic meeting, Feb 21 – Mar 3, 2022

Agenda Item: X.X.X

Source: Xiaomi

Title: Summary of [Post116-e][604][Relay] Remaining issues on service continuity (Xiaomi)

Document for: Discusawsion and Decision

# Introduction

This contribution is to kick off following email discussion,

* **[Post116-e][604][Relay] Remaining issues on service continuity (Xiaomi)**

 Scope: Discuss the remaining issues on service continuity:

* Measurement configuration and reporting:
	+ Whether to consider S-measure criterion based on RSRP of serving relay and other AS criteria for indirect-to-direct path switch (P8-1/P8-2 of R2-2111276)
	+ Whether to consider AS criteria for measurement when performing SL measurement for path switch (P7-1 of R2-2111276)
	+ Whether to have allow-list and block-list of relay UEs (or serving cells of relay UEs) (P3 of R2-2111276)
	+ Whether to have new events in addition to Event X and Event Y (serving relay/neighbour cell for indirect-to-direct, candidate relay for direct-to-indirect) (P6 or R2-2111276)
	+ Which ID to report for serving cell of relay UE (NCGI/NCI/PCI) (P10 of R2-2111276)
	+ Relay UE ID to include in measurement report and how the network learns the ID (P9-1/P9-2 of R2-2111276)
	+ Conclude on the proposal that relay (re)selection is not performed by an RRC\_CONNECTED L2 remote UE, except for the RLF case (P11 of R2-2111276)
* Determine an option for ensuring UL PDCP lossless behaviour in indirect-to-direct path switch (P26 of R2-2111276):
	+ Option 1: No spec impact, i.e., assume loss of UL PDCP PDUs is a corner case or can be addressed by network implementation
	+ Option 2: Remote UE retransmits PDCP SDUs for which the successful delivery of the corresponding PDCP PDU has not been confirmed by PDCP status report after path switch

 Intended outcome: Report to next meeting

 Deadline: Long

# Discussion

## Measurement configuration and reporting

### S measure criterion in direct to indirect path switch

On Uu, S measure criterion is introduced to save UE power. gNB could configure a RSRP threshold. UE performs measurement if the NR SpCell RSRP is lower than the threshold, otherwise UE does not perform measurement. Note the S measure can only control the measurement of measurement object whose associated *reportType* is *periodical, eventTriggered* or *condTriggerConfig*, which is mainly used for mobility purpose. Related specification could be found as following,

|  |
| --- |
| 2> if the *reportType* for the associated *reportConfig* is *periodical*, *eventTriggered* or *condTriggerConfig*:3> if a measurement gap configuration is setup, or3> if the UE does not require measurement gaps to perform the concerned measurements:4> if *s-MeasureConfig* is not configured, or4> if *s-MeasureConfig* is set to *ssb-RSRP* and the NR SpCell RSRP based on SS/PBCH block, after layer 3 filtering, is lower than *ssb-RSRP,* or4> if *s-MeasureConfig* is set to *csi-RSRP* and the NR SpCell RSRP based on CSI-RS, after layer 3 filtering, is lower than *csi-RSRP*:5> if the *measObject* is associated to NR and the *rsType* is set to *csi-rs*:6> if reportQuantityRS-Indexes and maxNrofRS-IndexesToReport for the associated reportConfig are configured:7> derive layer 3 filtered beam measurements only based on CSI-RS for each measurement quantity indicated in *reportQuantityRS-Indexes*, as described in 5.5.3.3a;6> derive cell measurement results based on CSI-RS for the trigger quantity and each measurement quantity indicated in *reportQuantityCell* using parameters from the associated *measObject*, as described in 5.5.3.3;…… |

P8-1 in [1] propose to discuss whether S-measure criterion based on RSRP of serving relay could be introduced during indirect to direct path switching. Namely, gNB could configure SL-RSRP threshold. Remote UE doesn’t perform measurement on Uu if the serving relay UE’s SL-RSRP is higher than the threshold, otherwise remote UE performs measurement on Uu.

**Q1: Do you agree to introduce S-measure criterion based on SL/SD-RSRP of serving relay during indirect to direct path switching.**

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comments |
| InterDigital | Yes | Measurements for service continuity should use Uu measurements as a baseline. So s-measure should be supported for the same benefits (power savings) as in Uu. |
| OPPO | No | Since even the relay link is good enough, remote UE may still like to switch to direct link since it can acquire better performance. Besides, it may be also that the Uu-link of relay is not good, so relay searching by remote UE is still beneficial for possible Uu-RLF of relay. |
| Xiaomi | Yes | S measure could save UE power by reducing measurement on Uu, in case the radio channel quality between remote UE and relay UE is good enough. |
| Qualcomm | No | Same view as OPPO. In addition, we don’t think it is an essential issue to address in first release of SL relay. |
| Ericsson | No | Same view as Qualcomm and OPPO. |
| LG | No | Same view as OPPO |
| Huawei, HiSilicon | No | Similar view as above, seems not an urgent issue for this release. |
| Intel | No | Agree with OPPO.  |
| Samsung | No | Same view as OPPO |
| vivo | No | Share OPPO’s and Qualcomm’s views.  |
| Nokia | No | We share the view of the other companies that s-measure criteria cannot be applied as is, since the remote UE may still like to perform the path switch. However we do agree on the intention of the proposal if it were not a strict requirement. |
| Apple | No | We share the view of OPPO. |
| ZTE | No | The remote UE may prefer the direct link access even if the sidelink quality with a relay UE is good, so the Uu measurement of the remote UE should not be limited. In addition, the relay selection and cell selection of remote UE may be performed independently. When to perform Uu measurement for the remote UE connected with a relay can be up to UE implementation. |
| CATT | No | Not only PC5 link should be considered, but also the Uu link quality should also be considered. If the Uu link is below threshold and PC5 link is good, UE should also perform measurement. |
| Futurewei | No | Direct Uu link may be preferred even if relay link is still good. |
| Spreadtrum | No | Same view as OPPO |
| Philips | Yes | Monitoring Uu link all the time can be power hungry for low power Remote UEs. Having an S criteria based on SL/SD RSRP can alleviate it. |
| ASUSTeK | No |  |
| Lenovo | No | Whether to perform measurement depends on both source PC5 link and source Uu link.  |

3 companies support to introduce S-measure based on SL-RSRP/SD-RSRP to save UE power. 16 companies prefer not to introduce. Without S-measure, remote UE would always perform measurement on Uu. Rapporteur suggests to go with clear majority.

**Proposal 1: S-measure criterion based on SL/SD-RSRP of serving relay during indirect to direct path switching in not introduced.**

If S-measure is preferred in Q1, P8-2 in [1] further propose to discuss whether measurement result other than SL-RSRP could be used to control remote UE performing measurement on Uu, e.g. CBR

**Q1-1: Do you agree to introduce S-measure criterion based on other measurement result.**

**Option 1: CBR**

**Option 2: Other**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| InterDigital | Yes | This would be beneficial since SL RSRP only does not define whether a relayed link is preferred over a direct link. We think we should support this as long as we keep the rule simple (e.g. a single CBR threshold configured by the network). |
| Xiaomi | No | CBR is used to control resource selection and congestion control, which doesn’t reflect the radio channel quality. Therefore, it’s not aligned with S measure principle. |
| LG | No |  |
| Philips | No | Agree with Xiaomi |

Since S-measure is not introduced according to proposal 1, no proposal is made based on Q1-1.

### AS criteria for measurement report when performing SL measurement for path switch

P7-1 in [1] propose to discuss whether AS criteria for measurement report should be considered when performing SL measurement for path switch.

Rapporteur understands following options were discussed by companies as AS criteria during SL measurement report for path switch,

Option 1: The configured measurement report event.

Option 2: The SD-RSRP/SL-RSRP threshold used in relay selection/reselection.

Option 1 is aligned with legacy behavior. Remote UE shall report relay UEs, whose measurement result fulfills the configured report event. Option 2 introduce additional filtering of relay UE based on threshold for relay selection/reselection. Even the relay UE, whose measurement result fulfills the measurement report event, may be filtered out by SD-RSRP/SL-RSRP threshold, since the two AS criteria are configured independently. This may result in measurement report is triggered, but no relay UE is included.

**Q2: Do you agree the Remote UE does not consider the AS criteria for measurement report when performing SL measurement for path switch, except for configured measurement report event.**

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comments |
| InterDigital | Yes | Measurement thresholds related to relay selection/reselection should not be used in measurement reporting.  |
| OPPO | Yes (i.e., not consider) |  |
| Xiaomi | Yes |  |
| Qualcomm | Yes | We agree with Rapporteur’s analysis. And it is aligned with Uu RRM principle. |
| Ericsson | Yes |  |
| LG | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Intel | Yes | While we agree that considering thresholds in not necessary, we wonder if agreed AS criteria of cell ID/PLMN ID and L2/L3 relay support are checked before sharing the measurement report. |
| Samsung | Yes |  |
| vivo | Yes | Agree with InterDigital. For the final proposal to be made, would it be better to say “… the Remote UE does not consider other AS criteria for…, except for configured measurement report events”? |
| Nokia  | yes |  |
| Apple | Yes |  |
| ZTE | Yes | In addition, AS criteria of cell ID for relay (re)selection is also not necessary to be considered for measurement report. |
| CATT | Yes |  |
| Futurewei | Yes |  |
| Spreadtrum | Yes |  |
| Philips | Yes |  |
| ASUSTeK | Yes |  |
| Lenovo | Yes |  |

Unanimous support to this question.

**Proposal 2: Remote UE does not consider the AS criteria for measurement report when performing SL measurement for path switch, except for configured measurement report event.**

### Allow-list/Block-list of relay UE

In Uu, the network may configure a list of cell specific offsets, a list of 'blacklisted' cells and a list of 'whitelisted' cells. Blacklisted cells are not applicable in event evaluation or measurement reporting. Whitelisted cells are the only ones applicable in event evaluation or measurement reporting. How to set the list is up to NW implementation. With these lists, power consumption and signaling overhead could be saved by avoidance of unnecessary event evaluation or measurement report. Rapporteur understands Whitelist/Blacklist cells is legacy procedure and supported during indirect to direct path switch, without spec impact. Rapporteur would like to clarify the understanding of legacy blacklist/whitelist cell applicability.

**Q3: Do you agree the legacy blacklist/whitelist cells is supported during indirect to direct path switch, without spec impact.**

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comments |
| InterDigital | Yes |  |
| OPPO | Yes |  |
| Xiaomi | Yes |  |
| Qualcomm | Yes |  |
| Ericsson | Yes |  |
| LG | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Intel | Yes |  |
| Samsung | Yes |  |
| vivo | Yes |  |
| Nokia | Yes | As a note, we think that we should preferably use allow/block as in the title and the remaining questions |
| Apple | Yes |  |
| ZTE | Yes |  |
| CATT | Yes |  |
| Futurewei | Yes |  |
| Spreadtrum | Yes |  |
| Philips | Yes |  |
| ASUSTeK | Yes |  |
| Lenovo | Yes |  |

All companies agree there is no spec impact to support legacy blacklist/whitlist, so there is no need to make a proposal.

Following the same logic, during direct to indirect path switch, certain relay UEs may not be suitable to access due to overload or other NW implementation. gNB would not switch remote UE to these relay UEs. It’s unnecessary for remote UE to evaluate event and report these relay UE’s measurement result, which results in power wasting and signaling overhead. Therefore, companies proposed to introduce allow-list/block-list during direct to indirect path switch. Namely, Relay UEs indicated by block-listed are not applicable in event evaluation or measurement reporting. Relay UEs indicated by allow-list cells are the only ones applicable in event evaluation or measurement reporting.

**Q4: Do you agree to introduce Allow-list/Block-list of relay UE during direct to indirect path switch. Namely, Relay UEs indicated by block-listed are not applicable in event evaluation or measurement reporting. Relay UEs indicated by allow-list cells are the only ones applicable in event evaluation or measurement reporting.**

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comments |
| InterDigital | Yes | This is a logical extension of Uu and can be supported to save power at the remote UE. |
| OPPO | No | Do not think this is a critical issue at this late stage. If network would like to prevent the accessibility of some relay UEs, network can direct avoid to provide relay configuration towards those relay UEs so that remote UE will not detect the discovery of those relay UEs. On the other hand, those relay UE which can be detected by remote UEs should be within the allow-list by default. |
| Xiaomi | Yes | Allow-list/Block-list could save UE power by avoiding unnecessary measurement and report on the relay UEs, which is not suitable for path switching. |
| Qualcomm | No | Same view as OPPO (i.e., it is not an essential issue to be addressed in this release). Furthermore, we have below 2 concerns/comments: 1. As agreed in last RAN2 meeting, Remote UE performs report filtering based on upper layer criteria because upper layer info of relay UE is not aware by remote UE. Then, following same logic, we questioned how gNB can determines such list by itself. If such list is introduced, do we need to further specify how relay coordinates with gNB on generating this list?
2. At least Allow-list (similar to whitelist) is not needed. Please note that blacklist was introduced in Rel-8 but whilelist was introduced in Rel-13 for a particular use case. We don’t see such case should be considered in L2 relay.
 |
| Ericsson | No | Not necessary to be introduced, at least in this release. |
| LG | No | Allow-list/block-list of relay UE can be handled by discovery message. If the relay UE is in a block-list, for example, cause of overload, the relay UE may not transmit discovery message. So, we think the allow-list/block-list of relay UE is not necessary. |
| Huawei, HiSilicon | Yes | We understand Allow-list/Block-list can save some unnecessary measurement report and UE power in some cases. For instance, the network may provide the cell ID and relay ID to limit the measurement on intra-gNB relays, please note only network but not UE can differentiate gNB based on CGI. As the configuration and handling of the two list are very straightforward (with not much standard effort), we prefer to have it in this release. |
| Intel | No | We think there are different ways to accomplish this; it can be up to network or Relay UE implementation. |
| Samsung | No | We think that this feature is not essential.  |
| vivo | No | Same view as OPPO, Qualcomm and Ericsson. |
| Nokia | No | Same view as other companies |
| Aple | Yes | We think the intention of allowlist/blocklist is for UE power saving. So we support the proposal. |
| ZTE | No | It’s not necessary to introduce allow-list/block-list of relay UE. To determine such list, gNB may need to coordinate with relay UEs to acquire relay UE’s information (e.g. load information). If some cells of relay UEs experience overload, access control for remote UE and relay UE can be applied and remote UE may not discover such relay UEs. |
| CATT | No | It is not an essential issue and network implementation can solve it. |
| Futurewei | No | Not critical for this release. |
| Spreadtrum | No | Not necessary to introduce Allow-list/Block-list of relay UE, network implementation can avoid this problem. |
| Philips | Yes | We agree with InterDigital and Xiaomi. |
| ASUSTeK | No |  |
|  Lenovo | Yes | In rel-17, we do not support inter-gNB mobility. UE need not measure the relay belonging to other gNB. |

6 companies support to introduce allow-list/block-list, for following reasons,

* 1. Power saving due to less measurement and report;
	2. Prevent UE to access inter-gNB which is not supported in R17;
	3. Logcial extension of the exiting procedure without much spec effort;

13 companies prefer not to introduce allow-list/block-list, for following reasons,

* 1. it’s not essential/critical issue
	2. Unclear how gNB could set the list
	3. Allow-list/Block-list could be achieved by implementation.

There is no clear majority view. Rapporteur suggest RAN2 to further discuss on this.

**Proposal 3: RAN2 to discuss whether Allow-list/Block-list of relay UE during direct to indirect path switch is introduced.**

If Allow-list/Block-list is preferred in Q4, rapporteur suggest to further discuss how to formulate the allow-list/block-list. Two options were proposed by companies,

Option 1: Allow-list/Block-list include relay UE’s serving cell ID. Remote UE could identify whether one relay UE is indicated by allow or bloc list by its serving cell ID included in discovery message.

Option 2: Allow-list/Block-list include relay UE ID. Remote UE could identify whether one relay UE is indicated by allow or block list by its relay UE ID included in discovery message.

To determine how to set the list, NW shall be aware of the necessary information of each element in the list, e.g. load information. In option 1, NW shall be aware of each cell related information, which is already supported in legacy. NW could set the allow-list/block-list in similar way as legacy black/white cell. In option 2, NW shall be aware of relay UE related information, which may be provided by relay UE’s report.

**Q4-1: Which option do you prefer to formulate the allow-list/block-list,**

**Option 1: Allow-list/Block-list include relay UE’s serving cell ID.**

**Option 2: Allow-list/Block-list include relay UE ID.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| InterDigital | Option 1 or 2 | Either option could work for an RRC\_CONNECTED relay, since the NW is aware of the association between relay UE and serving cell when the relay is in RRC\_CONNECTED.  |
| Xiaomi | Option 1 | Option 1 is more aligned with legacy procedure and can apply to relay UE in all RRC states. Option 2 requires gNB to be aware of candidate relay UE’s ID, which may not be applicable to relay UEs in IDLE/INACTIVE. Also, option 2 would require gNB to be aware of relay UE’s information, e.g. load, which may need new report from relay UE. |
| Huawei, HiSilicon | Option 1 and 2 | We share the similar view with InterDigital, option 1 is more useful for IDLE/INACTIVE relay, option2 have finer granularity. So both options are useful. |
| Apple | Option 1 or 2 |  |
| Philips | Option 1 or 2 |  |
| Lenovo | Option1 | It depends on the purpose. |

All participated companies support option 1. 4 companies prefer both options could be supported depending on NW implementation.

This question is related to proposal 3. Therefore, rapporteur suggest following proposal,

**Proposal 4: If Allow-list/Block-list of relay UE during direct to indirect path switch is introduced, allow-list/block-list include relay UE’s serving cell ID. FFS whether it could include relay UE ID.**

### New events in addition to Event X and Event Y

During indirect to direct path switch, Event X is agreed. In addition, following events were proposed by companies,

Option 1: serving relay is worse than a threshold,

Option 2: neighbor Uu cell is offset better than serving relay.

Option 1 is similar as Event A2 on Uu. Option 2 is similar as Event A3 on Uu. However, since measurement on Uu and SL is based on different reference signal, it’s unclear whether it’s appropriate to directly compare the measurement result on Uu and sidelink.

**Q5: which event do you prefer to introduce during indirect to direct path switch,**

**Option 1: serving relay is worse than a threshold,**

**Option 2: neighbor Uu cell is offset better than serving relay**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| InterDigital | Option 1 and 2 | For option 2, the gNB can compensate for difference in reference signal based on proper configuration of the offset. |
| OPPO | Option 1 | For option 2, it is very unreasonable to compare Uu signal and PC5 signal in a direct way since the RS design, as well as power control strategy for the channels in these two interfaces are totally different. |
| Xiaomi | Option 1 | We are not sure whether it’s appropriate to directly compare the measurement result on Uu and sidelink. |
| Qualcomm | Option 1 | Same view as OPPO and Xiaomi. In addition, we want to confirm that Option 1 is actually S2 event introduced in Rel-16, right? Then, no new event is required to be introduced.  |
| Ericsson | Option 1 and Option 2 |  |
|  LG | none | We think none of option1 and option 2 do not need to specify some events. If option 1 happens, the operation of remote UE should be left on the UE implementation. Option 2 is not proper to compare Uu link and SL directly. |
| Huawei, HiSilicon | Option 1 |  |
| Intel | Option 1 Do not prefer option 2 | Similar view to OPPO/Xiaomi Similar question to Qualcomm to understand whether this is a new event or based on S2. We support reusing existing events as much as possible.  |
| Samsung | Option1 | Regarding option 2, we share the view that the comparison between Uu and SL is inappropriate. |
| vivo | Option 1 | We had already the following agreements in RAN2 #115e. We think option 1 is just the specific form of the below yellow highlighted event in the I2D path switch case. Apart from the events agreed below, we don’t think any other new event (e.g. comparing SL and Uu radio quality like in option 2) is needed in this release. *Agreement:**Proposal 7 (easy)(modified): New measurement events for the remote UE can be defined to compare SL relay link measurement with a threshold and/or to compare SL relay link measurement with threshold A and Uu link measurement with threshold B.* |
| Nokia | None | We agree to LG comments that we do not necessarily need option 1, but no strong view, and also with other companies that for option 2 it is not possible to compare simply by an offset |
| Apple | Option 1 | Our understanding is that Option 1 is an existing event so no new event is needed. |
| ZTE | Option 1 | For option 2, it’s not reasonable to directly compare measurement results of Uu and sidelink. |
| CATT | Option 1 | Option 2 is not proper to compare Uu link and SL directly. |
| Futurewei | Option 1 | Uu and SL may be directly comparable, and Uu may be always preferred as long as its link quality is sufficient. |
| Spreadtrum | Option 1 |  |
| Philips | Option 1 |  |
| ASUSTeK | Option 1 |  |
| Lenovo | None |  |

16 of 19 companies support option 1. Some company ask whether option 1 is equivalent to legacy S2. Rapporteur thinks there may be difference between option 1 and S2, for example, option 1 is used to trigger measurement report to gNB, while S2 is used to trigger measurement report to peer UE.

2 of 19 companies support option 2. The main concern of option 2 is the measurement on Uu and SL is based on different reference signal, it’s unclear whether it’s appropriate to directly compare the measurement result on Uu and sidelink.

3 of 19 companies think none is necessary. But 1 company also show no strong view on option 1.

Therefore, rapporteur suggest to agree option 1.

**Proposal 5: Introduce following event during indirect to direct path switch,**

* **Serving relay is worse than a threshold**

During direct to indirect path switch, Event Y is agreed. In addition, following events were proposed by companies,

Option 1: candidate relay is better than a threshold,

Option 2: candidate relay is offset better than serving Uu cell,

Option 3: CBR as well as SL and/or Uu radio signal measurements.

Option 1 is similar as Event A4 on Uu. Option 2 is similar as Event A3 on Uu. However, same as above, it’s unclear whether it’s appropriate to directly compare the measurement result on Uu and sidelink. Option 3 introduce new event, which combine the CBR and SL/Uu radio signal measurement. Rapporteur understands two thresholds should be defined, which are used to compare the CBR and SL/Uu radio signaling measurement result respectively.

**Q6: which event do you prefer to introduce during direct to indirect path switch,**

**Option 1: candidate relay is better than a threshold,**

**Option 2: candidate relay is offset better than serving Uu cell,**

**Option 3: CBR as well as SL and/or Uu radio signal measurements.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| InterDigital | Options 1, 2, and 3 | For option 2, the same comments as in Q5 apply. For option 3, we agree with rapporteur that a separate CBR threshold should be configured for such events. |
| OPPO | Option 1 | For option 2, similar comment as above.For option 3, CBR is a per resource pool measurement/configuration, which is only used for congestion control and resource selection and has no relationship to service continuity. |
| Xiaomi | Option 1 | For option 2, We are not sure whether it’s appropriate to directly compare the measurement result on Uu and sidelink.For option 3, agree with OPPO. |
| Qualcomm | None or Option 1 | Uu A4 event is not an important one. As long as we have A2 (serving cell is worse than one threshold) and new event Y, we think their combination can handle all scenarios.However, if majority prefer to introduce Option 1, we can accept.  |
| Ericsson | Options 1, 2, and 3 |  |
| LG | None | Same answer on the Q5. Option 3 is not proper because CBR is for resource selection and scheduling. |
| Huawei, HiSilicon | Option1 |  |
| Intel | None or option 1 depending on majority | We think that the newly defined event Y could be sufficient. While we do not prefer option 2 and neutral to option 3, we are not sure whether option 1 may cause unnecessary toggling as there may be multiple Relays available around the Remote UE whereas it is not such a case in Uu.  |
| Samsung | None | Regarding option 1, we have the same view as Qualcomm. For option2, same comment as Q5. |
| vivo | Option 1 | Similar view as to Q5.  |
| Nokia | None, or option 1 |  |
| Apple | None | We think there is no need to introduce a new event here. Event Y is enough.  |
| ZTE | None | For option 1, we share the same view as Qualcomm and Intel. |
| CATT | None or Option 1 | Share the same view as QC. |
| Futurewei | Option 1 | Option 2 & 3 may be optimizations that are not needed in this release. |
| Spreadtrum | None | Similar view with QC. |
| Philips | Option 1 |  |
| ASUSTeK | Option 1 |  |
| Lenovo | None |  |

13 of 19 companies support option 1.

2 of 19 companies support option 2. The main concern of option 2 is the measurement on Uu and SL is based on different reference signal, it’s unclear whether it’s appropriate to directly compare the measurement result on Uu and sidelink.

2 of 19 companies support option 3.

10 of 19 companies thinks none should be supported. But 7 companies also can accept option 1.

Therefore, rapporteur suggest to support option 1.

**Proposal 6: Introduce following event during direct to indirect path switch,**

* **Candidate relay is better than a threshold**

### ID to report for serving cell of relay UE

It was agreed that the SL relay measurement report shall include serving cell ID of the Relay UE. In RAN2 #115 meeting, NCI included in the relay discovery message is taken as the WA. However, PCI, NCI and NCGI were proposed by companies. Rapporteur understands all these IDs can work and the major difference is signaling overhead, i.e. PCI is 10 bits, NCI is 36 bits and NCGI is 52 bits (as PLMN ID is 16 bits).

**Q7: which cell ID do you prefer when relay UE report as its serving cell ID,**

**Option 1: PCI,**

**Option 2: NCI,**

**Option 3: NCGI.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| InterDigital | No strong view | As mentioned by rapporteur, all of these can work and there is little difference in the signaling overhead. |
| OPPO | Option 2, option 3 | Depend on whether to support RAN sharing, i.e., if no RAN sharing, NCI is sufficient, otherwise, NCGI including PLMN ID is needed. |
| Xiaomi | Option 1 or 2 | We think PCI is enough. If PCI can be reused in neighbor cells, NCI is preferred. |
| Qualcomm | Option 2, option 3 | Same view as OPPO, depending on outcome of whether to support RAN sharing |
| Ericsson | Option 2 |  |
| LG | No strong view | All can work |
| Huawei, HiSilicon | Option 2 | To clarify, the question is **which cell ID do you prefer ~~when relay UE report~~ as ~~its~~ serving cell ID** **of the Relay UE in SL relay measurement report**? |
| Intel | Option 1 or Option 2 | We would like to clarify which WA the rapp is referring to. Is it from Relay reselection? We think both PCI and NCI could work, but since we agreed to use NCI for discovery message which the Remote UE uses for relay reselection, we can go with the same or go for reduced bits over Uu and use PCI. No strong view. |
| Samsung | Option 1 | Based on the agreement that Remote UE needs to know the PCI of Relay UE’s serving cell, PCI with the lowest overhead is preferred. |
| vivo | Option 2 or Option 3 | Between these two options, the final decision may be pending whether RAN sharing is supported or not. |
| Nokia | No strong view yet | Depends on the RAN sharing outcome |
| Apple | Option 2 |  |
| ZTE | Option 3 | Since SA2 specifies NCGI is included in discovery message, remote UE can acquire NCGI and directly report the NCGI in measurement report. For NCI, remote UE needs further decode the NCI from NCGI, which increases remote UE complexity and power consuming. For PCI, remote UE needs further acquire PCI of relay UE, which may bring spec impact. |
| CATT | Option 2 or Option 3 | Option 2 if RAN sharing is not supported; otherwise, Option 3 should be adopted. |
| Futurewei | Configurable by network | It depends on network deployment – if there is reuses of PCIs and NCIs. |
| Spreadtrum | Option 2 |  |
| Philips | Option 2 or 3 | It depends whether RAN sharing is supported or not |
| ASUSTeK | Option 2 or 3 |  |
| Lenovo | Option2 | If RAN sharing is not supported in this release. we support option2. otherwise, go option3. |

3 companies support option 1;

13 companies support option 2;

7 companies support option 3;

3 companies doesn’t have strong view.

1 company think it should be configurable by NW.

There is no majority view for this question and the views are pretty diverse. Many companies think this question is related to whether RAN sharing is supported in L2 relay. Therefore, rapporteur suggest RAN2 further discuss this issue considering the conclusion of RAN sharing support.

**Proposal 7: RAN2 to discuss which ID is included in measurement report as relay UE’s cell ID.**

### Relay UE ID in measurement report

It’s agreed SL relay measurement report can include Relay UE ID. Regarding which ID is included, majority prefer to use relay UE’s source L2 ID according to companies’ contributions in RAN2#116. Rapporteur suggest to follow majority view.

**Q8: Do you agree to use relay UE’s source L2 ID as relay UE ID in measurement result.**

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comments |
| InterDigital | Yes |  |
| OPPO | Yes |  |
| Xiaomi | Yes |  |
| Qualcomm | Yes | UE ID in measurement report should be same as the relay UE ID used in discovery message. And SA2 has captured that relay UE ID included in discovery message is Source L2 ID self-selected by the Relay UE in TS 23.304 clause 5.8.3.1. |
| Ericsson | Yes |  |
| LG | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Intel | Yes |  |
| Samsung | Yes |  |
| vivo | Yes |  |
| Nokia | Yes |  |
| Aplpe | Yes with comment | RAN2 need also consider how to handle the ID collision issue as this L2 Src ID is self-generated. |
| ZTE | Yes |  |
| CATT | Yes |  |
| Futurewei | Yes |  |
| Spreadtrum | Yes |  |
| Philips | Yes |  |
| ASUSTeK | Yes |  |
| Lenovo | Yes |  |

Unanimous support to this question.

**Proposal 8: Relay UE ID included in measurement report is relay UE’s source L2 ID.**

If source L2 ID is preferred in Q8, gNB is unable to map the source L2 ID to relay UE, since relay UE doesn’t report its source L2 ID. So, gNB is unable to prepare the relay UE in advance. To enable the mapping, companies proposed for relay UE in RRC\_CONNECTED to report its source L2 ID to gNB.

**Q8-1: Do you agree relay UE in RRC\_CONNECTED reports its source L2 ID to gNB.**

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comments |
| InterDigital | Yes |  |
| OPPO | Yes |  |
| Xiaomi | Yes |  |
| Qualcomm | Yes |  |
| Ericsson | Yes but | We think that the relay UE does not needs to be necessarily in RRC\_CONNECTED to report the L2 ID. The reporting can happen in any RRC state as far there is a PC5 connection (for sidelink relay purposes up and running). |
| LG | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Intel | Yes |  |
| Samsung | Yes |  |
| vivo | Yes |  |
| Nokia | Yes |  |
| Apple | Yes | If relay UE is not in RRC\_CONNECTED, then there is no need for gNB to identify the relay in path switch, |
| ZTE | Yes |  |
| CATT | Yes |  |
| Futurewei | Yes |  |
| Spreadtrum | Yes |  |
| Philips | Yes |  |
| ASUSTeK | Yes |  |
| Lenovo | Yes |  |

If companies prefer Y in Q8-1, a following question is which message is used to report source L2 ID.

**Q8-2: which message do you prefer for relay UE in RRC\_CONNECTED to report source L2 ID,**

**Option 1: *SidelinUEInformationNR*,**

**Optoin 2: *UEAssistanceInformation*,**

**Option 3: New message.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| InterDigital | Option 1 | This is better aligned with current reporting of the L2 ID. |
| OPPO | Option 1 |  |
| Xiaomi | Option 1 |  |
| Qualcomm | Option 1 |  |
| Ericsson | Option 1 but | We think that the relay UE does not needs to be necessarily in RRC\_CONNECTED to report the L2 ID. The reporting can happen in any RRC state as far there is a PC5 connection (for sidelink relay purposes up and running). |
| LG | Option 1 |  |
| Huawei, HiSilicon | Option 1 |  |
| Intel | Option 1 |  |
| Samsung | Option 1 |  |
| vivo | Option 1 |  |
| Nokia | Option 1 |  |
| Apple | Option 1 with comment | However, after receiving SUI message, gNB may detect ID collision issue as this L2 Src ID is self-generated and may be used by more than one relay UE. So, some additional work are still needed in RAN2. |
| ZTE | Option 1 |  |
| CATT | Option 1 |  |
| Futurewei | Option 1 |  |
| Spreadtrum | Option 1 |  |
| Philips | Option 1 |  |
| ASUSTeK | Option 1 |  |
| Lenovo | Option 1 |  |

Unanimous support to Q8-1 and Q8-2. Rapporteur suggest to make a joint proposal to cover these two questions.

**Proposal 9: Relay UE in RRC\_CONNECTED reports its source L2 ID to gNB, via *SidelinkUEInformationNR*.**

### Relay (re)selection performed by RRC\_CONNECTED L2 remote UE

For L2 remote UE in RRC\_IDLE/RRC\_INACTIVE relays, the (re)selection procedure is UE autonomous and triggered based on measurements of SL-RSRP. However, for remote UE in RRC\_CONNECTED, mobility should be controlled by the network. In this case, UE autonomous (re)selection (similar to LTE) should not be performed by the remote UE in RRC\_CONNECTED except for some exceptional cases such as when the remote UE cannot reliably communicate with the network.

**Q9: Do you agree Relay (re)selection procedure is not performed by a L2 Remote UE in RRC\_CONNECTED, except for the case of RLF**

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comments |
| InterDigital | Yes, with comments | Here we understand RLF to be either SL-RLF detected by the remote UE, and Uu-RLF indication sent to the remote UE by the relay UE via PC5-RRC message.For PC5-S release message, or PC5-RRC message indicating HO by the relay, we think these require further discussion as to whether (re)selection is performed, and whether the remote UE stays in RRC\_CONNECTED in this case. |
| OPPO | Yes |  |
| Xiaomi | Yes |  |
| Qualcomm | No (at least clarification is needed) | Proponents please clarify below our questions before making summary proposals:1. We are not sure what “the case of RLF” includes: does it only include PC5 RLF detected by remote UE, or it also includes Uu RLF notified by relay UE via PC5 RRC message? Our understanding is that both cases are included
2. Does exception also include the case that remote UE receives the PC5-S message for release from relay UE? We think it also need to include this exception case.
3. Does exception also include the case that remote UE receives the PC5 RRC message on notification of HO from relay UE? We think it also need to include this exception case.

For above case 2) and 3), please also note that relay UE is not aware of remote UE’s RRC state per current agreements. So, if 2) and 3) are not exception case, RAN2 need to specify how to prevent misalignment between remote UE and relay UE (i.e., relay UE think the PC5 link has been released but remote UE actually doesn’t release because it is in CONNECTED state) |
| Ericsson | Yes |  |
| LG | No | The exceptional case may be included the following cases:* Relay UE indicates HO to the remote UE
* Relay UE indicates Uu RLF to the remote UE

Relay UE performs cell reselection |
| Huawei, HiSilicon | Yes with comments | Our understanding is in the normal connected mode, L2 Remote UE does not need to perform relay (re)selection, but for some exceptional cases trigger Remote UE do RRC reestablishment, the UE needs to find a suitable relay or Uu cell, this is when relay (re)selection can be performed. |
| Intel | Yes in generalSee comment | We understand the intention of the question, but we can wait to see whether we will define Remote UE behavior upon reception of the notification message from Relay UE upon RLF, HO.  |
| Samsung | Yes | Agree with the Rapporteur that the relay reselection by RRC\_CONNECTED Remote UE is to be allowed only for some exceptional cases. |
| vivo | See comments | We think this should be further discussed after the intended UE behavior in the case of relay UE HO is concluded. Also, we think Qualcomm raised another interesting scenario: what if the relay UE releases the PC5 RRC connection with the Remote not actually due to link problems? The intended UE behavior in this case may also need to be first confirmed.  |
| Nokia | See comments | We would also like further discussions to clarify the scenarios |
| Apple | No | We agree with Qualcomm and we think there are a couple of exceptional cases need to be discussed first. |
| ZTE | Yes | As point out in above comments, other exceptional cases shall also be considered. |
| CATT | Yes |  |
| Futurewei | Yes in general | As principle, relay reselection is not needed when an active UE-to-network connection is maintained. |
| Spreadtrum | Yes |  |
| Philips | No | As explained by Qualcomm, there may be more scenarios, other than RLF, where the Remote UE needs to perform Relay re-selection |
| ASUSTeK | See comment | According to the endorsed running RRC CR(R2-2111490), it is clear that the remote UE in RRC\_CONNECTED performs RRC re-establishment procedure covering initiation of cell selection and/or relay selection, upon SL RLF or reception of *NotificationMessageSidelink* message (indicating e.g. Uu RLF, HO of Relay UE).In case of receiving PC5-S message for release from Relay UE, according to the endorsed running Stage 2 CR (R2-2111437), Remote UE will trigger U2N Relay reselection. We think the remote UE in RRC\_CONNECTED should also perform RRC re-establishment procedure covering initiation of cell selection and/or relay selection, upon reception of PC5-S message for release from Relay UE. |
| Lenovo | See comments | In Uu legacy, UE performs cell selection during re-establishment procedure. Similarly, remote UE in connected state performs cell/relay selection during re-establishment when the following cases happens.* PC5 RLF;
* the reception of Uu RLF
* the reception of relay HO

Therefore, we suggest the following modification: Relay (re)selection procedure is not performed by a L2 Remote UE in RRC\_CONNECTED, except for the case of re-establishment. |

11 of 19 companies agree with the question.

8 of 19 companies thinks more cases should be considered, e.g. relay UE handover.

Rapporteur would like to clarify the question aims at remote UE autonomously triggered relay reselection. However, rapporteur also see the point of opponents that it’s still open how to trigger remote UE reselection during relay handover and relay UE’s RLF. Therefore, rapporteur suggest RAN2 to further discuss this issue,

**Proposal 10: RAN2 to discuss whether remote UE can perform autonomous relay reselection in other cases, e.g. upon relay UE’s handover and relay UE’s RLF.**

## UL PDCP lossless behaviour in indirect-to-direct path switch

For UL data delivery during the path switch, certain data PDU may be received by the relay UE but not be transmitted to gNB. After path switch, the remote UE may be indicated to do PDCP reestablishment or PDCP data recovery to retransmit the data which has been confirmed by RLC. However, the confirmation from RLC doesn’t reflect the successful reception by gNB. Therefore, UL PDCP lossless may not be ensured.

Regarding how to ensure UL PDCP lossless in indirect-to-direct path switch, the solution seems to be ask remote UE to retransmit the PDCP SDUs according to PDCP status report from gNB.

While some companies think this issue only happens when relay fails to complete the transmission towards gNB, e.g., when gNB release the RLC channel intentionally, or RLF happens in an unexpected manner. Therefore, it’s a corner case.

**Q10: which option do you prefer to ensure UL PDCP lossless in indirect-to-direct path switch,**

**Option 1: No spec impact, i.e., assume loss of UL PDCP PDUs is a corner case or can be addressed by network implementation,**

**Option 2: Remote UE retransmits all the PDCP SDUs for which the successful delivery of the corresponding PDCP Data PDU has not been confirmed by PDCP status report in the target side after path switch.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| InterDigital | Option 1 | We think a path switch occurring simultaneously with Uu RLF is a corner case and we can avoid special handling of it in this release. |
| OPPO | Option 1 | We agree with rapporteur’s observation that it is a corner case that Uu RLF and path switch occurring simultaneously. |
| Xiaomi | Option 1 |  |
| Qualcomm | Option 1 | We also think it is a corner case. |
| Ericsson | Option 1 |  |
| LG | Option 1 |  |
| Huawei, HiSilicon | Prefer option 2 | The Remote UE’s UL data may loss during Relay UE’s Uu link change, e.g. Uu RLF, Uu HO to the same or other gNB. Although we agree that the above cases may not happen very frequently, but as the solution in option2 is simple and effective, we slightly prefer to adopt it to address the potential issues. |
| Intel | Option 1 |  |
| Samsung | Option 1 | We agree the analysis by the Rapporteur. |
| vivo | Option 1 |  |
| Nokia | Option 1 |  |
| Apple | Option 2 | RAN2 has agreed to rely on PDCP status report to handle this problem. So, we think it is reasonable to use Option 2 to avoid packet loss. |
| ZTE | Option 2 | As the consensus we have reached, to ensure service continuity during path switch, lossless delivery shall be considered and based on PDCP status report. It is possible the remote UE’s UL data may loss in some cases and we shall address the issue. |
| CATT | Option 2  | Share the same view as Huawei. |
| Futurewei | Option 2 | Option 2 is a straightforward reuse of existing HO procedure. |
| Spreadtrum | Option 1 |  |
| Philips | Option 2 | Agree with Apple |
| ASUSTeK | Option 1 |  |
| Lenovo | Option 1 |  |

13 of 19 companies thinks this is corner case and there is no spec impact.

6 of 19 companies would like to rely on PDCP status to resolve this problem.

Rapporteur suggest RAN2 to further discuss this issue.

**Proposal 11: RAN2 to discuss which option to ensure UL PDCP lossless in indirect-to-direct path switch,**

**Option 1: No spec impact, i.e., assume loss of UL PDCP PDUs is a corner case or can be addressed by network implementation,**

**Option 2: Remote UE retransmits all the PDCP SDUs for which the successful delivery of the corresponding PDCP Data PDU has not been confirmed by PDCP status report in the target side after path switch.**

# Conclusion

Proposal 1:[Easy] S-measure criterion based on SL/SD-RSRP of serving relay during indirect to direct path switching in not introduced.

Proposal 2:[Easy]Remote UE does not consider the AS criteria for measurement report when performing SL measurement for path switch, except for configured measurement report event.

Proposal 3: RAN2 to discuss whether Allow-list/Block-list of relay UE during direct to indirect path switch is introduced.

Proposal 4: If Allow-list/Block-list of relay UE during direct to indirect path switch is introduced, allow-list/block-list include relay UE’s serving cell ID. FFS whether it could include relay UE ID.

Proposal 5:[Easy]Introduce following event during indirect to direct path switch,

* + - * + **Serving relay is worse than a threshold**

Proposal 6:[Easy]Introduce following event during direct to indirect path switch,

* + - * + **Candidate relay is better than a threshold**

Proposal 7: RAN2 to discuss which ID is included in measurement report as relay UE’s cell ID.

Proposal 8:[Easy]Relay UE ID included in measurement report is relay UE’s source L2 ID.

Proposal 9:[Easy]Relay UE in RRC\_CONNECTED reports its source L2 ID to gNB, via SidelinkUEInformationNR.

Proposal 10: RAN2 to discuss whether remote UE can perform autonomous relay reselection in other cases, e.g. upon relay UE’s handover and relay UE’s RLF.

Proposal 11: RAN2 to discuss which option to ensure UL PDCP lossless in indirect-to-direct path switch,

* + - * + **Option 1: No spec impact, i.e., assume loss of UL PDCP PDUs is a corner case or can be addressed by network implementation,**
				+ **Option 2: Remote UE retransmits all the PDCP SDUs for which the successful delivery of the corresponding PDCP Data PDU has not been confirmed by PDCP status report in the target side after path switch.**

# Reference

[1] R2-2111276 Summary of AI 8.7.2.2 Service continuity Huawei, HiSilicon