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# 1 Introduction

This document is to summarize the proposals made by the contributions submitted under the AI 8.7.2.2.

Please note that the main focus of this summary (as also requested by the Session Chair) focuses mainly on Stage 2 aspects and leave the stage 3 details to further discussions, if time allows.

Also, proposals that are somehow related to the summary submitted by Samsung in [R2-2107710](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs//R2-2107710.zip) are not part of this summary.

# 2 Summary of remaining issues

## 2.1 Sidelink relay measurement framework

A good number of companies submitted proposals related on how the measurement framework would work for the case of sidelink relay. Main proposals involve when performing measurement, what to include in the measurements, and how the measurements (and by whom) the measurements are reported.

According to the proposals formulated by all the companies, there is some common ground regarding some aspects. One of them is that no S-measure criteria should be considered for the case of SL relay (at least 3 companies propose to not have it in [5,18,24] while only one company is in favour in [6]).

1. RAN2 to discuss whether S-measure criteria shall be used in NR sidelink relay.

Another aspect that is touched by different companies is how the relay UE candidate(s) should be reported by the UE in case of path switch and when this should be reported. In general, what the companies proposes (at least companies in [1,3,5,10,16,18,23,24]) is that the remote UE should report the relay UE candidate(s) filtered based on the AS and high-level criteria.

1. RAN2 to confirm that the Remote UE shall report only the Relay UE candidate(s) that fulfil the AS and higher layer criteria.

A further topic addressed by companies’ contributions is what SL measurement quantity should be reported in case of a path switch. Here there are different options on the table and there is also a difference on whether the path switch is performed from a direct path to an indirect path or vice versa.

In particular, at least companies in [20,27] propose that from indirect to direct path switch, the SL measurement quantity is SL-RSRP while companies in [3] proposes that the Sidelink RSRP included in measurement report is L3 filtered SD-RSRP.

1. RAN2 to discuss whether the SL measurement quantity should be SL-RSRP for the case of path switch from indirect to direct path.

At the same time, at least companies in [3,27,20] propose that from direct to indirect path switch, the SL measurement quantity is SD-RSRP and still companies in [27,20] also open to the possibility to report SL-RSRP.

1. RAN2 to discuss whether the SL measurement quantity should be SD-RSRP for the case of path switch from direct to indirect path.

About what to include in the measurement report, at least companies in [3,8] propose to include the Relay UE ID (i.e., L2 ID) in the measurement report.

1. RAN2 to discuss on whether the Relay UE ID is included in the measurement report and if this ID is the Source L2 ID.

Another aspect about measurements is whether the relay UE should be configured with measurements and in which case this should be done. At least companies in [17,27] believe that relay UE should be configured with measurement while a companies in [5] believe that this is not needed.

1. RAN2 to discuss whether the Relay UE can be configured with measurements towards one particular Remote UE for purposes of path switch of that Remote UE.

## 2.2 Path switch procedural aspects

### 2.2.1 The RRC state of the Relay UE

A good number of companies have proposal on whether, during path switch, the gNB may select, or be restricted to select, certain relay UEs according to their RRC state. Regarding this aspect, the following options are discussed/proposed for the direct to indirect path switch:

* For direct to indirect path switching, the gNB may select a target relay UE which is in RRC\_IDLE or RRC\_INACTIVE.[1]
* For HO from direct to indirect path, remote UE HO to INACTIVE relay UE is supported. The INACTIVE relay UE transits to CONNECTED state after the remote UE connects to the relay UE (as part of HO procedures) and the remote UE context is fetched from gNB at that point.[3]
* For HO from direct to indirect path, remote UE HO to IDLE relay UE is not supported. Remote UE can only perform relay (re)selection to IDLE relay UE and then perform Uu RRC Reestablishment after relay UE transitions to CONNECTED state.[3]
* The relay UE in INACTIVE/IDLE state can be selected by the gNB during path switch from direct to indirect link.[5]
* Direct to indirect path switch procedure supports the case where the relay UE is IDLE/INACTIVE.[6]
* As a baseline, agree that gNB makes a decision to switch (from direct to indirect link) and send handover command to Remote UE only if target Relay UE is in RRC\_CONNECTED.[7]
* IDLE/INACTIVE relay UE for path switching is supported in R17.[10]
* In case of direct to indirect path switch, Relay UE in RRC\_CONNECED only should be candidate target Relay UE.[12]
* For the path switch from direct to indirect link, both RRC\_Connected relay UE and RRC\_IDLE/INACTIVE relay UE may be selected by gNB as the target relay UE for remote UE.[18]
* RAN2 do not support network controlled HO from gNB to a relay UE in IDLE state.[23]
* RAN2 support network controlled HO from gNB to a relay UE in inactive state.[23]
* For service continuity from direct to indirect, the remote UE should either select only candidate relay UEs that are RRC\_CONNECTED or used a modified path switch procedure if the selected relay UE is in INACTIVE or both IDLE and INACTIVE.[24]
* Support relay UE in RRC INACTIVE/IDLE state during path switch from direct to indirect link.[26]
* RAN2 to prioritize the direct to indirect path switch via RRC\_CONNECTED Relay UE, and pursue the direct to indirect path switch via RRC\_INACTIVE/RRC\_IDLE Relay UE if time permitted.[27]

According to the proposal above, the views are the following:

* Support relay UE only in RRC\_IDLE:
* Support relay UE only in RRC\_INACTIVE: 2 companies
* Support relay UE in both RRC\_IDLE and RRC\_INACTIVE: 8 companies (1 company only if timer allows)
* Support relay UE only in RRC\_CONNECTED: 3 companies (1 company proposes to prioritize this case and leave the others if time allows).

Therefore, according to the majority view, it is suggested the following:

1. RAN2 to discuss whether a Relay UE in RRC\_INACTIVE state can be selected by the gNB during path switch from direct to indirect link.
2. RAN2 to discuss whether a Relay UE in RRC\_IDLE state can be selected by the gNB during path switch from direct to indirect link.

A related aspect to the previous proposal is also how the relay UE should transit to the RRC\_CONNECTED state to start the active relaying of data. Here the options are that the relay UE transits to RRC\_CONNECTED either by an indication coming from the gNB [5] or via a trigger coming from remote UE [23,27].

1. RAN2 to discuss how a Relay UE in RRC\_INACTIVE/RRC\_IDLE transits to RRC\_CONNECTED upon path switch (e.g., via indication coming from the gNB or Remote UE).

### 2.2.2 Need of timer T304 for the path switch procedure

An aspect that was touched by companies is whether the timer T304 is needed for the path switch procedure and also whether a different T304 is needed for the case of path switch from direct to indirect path and vice versa. Here a company in [6] claims that two different timer T304 are needed for the different path switch procedure whereas a company in [13] believe that no timer T304 at all is needed.

1. RAN2 to discuss the need of new timer(s) other than T304 for the path switch procedure and if yes, whether more than one new timer is needed (i.e., one for the direct to indirect path switch and another one for the indirect to direct path switch).

### 2.2.3 Remote and Relay UE IDs in RRC reconfiguration messages

A further aspect addressed by companies what information about the remote UE and relay UE should be included in the RRCReconfiguration and RRCReconfigurationComplete messages during the path switch procedure. A company in [8] proposes that the Remote UE ID should be part of the RRC reconfiguration message sent to the target relay, whether a company in [27] proposes to include the remote and relay UE IDs (i.e., in this case the C-RNTI) in the RRC reconfiguration and RRC reconfiguration complete messages.

Also, the same company in [27] proposes that path switch from direct to indirect via RRC\_INACTIVE/RRC\_IDLE Relay UE, the Relay UE ID in RRC Reconfiguration message can be index (e.g. allocated by Remote UE during discovery).

1. RAN2 to discuss whether the Remote UE ID and/or Relay UE ID needs to be included in the RRC reconfiguration and/or RRC reconfiguration complete message and whether there is a difference on what UE ID to include based on the RRC state.

## 2.3 Support of lossless path switch procedure

More than one company addressed the case on how to guarantee a lossless path switch procedure. According to this, the following proposals were formulated:

* For L2 U2N relay, PDCP retransmission should be performed based on PDCP status report.[1]
* For switching from indirect to direct link, RAN2 discuss whether / how to handle the issue of UL PDCP PDU acknowledged by PC5-RLC of relay UE but not by Uu-RLC of gNB.[4]
* No enhancement is needed to reestablish UE context in the relay UE and source gNB due to loss of handover command or handover failure, with the understanding that network can perform step 6 after step 5.[9]
* Support a time gap to allow relay UE to complete transmission of buffered RLC PDUs so that step 6 and step 7 always to be executed after step 8.[10]
* UE maintains the PC5 interface for receiving the DL data in the relay UE’s buffer when UE is performing RA for handover purpose.[13]
* It is suggested to keep the remote UE relevant configuration until the remote UE successfully connected to the gNB via Uu.[18]
* In order to ensure the UL lossless delivery during path switch from indirect to direct link, it is suggested that remote UE performs PDCP retransmission based on PDCP status report received from gNB after remote UE connects to the gNB via direct link.[18]
* In case of path switch from a direct to an indirect path, for the uplink direction the remote UE may ask for a PDCP status report via the relay to the gNB.[21]
* In case of path switch from a direct to an indirect path, for the downlink direction the gNB may ask for a PDCP status report via the relay to the remote UE.[21]
* In case of path switch from an indirect to a direct path, for the uplink direction the remote UE may ask directly to the gNB for a PDCP status report.[21]
* In case of path switch from an indirect to a direct path, for the downlink direction the gNB may ask directly to the remote UE for a PDCP status report.[21]
* The legacy PDCP behaviour is baseline for the lossless of serving continuity. RAN2 to discuss the need of remote UE PDCP re-transmission based on the PDCP status report as enhancement.[27]

According to the below, it is possible to group the proposal on how to guarantee a lossless path switch according to three options:

1. The DL/UL lossless delivery during the path switch is done according to the PDCP status report. FFS the signalling details for the Remote UE, Relay UE, and gNB.
2. The remote UE performs buffering until the path switch procedure is completed.
3. The remote UE keeps old configuration (if there is a need to perform PDCP retransmissions) until the path switch procedure is completed.

Given these three options, it seems there is a slight majority for re-using the PDCP status report framework.

1. RAN2 to confirm that the DL/UL lossless delivery during the path switch is done according to the PDCP status report. FFS the signalling details for the Remote UE, Relay UE, and gNB.

# 3 Conclusion

According to the discussion in section 2, the following proposals are formulated:

1. RAN2 to discuss whether S-measure criteria shall be used in NR sidelink relay.
2. RAN2 to confirm that the Remote UE shall report only the Relay UE candidate(s) that fulfil the AS and higher layer criteria.
3. RAN2 to discuss whether the SL measurement quantity should be SL-RSRP for the case of path switch from indirect to direct path.
4. RAN2 to discuss whether the SL measurement quantity should be SD-RSRP for the case of path switch from direct to indirect path.
5. RAN2 to discuss on whether the Relay UE ID is included in the measurement report and if this ID is the Source L2 ID.
6. RAN2 to discuss whether the Relay UE can be configured with measurements towards one particular Remote UE for purposes of path switch of that Remote UE.
7. RAN2 to discuss whether a Relay UE in RRC\_INACTIVE state can be selected by the gNB during path switch from direct to indirect link.
8. RAN2 to discuss whether a Relay UE in RRC\_IDLE state can be selected by the gNB during path switch from direct to indirect link.
9. RAN2 to discuss how a Relay UE in RRC\_INACTIVE/RRC\_IDLE transits to RRC\_CONNECTED upon path switch (e.g., via indication coming from the gNB or Remote UE).
10. RAN2 to discuss the need of new timer(s) other than T304 for the path switch procedure and if yes, whether more than one new timer is needed (i.e., one for the direct to indirect path switch and another one for the indirect to direct path switch).
11. RAN2 to discuss whether the Remote UE and Relay UE needs to be included in the RRC reconfiguration and/or RRC reconfiguration complete message and whether there is a difference on what UE ID to include based on the RRC state.
12. RAN2 to confirm that the DL/UL lossless delivery during the path switch is done according to the PDCP status report. FFS the signalling details for the Remote UE, Relay UE, and gNB.

# 4 Proposal not included

Here is a list of proposals left out since either they propose stage 3 details, or their propose to address topics or issues that are not included in the current SL Relay WID.

* For gNB to be aware of Relay UE in measurement report, Relay UE’s Source L2 ID in discovery message can be included in SidelinkUEInformationNR message.[3]
* For HO from indirect to direct path, RAN2 confirm that NW controlled inter-gNB switch can be supported without new signaling required compared with intra-gNB case.[3]
* For HO from direct to indirect path, RAN2 confirm that NW controlled inter-gNB switch can’t be supported due to spec change on Xn signaling required, but UE controlled inter-gNB switch can be supported (i.e. upon detection of PC5 RLF and/or Uu RLF, remote UE may perform relay selection and then Uu RRC Reestablishment via relay UE served by different cell).[3]
* For path switch between two indirect paths, RAN2 confirm that NW controlled solution is not supported in this release, but UE controlled path switch can be supported via below procedure:[3]
  + Intra-gNB case: Upon detection of PC5 RLF and/or Uu RLF, remote UE may perform relay reselection and then Uu RRC Reestablishment via another relay UE in same cell
  + Inter-gNB case: Upon detection of PC5 RLF and/or Uu RLF, remote UE may perform relay reselection and then Uu RRC Reestablishment via another relay UE served by different cell.
* Discovery transmission/reception can be explicitly enabled/disabled by the network for a relay/remote UE in RRC\_CONNECTED.[6]
* Relay (re)selection procedure is not performed by a L2 remote UE in RRC\_CONNECTED, except for certain exceptional cases (e.g., RLF).[6]
* The network can provide a list of (e.g., prioritized) relays to be used by the L2 remote UE in (re)selection procedure.[6]
* A PC5 RRC connection release condition is added to the Spec for the Remote UE: the Remote UE releases the PC5 RRC connection, if the PC5 RRC connection is used for L2 relaying only and if the RRC reconfiguration with sync for indirect-to-direct path switch is received.[8]
* A sidelink DRB release condition is added into the Spec for the relaying specific PC5 RLC bearers for the Remote UE: if the RRC reconfiguration with sync for indirect-to-direct path switch is received on a PC5 RRC connection not only used for L2 relaying, the condition to release the PC5 RLC bearers specific for L2 relaying is considered as satisfied”.[8]
* A PC5 RRC connection release condition is added to the Spec for the Relay UE: the Relay UE releases the PC5 RRC connection with a Remote UE, if the PC5 RRC connection is used for relaying only and if an RRC reconfiguration message indicating indirect-to-direct path switch for the connected Remote UE is received.[8]
* A sidelink DRB release condition is added into the Spec for the relaying specific PC5 RLC bearers for the Relay UE: if an RRC reconfiguration message is received by the Relay UE indicating indirect-to-direct path switch for a Remote UE and the PC5 RRC connection is not for relaying only, the condition to release the PC5 RLC bearers specific for L2 relaying is considered as satisfied.[8]
* When the conditions in Proposal 7/7a are satisfied, the Remote UE and the Relay UE may release the PC5 RLC entities and logical channels of all the PC5 RLC bearers specific for L2 relaying (not shared by non-relaying traffic), as per the related procedure in 5.8.9.1a.1.2 in the current Spec.[8]
* If indirect-to-direct path switch happens between a Remote UE and a Relay UE, the Remote UE releases all the Uu PDCP entities specific for L2 relaying with this Relay UE; the Relay UE releases all the Uu bearers that are specifically used for the concerned Remote UE (if any).[8]
* Legacy reconfigurationWithSync IE included in RRCreconfiguration can be reused for path switching command from relay link to Uu link.[13]
* RAN2 needs to discuss if legacy reconfigurationWithSync IE included in RRCreconfiguration can be used to indicate the remote UE to switch from relay link to Uu link if the target cell is the same cell serving the relay.[13]
* The relay belonging to the serving cell can prioritized over the neighbour cell and the suitable relay belonging to the neighbour cell during re-establishment.
* The serving gNB may indicate L2-Relay-support availability in the target gNB to the Relay-UE.[15]
* The Relay UE or the serving network may indicate L2-Relay-support availability in the target gNB to the Remote-UE.[15]
* RAN2 to discuss remote UE’s behavior if handover is not performed due to target UE’s serving cell change,[16]
* If only suitable cell(s) are available and the previous serving cell of remote UE is included in the suitable cell, the remote UE initiates RRC re-establishment procedure preferentially towards the previous serving cell.
* If only suitable cell(s) are available and the previous serving cell of remote UE is not included in the suitable cell, the remote UE can initiate RRC re-establishment procedure towards suitable any cells.
* If only suitable relay(s) are available, remote UE selects preferentially the relay UE(s) being camping on or in RRC CONNECTED in the previous serving cell of remote UE. The remote UE initiates RRC re-establishment procedure via selected relay UE.
* If only suitable relay(s) are available and there is no relay UE(s) being camping on or in RRC CONNECTED in the previous serving cell of remote UE, remote UE selects any relay UE based on its implementation. The remote UE initiates RRC re-establishment procedure via selected relay UE.[19]
* If both suitable cell(s) and suitable relay(s) are available, remote UE can select preferentially a cell, which also has suitable relay UE(s), to initiate RRC re-establishment procedure.[19]
* If both a suitable cell(s) and a suitable relay(s) are available, remote UE can select preferentially a relay UE, which also has suitable cell(s), to initiate RRC re-establishment procedure.[19]
* When relay performs HO to another gNB, an AS layer procedure should be used to inform the remote UEs to either release the RRC connection or to switch from indirect to direct connection.[24]
* RAN2 is asked to consider using the sidelink communication to reduce interruption time during handover.[25]
* For SL measurement of indirect to direct path switch, the SL measurement object can reuse R16 SL measurement object (i.e. SL carrier).[27]
* For SL measurement of direct to indirect path switch, the SL measurement object can reuse R16 SL measurement object (i.e. SL carrier). FFS on whether “Allow-list/Blocklist” is supported.[27]
* RAN2 to discuss whether to consider the A2 event (i.e. Uu-RSRP of serving cell is worse than a threshold) as new trigger event for SL measurement for direct to indirect path switch.[27]
* The serving cell ID included in the neighbor Relay UE measurement report is CGI+PCI.[27]

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