**3GPP TSG-WG3 Meeting #121 R3-234673**

**Toulouse, France, Aug, 2023**

**Source: CMCC, Ericsson, CATT, Huawei, China Telecom, NEC, Samsung**

**Title: (TP for SL relay to TS 38.300) Considerations on service continuity**

**Agenda item:** **16.3**

**Document Type: Approval**

# Introduction

In this paper, a TP is presented to include some details in RRC signaling and XnAP for inter-gNB path switching.

# TP for TS 38.300

Below, a draft TP is presented where the proposals made in this paper are reflected.

**<<<<<< Start of CHANGES >>>>>>**

## 16.12 Sidelink Relay

### 16.12.6 Service Continuity for L2 U2N relay

#### 16.12.6.0 General

The service continuity procedure is applicable for the mobility cases of path switch from indirect to direct path, and from direct to indirect path when the L2 U2N Remote UE and L2 U2N Relay UE belong to the same gNB or different gNB. This procedure is also applicable for the mobility cases of path switch from indirect to indirect path when the two L2 U2N Relay UEs belong to the same gNB or different gNBs. For inter-gNB path switching, the source gNB decides to trigger path switching and the path switch type, i.e. direct or indirect path.

#### 16.12.6.1 Switching from indirect to direct

For service continuity of L2 U2N Relay, the following procedure is used, in case of L2 U2N Remote UE switching from indirect to direct path under the same gNB:



Figure 16.12.6.1-1: Procedure for L2 U2N Remote UE intra-gNB indirect to direct path Switching

1. The Uu measurement configuration and measurement report signalling procedures are performed to evaluate both relay link measurement and Uu link measurement. The measurement results from L2 U2N Remote UE are reported when configured measurement reporting criteria are met. The sidelink relay measurement report shall include at least L2 U2N Relay UE's source L2 ID, serving cell ID (i.e., NCGI/NCI), and sidelink measurement quantity result. The sidelink measurement quantity can be SL-RSRP of the serving L2 U2N Relay UE, and if SL-RSRP is not available, SD-RSRP is used.

2. The gNB decides to switch the L2 U2N Remote UE onto direct Uu path.

3. The gNB sends the *RRCReconfiguration* message to the L2 U2N Remote UE. The L2 U2N Remote UE stops UP and CP transmission via the L2 U2N Relay UE after reception of the *RRCReconfiguration* message with the path switch configuration.

4. The L2 U2N Remote UE synchronizes with the gNB and performs Random Access.

5. The UE (i.e., L2 U2N Remote UE in previous steps) sends the *RRCReconfigurationComplete* message to the gNB via the direct path, using the configuration provided in the RRCReconfiguration message. From this step, the UE (i.e., L2 U2N Remote UE in previous steps) uses the RRC connection via the direct path to the gNB.

6. The gNB sends the *RRCReconfiguration* message to the L2 U2N Relay UE to reconfigure the connection between the L2 U2N Relay UE and the gNB. The *RRCReconfiguration* message to the L2 U2N Relay UE can be sent any time after step 3 based on gNB implementation (e.g., to release Uu and PC5 Relay RLC channel configuration for relaying, and bearer mapping configuration related to the L2 U2N Remote UE).

7. Either L2 U2N Relay UE or L2 U2N Remote UE's AS layer can release PC5-RRC connection and indicates upper layers to release PC5 unicast link after receiving the *RRCReconfiguration* message from the gNB. The timing to execute link release is up to UE implementation.

8. The data path is switched from indirect path to direct path between the UE (i.e., previous L2 U2N Remote UE) and the gNB. The PDCP re-establishment or PDCP data recovery in uplink is performed by the UE (i.e., previous L2 U2N Remote UE) for lossless delivery during path switch if gNB configures it.

NOTE: Step 8 can be executed any time after step 4. Step 8 is independent of step 6 and step 7.

For service continuity of L2 U2N Relay, the following procedure is used, in case of L2 U2N Remote UE switching from indirect to direct path under another gNB:



Figure 16.12.6.1-2: Procedure for L2 U2N Remote UE inter-gNB indirect to direct path switching

1. The Uu measurement configuration is configured by the source gNB, and measurement report signalling procedures are performed by the L2 U2N Remote UE to evaluate both relay link measurement and Uu link measurement. The measurement results from L2 U2N Remote UE are reported when configured measurement reporting criteria are met. The sidelink relay measurement report shall include at least L2 U2N Relay UE's source L2 ID, serving cell ID (i.e., NCGI/NCI), and sidelink measurement quantity result. The sidelink measurement quantity can be SL-RSRP of the serving L2 U2N Relay UE, and if SL-RSRP is not available, SD-RSRP is used.

 2. The source gNB decides to trigger path switch for the L2 U2N Remote UE onto direct path.

3. The source gNB sends the HANDOVER REQUEST message to the target gNB with necessary information to prepare the handover at the target side.

4. Admission Control may be performed by the target gNB.

5. The target gNB selects one target Relay UE from the list provided by the source gNB, and sends the HANDOVER REQUEST ACKNOWLEDGE message to the source gNB, which contains new RRC configuration for the L2 U2N Remote UE.

6. The source gNB triggers the path switch by sending an *RRCReconfiguration* message to the L2 U2N Remote UE, containing at least cell ID and the information required to access the target cell. The L2 U2N Remote UE stops UP and CP transmission via the L2 U2N Relay UE after reception of the *RRCReconfiguration* message.

7. The L2 U2N Remote UE synchronizes with the target gNB and performs Random Access.

8. The L2 U2N Remote UE sends *RRCReconfigurationComplete* message to target gNB via the direct path.

9. The target gNB sends the UE CONTEXT RELEASE to inform the source gNB about the success of the path switch.

10. The source gNB sends *RRCReconfiguration* message to the L2 U2N Relay UE to reconfigure the connection between the L2 U2N Relay UE and the source gNB. The *RRCReconfiguration* message to the L2 U2N Relay UE can be sent any time after step 6 based on source gNB implementation (e.g., to release Uu and PC5 Relay RLC channel configuration for relaying, and bearer mapping configuration related to the L2 U2N Remote UE).

11. Either L2 U2N Relay UE or L2 U2N Remote UE’s AS layer can release PC5-RRC connection and indicates upper layer to release PC5 unicast link after receiving the *RRCReconfiguration* message from the source gNB. The timing to execute link release is up to UE implementation.

NOTE: In order to support the DL lossless handover for the L2 U2N Remote UE, the source gNB may not discard the DL data even though the delivery of the data may be acknowledged by the L2 U2N Relay UE based on the gNB implementation. Then, the source gNB forwards the buffered DL data to the target gNB.

#### 16.12.6.2 Switching from direct to indirect

The gNB can select a L2 U2N Relay UE in any RRC state i.e., RRC\_IDLE, RRC\_INACTIVE, or RRC\_CONNECTED, as a target L2 U2N Relay UE for direct to indirect path switch.

For service continuity of L2 U2N Remote UE, the following procedure is used, in case of the L2 U2N Remote UE switching from direct to indirect path under the same gNB via a L2 U2N Relay UE in RRC\_CONNECTED:



Figure 16.12.6.2-1: Procedure for L2 U2N Remote intra-gNB direct to indirect path switching via a L2 U2N Relay UE in RRC\_CONNECTED

1. The L2 U2N Remote UE reports one or multiple candidate L2 U2N Relay UE(s) and Uu measurements, after it measures/discovers the candidate L2 U2N Relay UE(s):

- The L2 U2N Remote UE filters the appropriate L2 U2N Relay UE(s) according to relay selection criteria before reporting. The L2 U2N Remote UE shall report only the L2 U2N Relay UE candidate(s) that fulfil the higher layer criteria;

- The reporting includes at least a L2 U2N Relay UE ID, a L2 U2N Relay UE' s serving cell ID, and a sidelink measurement quantity information. SD-RSRP is used as sidelink measurement quantity.

2. The gNB decides to switch the L2 U2N Remote UE to a target L2 U2N Relay UE. Then the gNB sends an *RRCReconfiguration* message to the target L2 U2N Relay UE, which includes at least the L2 U2N Remote UE's local ID and L2 ID, Uu and PC5 Relay RLC channel configuration for relaying, and bearer mapping configuration.

3. The gNB sends the *RRCReconfiguration* message to the L2 U2N Remote UE. The *RRCReconfiguration* message includes at least the L2 U2N Relay UE ID, Remote UE's local ID, PC5 Relay RLC channel configuration for relay traffic and the associated end-to-end radio bearer(s). The L2 U2N Remote UE stops UP and CP transmission over the direct path after reception of the *RRCReconfiguration* message from the gNB.

4. The L2 U2N Remote UE establishes PC5 RRC connection with target L2 U2N Relay UE.

5. The L2 U2N Remote UE completes the path switch procedure by sending the *RRCReconfigurationComplete* message to the gNB via the L2 U2N Relay UE.

6. The data path is switched from direct path to indirect path between the L2 U2N Remote UE and the gNB.

In case the selected L2 U2N Relay UE for direct to indirect path switch is in RRC\_IDLE or RRC\_INACTIVE, after receiving the path switch command, the L2 U2N Remote UE establishes a PC5 link with the L2 U2N Relay UE and sends the *RRCReconfigurationComplete* message via the L2 U2N Relay UE, which triggers the L2 U2N Relay UE to enter RRC\_CONNECTED state. The procedure for L2 U2N Remote UE switching to indirect path in Figure 16.12.6.2-1 can be also applied for the case that the selected L2 U2N Relay UE for direct to indirect path switch is in RRC\_IDLE or RRC\_INACTIVE with the exception that the *RRCReconfiguration* message is sent from the gNB to the L2 U2N Relay UE after the L2 U2N Relay UE enters RRC\_CONNECTED state, which happens between step 4 and step 5.

For service continuity of L2 U2N Remote UE, the following procedure is used, in case of the L2 U2N Remote UE switching from direct to indirect path under the target gNB via a L2 U2N Relay UE in RRC\_CONNECTED:



Figure 16.12.6.2-2: Procedure for L2 U2N Remote UE inter-gNB switching from direct to indirect path

1. The L2 U2N Remote UE reports one or multiple candidate L2 U2N Relay UE(s) and Uu measurements to the source gNB, after it measures/discovers the candidate L2 U2N Relay UE(s):

-     The L2 U2N Remote UE filters the appropriate L2 U2N Relay UE(s) according to relay selection criteria before reporting. The L2 U2N Remote UE shall report only the L2 U2N Relay UE candidate(s) that fulfil the higher layer criteria;

-     The reporting includes at least a L2 U2N Relay UE ID, a L2 U2N Relay UE' s serving cell ID, and a sidelink measurement quantity information. SD-RSRP is used as sidelink measurement quantity.

2. The source gNB trigger path switch for the L2 U2N Remote UE onto indirect path of the target gNB, based on *MeasurementReport* and RRM information.

3. The source gNB sends a HANDOVER REQUEST message to the target gNB to prepare the path switch at the target side. The HANDOVER REQUEST message includes Remote UE L2 ID and a list of candidate target relay UE IDs belonging to one cell.

4. Admission Control may be performed by the target gNB.

5. The target gNB sends the *RRCReconfiguration* message to L2 U2N Relay UE for relaying configuration, which includes at least the L2 U2N Remote UE's local ID and L2 ID, Uu and PC5 Relay RLC channel configuration for relaying, and bearer mapping configuration.

6. The target gNB selects one target Relay UE from the list provided by the source gNB, and sends the HANDOVER REQUEST ACKNOWLEDGE message to the source gNB, which contains new RRC configuration for Remote UE.

7. The source gNB sends the *RRCReconfiguration* message to the L2 U2N Remote UE, which includes at least the L2 U2N Relay UE ID, Remote UE's local ID, PC5 Relay RLC channel configuration for relay traffic and the associated end-to-end radio bearer(s). The L2 U2N Remote UE stops UP and CP transmission over the direct path after reception of the *RRCReconfiguration* message from the source gNB.

8. The source gNB sends the SN STATUS TRANSFER message to the target gNB to convey the uplink PDCP SN receiver status and the downlink PDCP SN transmitter status of the L2 U2N Remote UE's DRBs for which PDCP status preservation applies (i.e. for RLC AM).

9. The L2 U2N Remote UE establishes PC5 connection with L2 U2N Relay UE, if not exist.

10. The L2 U2N Remote UE sends the *RRCReconfigurationComplete* message to target gNB via the L2 U2N Relay UE.

11. The data path is switched from direct path to indirect path between the L2 U2N Remote UE and the target gNB via the target L2 U2N Relay UE.

12. The target gNB sends the UE CONTEXT RELEASE to inform the source gNB about the success of the path switch. The source gNB can then release the L2 U2N Remote UE.

#### 16.12.6.x Switching from indirect to indirect

Notes: **RAN2 can put the description of intra-gNB i2i path-switching procedures in the 38.300 draft spec.**

For service continuity of L2 U2N Remote UE, the following procedure is used, in case of the L2 U2N Remote UE switching from indirect to indirect path under another gNB via a L2 U2N Relay UE in RRC\_CONNECTED:



Figure 16.12.6.x-2: Procedure for L2 U2N Remote UE inter-gNB indirect to indirect path switching

The signalling flow for U2N Remote UE switch from indirect path to indirect path under another gNB is shown as follows,

1. The L2 U2N Remote UE reports one or multiple candidate L2 U2N Relay UE(s) and Uu measurements to the source gNB, after it measures/discovers the candidate L2 U2N Relay UE(s):

-     The L2 U2N Remote UE filters the appropriate L2 U2N Relay UE(s) according to relay selection criteria before reporting. The L2 U2N Remote UE shall report only the L2 U2N Relay UE candidate(s) that fulfil the higher layer criteria;

-     The reporting includes at least a L2 U2N Relay UE ID, a L2 U2N Relay UE' s serving cell ID, and a sidelink measurement quantity information. SD-RSRP is used as sidelink measurement quantity.

2. The source gNB decides to trigger the L2 U2N Remote UE to switch to an indirect path of another gNB, based on *MeasurementReport* and RRM information.

3. The source gNB sends a HANDOVER REQUEST message to the target gNB to prepare the path switch at the target side. The HANDOVER REQUEST message includes Remote UE L2 ID and a list of candidate target relay UE IDs belonging to one cell.

4. Admission Control may be performed by the target gNB.

5. The target gNB sends *the RRCReconfiguration* message to the L2 U2N Relay UE for relaying configuration, which includes at least the L2 U2N Remote UE's local ID and L2 ID, Uu and PC5 Relay RLC channel configuration for relaying, and bearer mapping configuration.

6. The target gNB selects one target Relay UE from the list provided by the source gNB, and sends the HANDOVER REQUEST ACKNOWLEDGE to the source gNB, which contains new RRC configuration for Remote UE.

7. The source gNB sends the *RRCReconfiguration* message to the the L2 U2N Remote UE, which includes at least the target L2 U2N Relay UE ID, Remote UE's local ID, PC5 Relay RLC channel configuration for relay traffic and the associated end-to-end radio bearer(s). The L2 U2N Remote UE stops UP and CP transmission over the (source) indirect path after reception of the RRCReconfiguration message from the source gNB.

8. The source gNB sends the SN STATUS TRANSFER message to the target gNB to convey the uplink PDCP SN receiver status and the downlink PDCP SN transmitter status of the L2 U2N Remote UE's DRBs for which PDCP status preservation applies (i.e. for RLC AM).

9. The L2 U2N Remote UE establishes PC5 connection to target the L2 U2N Relay UE, if not exist.

10. The L2 U2N Remote UE sends the *RRCReconfigurationComplete* message to the target gNB via the target L2 U2N Relay UE.

11. The data path is switched from indirect path to indirect path between the L2 U2N Remote UE and the target gNB via the target L2 U2N Relay UE.

12. The target gNB sends the UE CONTEXT RELEASE to inform the source gNB about the success of the path switch. The source gNB can then release the L2 U2N Remote UE.

13. The source gNB sends the *RRCReconfiguration* message to the source L2 U2N Relay UE to reconfigure the connection between the source L2 U2N Relay UE and the source gNB. The *RRCReconfiguration* message to the L2 U2N Relay UE can be sent any time after step 6 based on source gNB implementation (e.g., to release Uu and PC5 Relay RLC channel configuration for relaying, and bearer mapping configuration related to the L2 U2N Remote UE).

14. Either L2 U2N Relay UE or L2 U2N Remote UE’s AS layer can release PC5-RRC connection and indicates upper layer to release PC5 unicast link after receiving the *RRCReconfiguration* message from the source gNB. The timing to execute link release is up to UE implementation.

NOTE: In order to support the DL lossless handover for the L2 U2N Remote UE, the source gNB may not discard the DL data even though the delivery of the data may be acknowledged by the L2 U2N Relay UE based on the gNB implementation. Then, the source gNB forwards the buffered DL data to the target gNB.