**3GPP TSG-RAN WG3 Meeting #122 R3-237808**

**Chicago, USA, 13th – 17th November 2023**

**Agenda Item: 16.4**

**Source: LG Electronics Inc.**

**Title: (TP for SL Relay BLCR to TS 38.401) Support of multi-path relay**

**Document for: Agreement**

# 1. Introduction

In this paper, a TP is presented to capture some agreements on Multi-path support.

# 7. Appendix: TP for TS 38.401

This appendix provides the Text proposal for TS 38.401 based on the RAN3 agreements.

***----------------Start of the First Change---------------***

# 3 Definitions and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply.
A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

**Associated QoS Flow:** as defined in TS 23.247 [27].

**Associated QoS flow information:** Information encompassing: QoS flow QoS parameters for associated QoS flows and mapping information between mapped (unicast) QoS flows and associated QoS flows. The respective information is included in a way that non-supporting RAN nodes would not establish respective RAN resources irrespective the multicast session state.

**Boundary IAB-node:** anIAB-node with one RRC interface terminating at a different IAB-donor-CU than the F1 interface. This definition applies to partial migration, inter-donor redundancy and inter-donor RLF recovery.

**Conditional Handover:** as defined in TS 38.300 [2].

**Conditional PSCell Addition:** as defined in TS 37.340 [12].

**Conditional PSCell Change:** as defined in TS 37.340 [12].

**DAPS Handover:** as defined in TS 38.300 [2].

**eNB-CP**: as defined in TS 36.401 [28].

**eNB-UP**: as defined in TS 36.401 [28].

**en-gNB**: as defined in TS 37.340 [12].

**Early Data Forwarding**: as defined in TS 38.300 [2].

**F1-terminating IAB-donor of boundary IAB-node**: Refers to the IAB-donor that terminates F1 for the boundary IAB-node.

**gNB:** as defined in TS 38.300 [2].

**gNB Central Unit (gNB-CU):** a logical node hosting RRC, SDAP and PDCP protocols of the gNB or RRC and PDCP protocols of the en-gNB that controls the operation of one or more gNB-DUs. The gNB-CU terminates the F1 interface connected with the gNB-DU.

**gNB Distributed Unit (gNB-DU):** a logical node hosting RLC, MAC and PHY layers of the gNB or en-gNB, and its operation is partly controlled by gNB-CU. One gNB-DU supports one or multiple cells. One cell is supported by only one gNB-DU. The gNB-DU terminates the F1 interface connected with the gNB-CU. For DC operation, the MgNB-DU designates the gNB-DU of an en-gNB or a gNB acting as master node, and the SgNB-DU designates the gNB-DU of an en-gNB or a gNB acting as secondary node.

**gNB-CU-Control Plane (gNB-CU-CP):** a logical node hosting the RRC and the control plane part of the PDCP protocol of the gNB-CU for an en-gNB or a gNB. The gNB-CU-CP terminates the E1 interface connected with the gNB-CU-UP and the F1-C interface connected with the gNB-DU. For DC operation, the MgNB-CU-CP designates the gNB-CU-CP of the gNB-CU for an en-gNB or a gNB acting as master node, and the SgNB-CU-CP designates the gNB-CU-CP of the gNB-CU for an en-gNB or a gNB acting as secondary node.

**gNB-CU-User Plane (gNB-CU-UP):** a logical node hosting the user plane part of the PDCP protocol of the gNB-CU for an en-gNB, and the user plane part of the PDCP protocol and the SDAP protocol of the gNB-CU for a gNB. The gNB-CU-UP terminates the E1 interface connected with the gNB-CU-CP and the F1-U interface connected with the gNB-DU. For DC operation, the MgNB-CU-UP designates the gNB-CU-UP of the gNB-CU for an en-gNB or a gNB acting as master node, and the the SgNB-CU-UP designates the gNB-CU-UP of the gNB-CU for an en-gNB or a gNB acting as secondary node.

**IAB-node**: as defined in TS 38.300 [2].

**IAB-donor**:as defined in TS 38.300 [2].

**IAB-donor-CU**: the gNB-CU of an IAB-donor, terminating the F1 interface towards IAB-nodes and IAB-donor-DU.

**IAB-donor-DU**: the gNB-DU of an IAB-donor, hosting the IAB BAP sublayer (as defined in TS 38.340 [22]), providing wireless backhaul to IAB-nodes.

**IAB-DU**: as defined in TS 38.300 [2].

**IAB-MT**: as defined in TS 38.300 [2].

**IAB Topology**: as defined in TS 38.300 [2].

**Mapped QoS flows:** Unicast QoS flows requested to be established, i.e. included in the legacy QoS flow lists in a way, that non-support RAN nodes would attempt to establish unicast QoS flows and supporting RAN nodes can identify them as mapped QoS flows based on the associated QoS information.

**Master node:** as defined in TS 37.340 [12].

**Master gNB:** see TS 37.340 [12].

**MBS session resource**: This term is used for specification of NG, Xn, F1 and E1 interfaces. It denotes NG-RAN interface and radio resources provided to support an MBS Session.

**MP Relay UE**: as defined in TS 38.300 [2].

**MP Remote UE**: as defined in TS 38.300 [2].

**Multi-path**: as defined in TS 38.300 [2].

**ng-eNB:** as defined in TS 38.300 [2].

**ng-eNB Central Unit (ng-eNB-CU):** as defined in TS 37.470 [21].

**ng-eNB Distributed Unit (ng-eNB-DU):** as defined in TS 37.470 [21].

**ng-eNB-CU-Control Plane (ng-eNB-CU-CP):** a logical node hosting the RRC and the control plane part of the PDCP protocol of the ng-eNB-CU for an ng-eNB. The ng-eNB-CU-CP terminates the E1 interface connected with the ng-eNB-CU-UP and the W1-C interface connected with the ng-eNB-DU.

**ng-eNB-CU-User Plane (ng-eNB-CU-UP):** a logical node hosting the user plane part of the PDCP protocol and the SDAP protocol of the ng-eNB-CU for an ng-eNB. The ng-eNB-CU-UP terminates the E1 interface connected with the ng-eNB-CU-CP and the W1-U interface connected with the ng-eNB-DU.

**NG-RAN node:** as defined in TS 38.300 [2].

**Non-F1-terminating IAB-donor of boundary IAB-node**: Refers to the IAB-donor that has an RRC connection with the boundary node but does not terminate F1 with this boundary node.

**PDU Session Resource**: This term is used for specification of NG, Xn, and E1 interfaces. It denotes NG-RAN interface and radio resources provided to support a PDU Session.

**Public Network Integrated NPN:** as defined in TS 23.501 [3].

**Secondary gNB:** see TS 37.340 [12].

**Stand-alone Non-Public Network:** as defined in TS 23.501 [3].

**U2N Relay UE:** as defined in TS 38.300 [2].

**U2N Remote UE:** as defined in TS 38.300 [2].

## 3.2 Abbreviations

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply.
A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

5GC 5G Core Network

AMF Access and Mobility Management Function

AP Application Protocol

AS Access Stratum

BH Backhaul

CAG Closed Access Group

CHO Conditional Handover

CLI Cross-Link Interference

CM Connection Management

CMAS Commercial Mobile Alert Service

CPA Conditional PSCell Addition

CPC Conditional PSCell Change

DAPS Dual Active Protocol Stack

EM Element Manager

EN-DC E-UTRA-NR Dual Connectivity

ETWS Earthquake and Tsunami Warning System

F1-U F1 User plane interface

F1-C F1 Control plane interface

F1AP F1 Application Protocol

FDD Frequency Division Duplex

FTEID Fully Qualified TEID

GTP-U GPRS Tunnelling Protocol

IAB Integrated Access and Backhaul

IP Internet Protocol

L2 Layer-2

MBS Multicast Broadcast Service

MCG Master Cell Group

MDT Minimization of Drive Tests

MN Master Node

MgNB Master gNB

MP Multi-Path

MRB MBS Radio Bearer

MRDC Multi-Radio Dual Connectivity

N3C Non-3GPP Connection

NAS Non-Access Stratum

NID Network identifier

NPN Non-Public Network

NSA Non Standalone

OAM Operation, Administration and Maintenance

PNI-NPN Public Network Integrated Non-Public Network

PTP Point to Point

PTM Point to Multipoint

PWS Public Warning System

QoE Quality of Experience

QoS Quality of Service

RET Remote Electrical Tilting

RIM Remote Interference Management

RIM-RS Remote Interference Management Reference Signal

RNL Radio Network Layer

RRC Radio Resource Control

SA Standalone

SAP Service Access Point

SCG Secondary Cell Group

SCTP Stream Control Transmission Protocol

SFN System Frame Number

SgNB Secondary gNB

SM Session Management

SMF Session Management Function

SN Secondary Node

SNPN Stand-alone Non-Public Network

SRAP Sidelink Relay Adaptation Protocol

TCE Trace Collection Entity

TDD Time Division Duplex

TDM Time Division Multiplexing

TEID Tunnel Endpoint Identifier

TMA Tower Mounted Amplifier

TNL Transport Network Layer

U2N UE-to-Network

**<<<<<< NEXT CHANGE >>>>>>**

8.xx Overall procedures for multi-path support

8.xx.1 Inter-DU direct path addition on top of indirect path

The signalling flow for inter-DU direct path addition is shown in Figure 8.xx.1-1. This procedure is only applicable to the MP Remote UE using PC5 link.



**Figure 8.xx.1-1: Signalling procedure of inter-DU direct path addition on top of indirect path**

1. The Uu measurement configuration and measurement report signalling is performed between MP Remote UE and gNB-CU to evaluate both relay link measurement and Uu link measurement. The MP Remote UE may report Uu measurement results of neighboring cells and one or multiple candidate MP Relay UE(s).

2. The gNB-CU decides to add the direct path to MP Remote UE under a different gNB-DU (i.e., gNB-DU1). Mode 1 resource configuration cannot be configured for MP Remote UE in inter-gNB-DU multi-path relay in this release.

3. The gNB-CU sends the UE CONTEXT SETUP REQUEST message for the MP Remote UE to the gNB-DU1, which contains at least the direct path configuration.

4. The gNB-DU1 responds to the gNB-CU with a UE CONTEXT SETUP RESPONSE message.

5. The gNB-CU sends an *RRCReconfiguration* message to the MP Relay UE to update the indirect path configuration if necessary.

6. gNB-CU sends the UE CONTEXT MODIFICATION REQUEST message for MP Remote UE by including the *RRCReconfiguration* message to the gNB-DU2. The contents in the *RRCReconfiguration* message may include at least direct path addition configuration, RLC channel configuration, bearer mapping and the associated radio bearer(s).

7. The gNB-DU2 sends the *RRCReconfiguration* message to the MP Remote UE.

8. The gNB-DU2 sends the UE CONTEXT MODIFICATION RESPONSE message to the gNB-CU.

9. The remote UE performs random access procedure at the gNB-DU1.

10. The MP Remote UE sends the *RRCReconfigurationComplete* message to the gNB-DU1 via direct path in order to complete the direct path addition procedure. In case the SRB1 with duplication is configured, the MP Remote UE also sends the *RRCReconfigurationComplete* message to the gNB-DU2 via indirect path.

11. The gNB-DU1 sends the UL RRC MESSAGE TRANSFER message to gNB-CU by including the *RRCReconfigurationComplete* message received in step 10. In case the SRB1 with duplication is configured, the gNB-DU2 also sends the UL RRC MESSAGE TRANSFER message to gNB-CU by including the *RRCReconfigurationComplete* message received in step 10a.

8.xx.2 Inter-DU indirect path addition on top of direct path

The signalling flow for inter-DU indirect path addition is shown in Figure 8.xx.2-1.



**Figure 8.xx.2-1 Signalling procedure of inter-DU indirect path addition on top of direct path**

1. If the MP Remote UE is connected with the MP Relay UE using PC5 link, the Uu measurement configuration and measurement report signalling is performed between MP Remote UE and gNB-CU to evaluate relay link measurement and Uu link measurement. The MP Remote UE may report Uu measurement results of neighboring cells and one or multiple candidate MP Relay UE(s).

 In case that the MP Remote UE is connected with the MP Relay UE using N3C and the MP Relay UE is in RRC\_CONNECTED state, the MP Remote UE reports at least the list of the C-RNTI and the cell ID of one or multiple candidate MP Relay UE(s).

2. The gNB-CU decides to add the indirect path via MP Relay UE to MP Remote UE under a different gNB-DU (i.e., gNB-DU2). Mode 1 resource configuration cannot be configured for MP Remote UE in inter-gNB-DU multi-path relay in this release.

3. The reconfiguration to MP Relay UE is performed among MP Relay UE, gNB-DU2 and gNB-CU if MP Relay UE is in RRC\_CONNECTED state. The gNB-CU sends an *RRCReconfiguration* message to the MP Relay UE. If the MP Relay UE is in RRC\_IDLE/INACTIVE state, this step is skipped.

4. The gNB-CU sends the UE CONTEXT SETUP REQUEST message for the MP Remote UE to the gNB-DU2, which contains the indirect path configuration at least.

5. The gNB-DU2 responds to the gNB-CU with a UE CONTEXT SETUP RESPONSE message.

6. gNB-CU sends the DL RRC MESSAGE TRANSFER message on the direct path for MP Remote UE by including the *RRCReconfiguration* message to gNB-DU1. If the MP Remote UE is connected with the MP Relay UE using the PC5 link, the contents in the *RRCReconfiguration* message may include at least indirect path addition configuration, PC5 RLC channel configuration for relay traffic, bearer mapping and the associated radio bearer(s). If the MP Remote UE is using N3C, the contents in the *RRCReconfiguration* message may include at least indirect path addition configuration, bearer mapping and the associated radio bearer(s).

7. gNB-DU1 sends the *RRCReconfiguration* message to the MP Remote UE.

8. If the MP Remote UE is using the PC5 link, the MP Remote UE establishes PC5 connection with the target MP Relay UE. If the MP Remote UE is connected with the MP Relay UE using N3C, this step is skipped.

9. The MP Remote UE sends the *RRCReconfigurationComplete* message to the gNB-DU1 via direct path in order to complete the indirect path addition procedure. In case the SRB1 with duplication is configured, the MP Remote UE also sends the *RRCReconfigurationComplete* message to the gNB-DU2 via indirect path.

NOTE: In the case that the target MP Relay UE for indirect path addition is in RRC\_IDLE/INACTIVE state, how the MP Remote UE triggers the MP Relay UE to be in RRC\_CONNECTED state is specified in TS 38.300 [2].

10. The gNB-DU1 sends the UL RRC MESSAGE TRANSFER message to gNB-CU by including the *RRCReconfigurationComplete* message received in step 9. In case the SRB1 with duplication is configured, the gNB-DU2 also sends the UL RRC MESSAGE TRANSFER message to gNB-CU by including the *RRCReconfigurationComplete* message received in step 9a.

8.xx.3 Intra-DU direct path addition on top of indirect path

The signaling flow for intra-DU direct path addition is shown in Fig. 8.xx.3-1. This procedure is only applicable to the MP Remote UE using PC5 link.



**Figure 8.xx.3-1: Signalling procedure of intra-DU direct path addition on top of indirect path**

1. The Uu measurement configuration and measurement report signalling is performed between MP Remote UE and gNB-CU to evaluate both relay link measurement and Uu link measurement. The MP Remote UE may report Uu measurement results of neighboring cells and one or multiple candidate MP Relay UE(s).

2. The gNB-CU decides to add the direct path to MP Remote UE under the same gNB-DU.

3. The gNB-CU sends the UE CONTEXT MODIFICATION REQUEST message for the MP Remote UE to the gNB-DU, which contains at least the direct path configuration.

4. The gNB-DU responds to the gNB-CU with a UE CONTEXT MODIFICATION RESPONSE message.

5. The gNB-CU sends an *RRCReconfiguration* message to the MP Relay UE to update the indirect path configuration if necessary.

6. gNB-CU sends the DL RRC MESSAGE TRANSFER message for MP Remote UE by including the *RRCReconfiguration* message to the gNB-DU. The contents in the *RRCReconfiguration* message may include at least direct path addition configuration, RLC channel configuration, bearer mapping and the associated radio bearer(s).

7. The gNB-DU sends the *RRCReconfiguration* message to the MP Remote UE.

8. The MP Remote UE performs random access procedure at the gNB-DU.

9. The MP Remote UE sends the *RRCReconfigurationComplete* message to the gNB-DU via direct path in order to complete the direct path addition procedure. In case the SRB1 with duplication is configured, the *RRCReconfigurationComplete* message is also sent to the gNB-DU via indirect path.

10. The gNB-DU sends the UL RRC MESSAGE TRANSFER message to gNB-CU by including the *RRCReconfigurationComplete* message.

8.xx.4 Intra-DU indirect path addition on top of direct path

The signaling flow for intra-DU indirect path addition is shown in Fig. 8.xx.4-1.



**Figure 8.xx.4-1: Signalling procedure of intra-DU indirect path addition on top of direct path**

1. If the MP Remote UE is connected with the MP Relay UE using PC5 link, the Uu measurement configuration and measurement report signalling is performed between MP Remote UE and gNB-CU to evaluate relay link measurement and Uu link measurement. The MP Remote UE may report Uu measurement results of neighboring cells and one or multiple candidate MP Relay UE(s).

 In case that the MP Remote UE is connected with the MP Relay UE using N3C and the MP Relay UE is in RRC\_CONNECTED state, the MP Remote UE reports at least the list of the C-RNTI and the cell ID of one or multiple candidate MP Relay UE(s).

2. The gNB-CU decides to add the indirect path via MP Relay UE to MP Remote UE under the same gNB-DU.

3. The reconfiguration to MP Relay UE is performed among MP Relay UE, gNB-DU and gNB-CU if MP Relay UE is in RRC\_CONNECTED state. The gNB-CU sends an *RRCReconfiguration* message to the MP Relay UE. If the MP Relay UE is in RRC\_IDLE/INACTIVE state, this step is skipped.

4. The gNB-CU sends the UE CONTEXT MODIFICATION REQUEST message for the MP Remote UE to the gNB-DU, which contains the indirect path configuration at least.

5. The gNB-DU responds to the gNB-CU with a UE CONTEXT MODIFICATION RESPONSE message.

6. gNB-CU sends the DL RRC MESSAGE TRANSFER message for MP Remote UE by including the *RRCReconfiguration* message to gNB-DU. If the MP Remote UE is connected with the MP Relay UE using the PC5 link, the contents in the *RRCReconfiguration* message may include at least indirect path addition configuration, PC5 RLC channel configuration for relay traffic, bearer mapping and the associated radio bearer(s). If the MP Remote UE is using N3C, the contents in the *RRCReconfiguration* message may include at least indirect path addition configuration, bearer mapping and the associated radio bearer(s).

7. gNB-DU sends the *RRCReconfiguration* message to the MP Remote UE.

8. If the MP Remote UE is using the PC5 link, the MP Remote UE establishes PC5 connection with the target MP Relay UE. If the MP Remote UE is using N3C, this step is skipped.

9. The MP Remote UE sends the *RRCReconfigurationComplete* message to the gNB-DU via direct path to complete the indirect path addition procedure. In case the SRB1 with duplication is configured, the *RRCReconfigurationComplete* message is also sent to the gNB-DU via indirect path.

NOTE: In the case that the target MP Relay UE for indirect path addition is in RRC\_IDLE/INACTIVE state, how the MP Remote UE triggers the MP Relay UE to be in RRC\_CONNECTED state is specified in TS 38.300 [2].

10. The gNB-DU sends the UL RRC MESSAGE TRANSFER message to gNB-CU by including the *RRCReconfigurationComplete* message.

***-----------------End of the First Change---------------***