**3GPP TSG-RAN WG2 #119bis-e *R2-221xxxx***

**E-meeting, October 2022**

Agenda Item: 8.9.4

Source: OPPO

Title: Summary of  [AT119bis-e][426][Relay] Control plane aspects for multi-path (OPPO)

Document for: Discussion, Decision

# Introduction

This is for the following offline discussion.

* [AT119bis-e][426][Relay] Control plane aspects for multi-path (OPPO)

Scope: Discuss P11/P12/P18/P19/P20 of R2-2209375, considering applicability to both scenarios 1 and 2.

Intended outcome: Report to CB session

Deadline: Monday 2022-10-17 1700 UTC

# Discussion

## Scenario

For Scenario, two proposals are provided in 09375

*Proposal 11 For scenario-1 of multi-path relay, R2 does not pursue applying multi-path relay to the procedures of SIB delivery, paging delivery, RRC setup/resume and re-establishment.*

*Proposal 12 For scenario-1 of multi-path Relay, R2 focus on the application of multi-path relay to RRC\_CONNCTED UEs only, i.e., after RRC setup/resume / re-establishment procedure.*

Firstly, to check companies view on the applicability of MP-relay for RRC states.

**Q1-1: Do you think multi-path Relay is applicable to RRC\_CONNECTED remote-UE or not?**

|  |  |  |  |
| --- | --- | --- | --- |
| Company | Scenario-1 | Scenario-2 | Comment |
| OPPO | Yes | Yes |  |
| Xiaomi | Yes | Yes |  |
| CATT | Yes | Yes |  |
| Huawei, HiSilicon | Yes | Yes |  |

**Q1-2: Do you think multi-path Relay is applicable to RRC\_INACTIVE remote-UE or not?**

|  |  |  |  |
| --- | --- | --- | --- |
| Company | Scenario-1 | Scenario-2 | Comment |
| OPPO | No | No |  |
| Xiaomi | No | No |  |
| CATT | No | No |  |
| Huawei, HiSilicon | No | No |  |

**Q1-3: Do you think multi-path Relay is applicable to RRC\_IDLE remote-UE or not?**

|  |  |  |  |
| --- | --- | --- | --- |
| Company | Scenario-1 | Scenario-2 | Comment |
| OPPO | No | No |  |
| Xiaomi | NO | NO |  |
| CATT | No | No |  |
| Huawei, HiSilicon | No | No |  |

Secondly, besides the applicability to the dimension of RRC states, to check companies view on the other dimension, i.e., related RRC procedures.

**Q2-1: Do you think R2 needs to enhance R17 mechanism of SIB-delivery for R18 MP Relay?**

|  |  |  |  |
| --- | --- | --- | --- |
| Company | Scenario-1 | Scenario-2 | Comment |
| OPPO | No | No | We do not think MP-Relay is applicable to RRC\_IDLE/RRC\_INACTIVE UEs, where R17 procedure (where the UE can by its implementation to perform the SI reception via direct path besides the indirect path) is sufficient.  Although it is applicable to RRC\_CONNECTED remote UE, we do not think there is a need for specific optimization for it:  If the SIB is delivered via dedicated RRC signaling, then it is a just about split-SRB configuration issue; Or if the SIB is delivered via SIB directly, then UE can acquire the SIB directly if configured with CSS. |
| Xiaomi | FFS | FFS | It’s not clear to us what ‘enhancement’ mean in the question. If we found some thing broken on SIB delivery in multipath, it should be fixed. At this early SI phase, we may need futher study.  [Rapp] If any ‘some thing broken’ identified now? if yes, please clarify  Re: We understand the SIB delivery is only applicable on the path which holds the RRC connection, e.g. anchor path, not on the other path. However, it’s still FFS whether such path differentiation is supported. So, we can’t make conclusion on the SIB delivery for now. |
| CATT | No | No | Agree with OPPO. When the remote UE is configured with multi-path, it is in RRC\_CONNECTED. Therefore, it is not needed to receive SIB/paging forward from the relay UE. |
| Huawei, HiSlicon | No | No | In Rel-17, no SIB deliver for connected Remote UE. We do not foresee any new requirement to enhance this/other aspects related to SIB forwarding for multipath. |

**Q2-2: Do you think R2 needs to enhance R17 mechanism of Paging-delivery for R18 MP Relay?**

|  |  |  |  |
| --- | --- | --- | --- |
| Company | Scenario-1 | Scenario-2 | Comment |
| OPPO | No | No | Since we do not think MP-Relay is applicable to RRC\_IDLE/RRC\_INACTIVE UEs, where R17 procedure (where the UE performs the paging reception via a single path) is sufficient. |
| Xiaomi | No | No | Paging is not applicable for CONNECTED remote UE. |
| CATT | No | No | Multi-path is only applied for the remote UE in RRC\_CONNECTED. Paging forward is not needed. |
| Huawei, HiSilicon | No | No |  |

**Q2-3: Do you think R2 needs to enhance R17 mechanism of RRC setup/resume/re-establishment procedure for R18 MP Relay?**

|  |  |  |  |
| --- | --- | --- | --- |
| Company | Scenario-1 | Scenario-2 | Comment |
| OPPO | No | No | R17 procedure (where the UE performs the RRC procedure via a single path) is sufficient. |
| Xiaomi | No for remote UE | No for remote UE | For remote UE, MP is not established during initial access.  For relay UE, we may need further study. If relay UE in IDLE/INACTIVE can be selected during MP addition as in Q4-1, we need to study how to trigger relay UE enter CONNECTED. Legacy procedure may be enhanced. |
| CATT | No for remote UE | No for remote UE | Agree with Xiaomi. Enhancement is needed on how to trigger relay UE in IDLE/INACTIVE enter CONNECTED. |
| Huawei, HiSilicon |  |  | Not so sure about the question, if the only connected UE can be configured with multiple path, the RRC setup/re-establishment/resume procedures seem not relevant. |

## PCell configuration

For Pcell configuration, one proposal is provided in 09375

*Proposal 18 For scenario-1 of multi-path Relay, PCell is always configured on the direct path when configured.*

**Q3: For UEs operating in MP Relay, if the two paths are for different cells, which case(s) is a valid case?**

**Case-1: The cell of direct path is PCell of the UE**

**Case-2: The cell of indirect path is PCell of the UE**

|  |  |  |  |
| --- | --- | --- | --- |
| Company | Scenario-1 | Scenario-2 | Comment |
| OPPO | Case-1 | Case-1 | If we put PCell on direct path, it means Uu interface is only with SCell, which did not happen before, and the problem is how to perform RACH, PUCCH reporting and RLM, which relies on the existence of PCell based on the current spec. |
| Xiaomi | Both | Both | In R17, it’s already supported the PCell is on the indirect path, since it’s the only way.  [Rapp comment] this Q is limited to ‘**For UEs operating in MP Relay**’, R17 is limited to single (indirect) path case.  In addition, direct path can be added to improve thoughput. In this case, it’s not CA between direct and indirect path. It’s more like DC structure. There should be one cell on the direct path acting as PSCell.  The motiviation of PCell on indirect path is to improve the reliability. Remote UE is expected at the cell edge, according to the Uu threshold condition. The indirect path may be more reliable at cell edge. If the associated cell of direct path and indirect path is different, it may be more reliable to put PCell on indirect path.  [Rapp comment] although might be anyway inevitable, still suggest to provide argument besides the DC-modelling / CP P/S-path thing which is a bit controversial at the current stage.. |
| CATT | Both | Case-1 | For scenario-1, in Rel-17, remote UE’s PCell is the serving cell of relay UE. For MP. For the case addition of direct path over indirect path, PCell should be the cell of indirect path. Remote UE should not change the MAC-I in path add/modification procedure. |
| Huawei, HiSilicon | Ask for clarification | Ask for clarification | We would like to better understand the question. In the original proposal 18, when it says PCell is “configured”, does it imply PCell change procedure? Because during other cases like RRC setup/re-establishment/resume, the UE takes the cell/Pcell of the connected Relay UE ( via which the RRC procedure is initated) as PCell, which is not configured by network. |

## Path Switching

R2 reached the conclusion as follows

Agreements:

Proposal 1-1A (modified): The following cases are to be supported for Scenario 1.

A. The remote UE operating only on the direct path adds the indirect path under the same gNB;

B. The remote UE operating only on the indirect path adds the direct path under the same gNB;

C. The remote UE operating in multi-path releases the indirect path;

D. The remote UE operating in multi-path releases the direct path;

G. The remote UE operating in multi-path changes to a new relay UE for the indirect path while keeping the direct path under the same gNB. FFS if this case would be supported via separate release-and-add (A+C in separate reconfigurations) or a single switch procedure (e.g. similar to i2i service continuity).

Proposal 1-1B (modified): The following case is to be not supported for Scenario 1 as a group mobility scenario.

F. The remote UE configured with multi-path keeps the serving relay UE for the indirect path and the serving cell of the remote UE for the direct path while the serving relay UE changes the serving cell of the relay UE under the same gNB;

Agreement:

The following case can be supported via separate release-and-add for scenario 1 (B+D in separate reconfigurations):

E. The remote UE operating in multi-path changes the direct path to a different cell of the same gNB while using the serving relay UE for the indirect path under the same gNB.

FFS if a single procedure for this case would be supported.

Agreements:

Proposal 1-2A: The following cases are proposed to be supported for Scenario 2.

A. The remote UE configured only on the direct path adds the indirect path under the same gNB;

C. The remote UE configured with multi-path releases the indirect path;

Proposal 1-2B: The following case is proposed to be not supported for Scenario 2.

F. The remote UE configured with multi-path keeps the serving relay UE for the indirect path and the serving cell of the remote UE for the direct path while the serving relay UE changes the serving cell of the relay UE under the same gNB;

Proposal 1-2C: Whether to support the following case can be further discussed for Scenario 2.

B. The remote UE configured only on the indirect path adds the direct path under the same gNB;

D. The remote UE configured with multi-path releases the direct path;

E. The remote UE configured with multi-path changes the serving cell of the remote UE for the direct path while keeping the serving relay UE for the indirect path under the same gNB;

G. The remote UE configured with multi-path changes to a new relay UE for the indirect path while keeping the direct path under the same gNB.

One proposal is provided in 09375

*Proposal 19 For scenario-1 of multi-path Relay, in case of path switching, a RRC\_IDLE/RRC\_INACTIVE Relay UE initiates RRC connection establishment procedure upon the message received from a Remote UE via SL-RLC, not limited to SL-RLC0/1.*

**Q4-1: For R18 MP Relay, for the supported path switching scenario (which scenarios to support is up to the specific discussion on scenarios), when there is an addition of indirect path or a change of indirect path, do you agree to support RRC\_IDLE/RRC\_INACTIVE target relay UE?**

|  |  |  |  |
| --- | --- | --- | --- |
| Company | Scenario-1 | Scenario-2 | Comment |
| OPPO | Yes | Yes | Same as in R17. |
| Xiaomi | Yes | Yes |  |
| CATT | Yes | Yes |  |
| Huawei, HiSilicon | Yes | No | For scenario 2, no need to consider the case relay UE is not in RRC connected, because before network configures relay UE to the remote UE, it needs to know and verify the relation between remote UE and relay UE, which means the relay UE should have been connected to the network already. |

**Q4-2: If Yes to Q4-1, how to trigger the RRC\_IDLE/RRC\_INACTIVE target relay UE to initiate RRC connection establishment procedure?**

**Option-1: Upon the message received from a Remote UE via SL-RLC, not limited to SL-RLC1**

**Option-2: Other (please clarify the solution if this is selected)**

**Option-3: Upon the indication/configuration received from a remote UE, e.g. indication/configuration in *RRCReconfigurationSidelink message***

**Option-4: gNB configures *RRCReconfigurationComplete* message deliverd via indirect path, e.g. configure duplication of SRB1 or change the primary RLC entity of SRB1 to indirect RLC entity.**

**Option-5: During discovery/PC5 unicast establishment for multi-path**

|  |  |  |  |
| --- | --- | --- | --- |
| Company | Scenario-1 | Scenario-2 | Comment |
| OPPO | 1 | 2 (Up to UE implementation) | For Sce-1: in R17, it is limited to SL-RLC1, yet for MP Relay, since SRB1 may not be configured at indirect path, it does not have to be limited to it.  For Sce-2: Since UE-to-UE link is a blackbox, maybe OK to leave it to UE implementation. |
| Xiaomi | 3 | Up to implementation | If relay UE is in IDLE/INACTIVE, NW can send essential multipath configuration to relay UE via remote UE during MP addition. Remote UE can forward the configuration via *RRCReconfigurationSidelink* message to relay UE. Upon reception of the configuration, relay UE can enter CONNECTED. |
| CATT | 4 or 3 | Up to implementation | Both 4 and 3 can trigger RRC\_IDLE/RRC\_INACTIVE target relay UE to initiate RRC connection establishment procedure. |
| Huawei, HiSilicon | 5 | Up to implementation | For scenario 1, according to what we learn from SA2 discussion, the relay UE needs to advertise it support multi-path via service code in discovery message, so when the remote UE establishes PC5 unicast link with the relay UE, the relay UE already knows the access is for multi-path service, then it should enter connected state.  For scenario 2, if the remote UE want to leverage multi-path, it can inform the relay UE to enter connected state on the non-3GPP interface, the detailed method is left to UE implementation. |

## RLM/RLF

One proposal is provided in 09375

*Proposal 20 For scenario-1 of multi-path Relay, UE performs RLM on both direct and indirect path.*

When UE operating in MP Relay, which path(s) to perform RLM?

|  |  |  |  |
| --- | --- | --- | --- |
| Company | Scenario-1 | Scenario-2 | Comment |
| OPPO | Uu + PC5 | Uu, and UE-UE link is left to UE implementation | For Scenario-1, it is clear and it is just to follow legacy procedure.  For Scenario-2, the handling of UE-UE link is a blackbox, so the key issue is whether/how to handle if there is some ‘failure’ like event at UE-UE link, yet no need to dig into the need of RLM though. |
| Xiaomi | Both | At least Uu | Although the RLM is performed on both link, the consequence of RLF on either path may be different. Note in legacy, UE would trigger RRC reestablishment if the RLF occurs on the only direct or indirect path. However, in multipath, RLF on one path may not trigger RRC reestablishment, if the path is only responsible for DRB transmission.  For scenario, whether ideal connection could fail can be clarified. |
| CATT | Both direct and indirect path | At least direct path. | For Scenario-1, reuse legacy procedure.  For Scenario-2, RLM for ideal link is up to UE implementation |
| Huawei, HiSilicon | Both | Uu | For scenario 1, the RLM on both paths are possible, but the detailed discussion also relates to the specific cases, e.g. whether the Uu Cell is PCell or not. |

1. xxx.

# Conclusion

We have the following proposals:

[Proposal 1 xxx.](#_Toc116550638)

# Reference

1. xxx