**3GPP T****SG-RAN WG2 Meeting #124 *R2-23xxxxx***

**Chicago, USA, Nov. 13th – 17th, 2023**

**Agenda item: 7.9.1**

**Source: Huawei, HiSilicon**

**Title: RRC open issues for Rel-18 Multi-path**

**Document for: Discussion**

1. Introduction

During running CR drafting and updating, some open issues were identified. In this contribution, the open issue list is provided which can be taken as a reference for further discussion and issue tracking.

1. Discussion

## Table 1: the existing open issues

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| --- | --- | --- |
| Issue no. | Issue description and status | Rapporteur’s suggestion |
| Issue#1. **Terminologies/definitions** of Multi-path, SL indirect path, N3C indirect path. (Common to scenario 1 and scenario 2) | After initial offline among WI CR editors and the post email discussion on [Post123][413] RRC CR for MP relay, the following definitions are captured in the endorsed CR R2-2309310:   |  | | --- | | **Multi-path:** Mode of operation of a remote UE in RRC\_CONNECTED configured with one direct path on which the UE connects to gNB using NR Uu, and one indirect path on which the UE connects to the same gNB via a relay UE using L2 U2N relay operation or non-3GPP connectivity.  **N3C indirect path:** In multi-path, the indirect path on which the remote UE connects to network via a relay UE using non-3GPP connectivity.  **SL indirect path:** In Multi-path, the indirect path on which the L2 U2N Remote UE connects to network via a L2 U2N Relay UE. |   It was observed that some companies may still have comments on the wording, and there is misalignment between stage 2 CR and RRC CR. For instance, L2 U2N Relay/relay UE on indirect path is used in RRC CR, but MP relay UE is used instead in stage 2 CR, thus some companies propose to add the definition of MP relay UE in RRC as well. | Continue the discussion during CR update.  Offline among WI CR editors should continue, in order to align the wording in stage 2 CR and stage 3 CRs. |
| Issue#2. Whether the PC5 unicast link can be maintained during **direct path addition/release** and **direct path change without indirect path change** procedures. (Scenario 1 only) | The issue has impact on RRC spec, i.e. when the Remote UE receives the direct path addition/release command or direct path change without indirect path change command, if it maintains the indirect path by default, the SL configurations in source side will be taken as baseline, on top of which the target configuration applied. But this kind of handling may not work in case of security update during the path management procedures.  In email discussion [Post123][407], it is assumed the source PC5 link will be maintained during direct path addition, but whether/how it can be maintained in all cases has not be discussed/confirmed, thus some dedicated discussion is needed. | The issue is not covered by post email discussion, thus dedicated discussion is needed. |
| Issue#3. Which PC5-RRC message to bring idle/inactive relay UE to connected state, and the new T420-like timer handling during **indirect path addition/change**. (Scenario 1 only) | This issue is under discussion in [Post123][407]. | The issue is covered by [Post123][407] already. |
| Issue#4. Which message is used for **indirect path failure reporting.** (Common to scenario 1 and scenario 2) | This issue has been discussed in previous meeting, but no conclusion was achieved, the following options are on table:  1. indirect path failure is reported via the *MCGFailureInformation* message  2. indirect path failure is reported via the *SidelinkUEInformationNR* message  3. indirect path failure is reported via a new message | The issue is not covered by any post email discussion now, thus further down-selection is needed. |
| Issue#5. Editor’s Note: FFS how to handle relayUE-HO. (Scenario 1 only) | The issue has been discussed in previous meeting, but no consensus was achieved. The options on table include:  Option 1: NW ensures that before relay UE’s HO, the indirect path is released at remote UE.  Option 2: relay UE indicates Uu HO in notification message to remote UE in Rel-17 way, and remote UE can suspend indirect path and wait for NW reconfiguration. | The issue is not covered by any post email discussion now, thus further down-selection is needed. |
| Issue#6. Which message is used to report relay UE in scenario 2, and whether multiple relay UEs can be reported. (Scenario 2 only) | This issue has not been discussed in previous meetings. The candidates may include:  1. relay UE(s) is reported via UE information procedure.  2. relay UE(s) is reported via UE Assistance Information.  3. relay UE(s) is reported via measurement reporting. | The issue is not covered by any post email discussion now, thus dedicated discussion is needed. |
| Issue#7. Whether/how idle/inactive relay UE can be reported in scenario 2. (Scenario 2 only) | This issue has been discussed in previous meetings, but no conclusion was achieved. If the reporting is allowed, which UE ID to be reported, there are following options:  1. S-TMSI for idle relay UEs, and I-RNTI for inactive relay UEs.  2. new UE IDs. | The issue is not covered by any post email discussion now, thus further discussion is needed in next meeting. |

## Table 2: collect companies views on other/more open issues

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| --- | --- | --- |
| Company name | Issue description | Comments or suggestions |
| Xiaomi | Whether UE can report available candidate relay UE measurement result in indirect path failure recovery message. Which message can be used is covered by issue#4. | If direct path fails, UE can report available cell measurement result in MFI. So that NW can choose the appropriate cell to perform direct path recovery, e.g. direct path change. Following the same logic, UE shall be able to report available relay UE measurement result during indirect path failure recovery message. So that NW can choose the appropriate relay UE to perform indirect path recovery, e.g. indirect path change.  [Lenovo] We have same view as Xiaomi which align with the legacy principle. |
| Xiaomi | How relay UE forward SIB1 in MP.  In R17, relay UE would forward SIB1 in unsolicited way according to following spec,  ‘The L2 U2N Relay UE initiates the Uu message transfer procedure when at least one of the following conditions is met:  …  1> upon unsolicited SIB1 forwarding to the connected L2 U2N Remote UE or upon receiving the updated *SIB1* from network;’  However, in MP, the serving cell of remote UE and relay UE may be different. The forwarded SIB1 is useless and result in additional signaling overhead. | If remote UE’s serving cell is different from relay UE’s serving cell, relay UE doesn’t forward SIB1 to remote UE. Relay UE can acquire remote UE’s serving cell ID in discovery message by implementation. |
| Sharp | Redundant report of *ConfigFailure* during T4xx  T4xx is stopped upon reception of *RRCReconfigurationCompleteSidelink* message.  However, *RRCReconfigurationFailureSidelink* could also be received during T4xx is running..  It results reporting *ConfigFailure* to NW by *SidelinkUEInformation*.  After that, when T4xx is expired, Indirect path failure information is used to report failure type t4xx-Expiry to NW.  So the report of *ConfigFailure* during T4xx is running is redundant. | Restrict the report of *ConfigFailure* only when T4xx is not running.  5.8.9.1.8 Reception of an *RRCReconfigurationFailureSidelink* by the UE  The UE shall perform the following actions upon reception of the *RRCReconfigurationFailureSidelink*:  1> stop timer T400 for the destination, if running;  1> continue using the configuration used prior to corresponding *RRCReconfigurationSidelink* message;  1> if UE is in RRC\_CONNECTED:  2> perform the sidelink UE information for NR sidelink communication procedure, as specified in 5.8.3.3 if T4xx is not running or clause 5.10.15 in TS 36.331 [10]; |
| Sharp | According to the CR, the relay UE is always released if *sl-IndiretPathAddChange* is released.    A UE configured with MP could experience the direct-to-indirect path switch. In this case, *sl-IndiretPathAddChange* has to be released, However, the target relay UE could be the same as the source relay UE.  The release of the source relay UE is no necessary in this case, and it could be kept. | The relay UE could be identified to avoid unnecessary release.  1> else if *sl-IndirectPathAddChange* is set to *release*:  2> consider the SL indirect path is released and release the corresponding configurations;  2> indicate to upper layer (to trigger the PC5 unicast link release) with the L2 U2N Relay UE which identity is different from the identity included in *sl-PathSwitchConfig*. |
| NEC | How to identify Rel-17 relay UE by gNB since PC5 based method is only available for Rel-18 relay UE in idle/inactive?  Rel-17 relay UE doesn’t support PC5 based method for trigging idle/inactive relay UE to entering RRC connected. | This issue has been discussed in previous meetings, but no conclusion was achieved. And it is not covered by any post email discussion now, thus further discussion is needed in next meeting. |
| Samsung | #Issue 1   * A. Non-3GPP connectivity vs. non-3GPP connection * B. Relay UE with N3C indirect path | 1. In most of places of RRC, “non-3GPP connection” is used. However, two places (i.e., definitions of multi-path and N3C indirect path) use “non-3GPP connectivity”. It is better to align. 2. Company suggest to use “relay UE N3C indirect path”. How about use a short name with similar format as Rel-17, e.g., N3C relay UE, N3C remote UE. Meanwhile, in section 3.1, we can add the definitions. |
| Samsung | #Issue 5   * Handling of relayUE-HO | This issue is also applicable for scenario 2. |
| Samsung | Triggering of indirect path failure information, which includes in Clause 5.7.3c.2 of current running CR:   * upon detecting a SL indirect path failure, including sidelink radio link failure on the PC5 unicast link or Uu failure of the L2 U2N Relay UE; * upon detecting a N3C indirect path failure, including N3C connection failure and Uu radio link failure of the relay UE with N3C indirect path | Some triggering is missing, e.g.,   * T4xx expiry * receiving NotificationMessageSidelink message with indicationType of relayUE-HO, relayUE-CellReselection, relayUE-Uu-RRC-Failure   According to the setting of failureTypeIndirectPath IE, the failure can be also caused by two cases, 1) receiving NotificationMessageSidelink message, 2) cell change.   * The case of “cell change” can be covered by “receiving NotificationMessageSidelink”. |
| Lenovo | Regarding the case of the direct path addition after UE has the indirect path already, the failure may happen in the PC5 link or Uu interface of the indirect path. Specifically, the remote UE may receive the notification message from relay UE due to e.g Uu RLF in the indirect path when UE is performing the direct path addition procedure. Or the remote UE may detect RLF on PC5 link in the first path when UE is performing the second direct path addition procedure. Same situation happens in direct path change case. | Suggest to discuss the case that the remote UE detects PC5 RLF or receives the notification message/PC5 unicast release message from relay UE when UE is performing the direct path addition/change procedure. |
| Lenovo | The RLF may happen in the direct path during indirect path addition/change. Specifically, when the timer for the indirect path addition/change is running, the remote UE detects RLF on direct path. | Suggest to discuss this case that RLF on direct path is declared when UE is performing indirect path addition/change. |
| CATT | In the last RAN2 meeting, the following working assumption is reached:  Working assumption:  Rel-17 relay UEs can be considered as candidate target UEs for MP procedures.  If this working assumption can be confirmed, it should further discuss whether enhancement is needed to help the gNB decide when to use the new PC5-RRC signaling to trigger IDLE/INACTIVE relay UE enter CONNECTED. | Further discussion on this issue is needed in the next meeting to determine whether gNB should be aware of the relay UE’s release. |
| CATT | In Uu CA, SCell activation/deactivation was introduced for further power saving, whether path activation/deactivation should be introduction for MP case for better power saving? | This issue has not been discussed, it had better discuss this in the next meeting to conclude on this issue. |
| Lenovo | In Rel-17, we handle the cases including relayUE-Uu-RLF, relayUE-HO, relayUE-CellReselection relayUE-Uu-RRC-Failure related to notification message. Only relayUE-CellReselection was discussed and concluded as follows. We need to further cover the remaining cases including relayUE-Uu-RLF, relayUE-HO, relayUE-Uu-RRC-Failure since RAN2 think it is normal case rather than rare case.  *upon the MP relay UE cell change to a different cell from the target cell commanded by the gNB, the remote UE considers that there has been an indirect path change/addition failure.* | Suggest to discuss the case that the remote UE receives notification message due to relayUE-Uu-RLF, relayUE-HO, relayUE-Uu-RRC-Failure when UE is performing indirect path addition/change. |
| InterDigital | In RAN2#119bis-e, it was agreed to support release of both the direct path and indirect path:  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;  In the running CR, the network can release the indirect path, but it seems a direct path release cannot be performed in a single step. | To be consistent, it would be preferable to have a similar approach for the direct path as for the indirect path (i.e., *sl-IndirectPathAddChange is set to release*) |
| Lenovo | Before indirect path is added for MP case, the UE maintains a C-RNTI. Then, the gNB sends the *RRCReconfiguration* message to the L2 Remote UE to add an indirect path on top of a direct path. Referring to Configuration of SL indirect path in the running CR (38.331), the network provides L2 U2N Remote UE configuration as specified in 5.3.5.16. according to RRC specification, a C-RNTI is mandatorily indicated to the L2 U2N Remote UE in the first *RRCReconfiguration*. The UE may be allocated two different C-RNTIs till this step. While in legacy, there is only one C-RNTI maintained in a single MAC entity. | To discuss whether the second C-RNTI is needed for indirect path addition. |

1. Conclusion

Based on the above discussion, the proposals are:

* **TBD**

1. References

[1] R2-23xxxxx, RRC Running CR for Rel-18 Multi-path, Huawei HiSilicon.