**3GPP TSG-RAN WG2 Meeting #113bis electronic** **R2-2104406**

**Online, April 12th – 20th, 2021**

**Agenda item: 8.7.4.2**

**Source: Futurewei**

**Title: Report of [AT113bis-e][604][Relay] Proposals from summary of agenda item 8.7.4.2**

**Document for: Discussion and Decision**

# Introduction

This document is to report the outcome of the following email discussion in RAN2#113bis-e Meeting.

**[AT113bis-e][604][Relay] Proposals from summary of agenda item 8.7.4.2 (Futurewei)**

Scope: Continue discussion of the summary of AI 8.7.4.2 and try to reach agreeable proposals.

Intended outcome: Report in R2-2104406

Deadline:  Friday 2021-04-16 1000 UTC

The email discussion takes the summary document of agenda item 8.7.4.2 [1] as starting point, and extends the discussion to invite companies’ view if the proposals in [1] are agreeable.

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| Intel |  |

# Adaptation Layer over PC5

It is almost evenly split among companies on whether or not adaptation layer should be specified over PC5 in Rel-17. Hence, an online discussion seems inevitable. Companies are, however, invited to state their preference, and to suggest wayforward to be considered. For example, the moderator is wondering if concerns of specification workload and additional UE implementation can be alleviated by limiting PC5 adaptation layer to be of similar PDU format (e.g., header content, control PDU) and functionalities as Uu adaptation layer.

**Proposal 1:** RAN2 to discuss and decide if adaptation layer over PC5 should be specified in Rel-17.

**Question 1:** Is Proposal 1 agreeable?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (preference & possible wayforward)** |
| Futurewei | Yes | It may be considered to limit PC5 adaptation layer to be of similar PDU format (e.g., header content, control PDU) and functionalities as Uu adaptation layer, in a way to address concerns of specification workload and additional UE implementation. |
| OPPO | Yes | We are OK to have this discussion.  For the view, from rapporteur perspective, we observe both proposals on having and not having adaptation layer over PC5 hop, so propose to make it configurable as compromise way-out. And we are OK to introduce UE capability on the support of adaptation layer over PC5 hop so that it is optional for UE to support it. |
| MediaTek | Yes | We support to discuss and decide the adaptation layer over PC5.  With regard to the preference and possible way forward: we support to have the adaptation layer over PC5.  As summarized in R2-2104505, the need of adaptation layer over PC5 is below:   1. Support N:1 mapping for remote UE Uu bearer to PC5 RLC channel; 2. Consistent support of multi-hop relay in a forward compatibility way; 3. Differentiated handling between non-relaying traffic and relaying traffic, e.g., exchanging adaptation layer control PDUs about link status between remote UE and relay UE; 4. Remote UE may also operate as relay UE, and should support Uu adaptation layer anyway.   Especially, the maximum number of SL RLC channels over a PC5 is smaller than the maximum number of DRBs over Uu. Hence N:1 mapping between Uu bearer and PC5 RLC channels should be supported.  Meanwhile, we see the value of the proposal from WI rapporteur (i.e. OPPO) to make PC5 adaptation layer configurable. This can be also a way forward. |
| Qualcomm | Yes/No (see comments) | We are confused with this question. The question is about whether to agree discussion of PC5 adaptation layer? Isn’t it been discussed in SI phase and has continued in WI phase? So, we are not sure to answer Yes or No.  With regarding to moderator mentioned way-forward, our suggestion to make progress on this controversial topic:   1. Make it clear the functionality of PC5 adaptation layer (if support in this release). Here, we want to remind companies to respect WID objective:   The objective of this work item is to specify solutions to enable single-hop, sidelink-based, L2 and L3 based UE-to-Network (U2N) relaying.  Work Item objectives specific to Layer-2 (L2) relaying:   1. Specify mechanisms for U2N **Adaptation layer design** [RAN2]   a. For bearer mapping and Remote UE identification, incl. RAN related security aspects if any  So, it is clear only single-hop and only bearer mapping and remote UE identification is in scope of this release. We think it is important to respect the WID objective and not discuss functionality beyond it (e.g. flow control)   1. Following 1), remote UE identification is not necessary for single-hop U2N because it is impossible to multiplex two different remote UEs’ SRB/DRB into one PC5 RLC at least in uplink direction. Therefore, it seems only N:1 bearer mapping can be considered. Thus, we suggest RAN2 to decide whether to adopt PC5 adaptation layer based on only whether to support N:1 bearer mapping (from remote UE Uu bearer to PC5 RLC/LCH) 2. For OPPO’s suggestion on configurable and UE capability, we think RAN2 should list it as a candidate solution on the table. We are fine to further consider/discuss it |
| Samsung | Yes but… | We share some of the same understanding as Qualcomm as to the value of this proposal. We additionally feel that Adapt over PC5 is not at the top of our priorities list.  And finally, while we appreciate the moderator’s suggestions for alleviating some of the concerns, from what we have seen however, many companies (ourselves included) simply do not think there is a valid technical reason for an adaptation layer on PC5 – and moderator’s suggestions to not seem to cater to this major concern. Specification workload – while important – is not the only concern. |
| vivo | Yes to discuss but | Same comment with Qualcomm and Samsung about this question intention.  To us, ok to have this discussion but we don’t think adaptation layer over PC5 is necessary.  From our point of view, the main motivation is to support bearer mapping between PC5 RLC bearer and remote UE E2E Uu bearer which is not necessary since U2N may not be a mainstream of deployment scenarios but just a supplement and no need to support all of Uu service types or maximum combination, e.g. 32 RBs simultaneously or URLLC service, therefore the current maximum number of radio bearer should be enough to cover the cases. |
| Huawei, HiSilicon |  | **We should use this offline email to have a quick voting.** |
| Xiaomi |  | **Agree with QC.** |
| Lenovo&MM | Yes | Obviously, whether adaptation layer is added over PC5 should be discussed. |
| Nokia | No | Our view is that it is not necessary for Rel-17: multi-hop support is out of the scope of Rel-17, and the N:1 bearer mapping is a nice to have feature. It was agreed at the WI discussion that RAN2 only specifies the necessary functions in Rel-17. We do not think that Uu adaptation layer can be re-used over PC5. |
| Sharp | Yes |  |
| ZTE | Yes | In order to support N:1 bearer mapping between remote UE’s SRB/DRB and PC5 RLC bearer, it is necessary to support the PC5 adaptation layer. In addition, the PC5 adaptation layer may be needed for forward compatibility for multi-hop relay in the future release. |
| Ericsson | Yes | Agree with QC, this question doesn’t give much outcome. It would be better to directly ask companies views on whether adaptation layer shall be support on PC5 interface.  We support to apply adaptation layer on PC5 interface, due to reasons   1. remote UE may work as relay UE 2. beneficial to support control PDU if adaptation layer is in place at PC5 interface.   In addition, we think adaptation layer on PC5 interface shall be always supported, it is unnecessary to add configurability, which would just add unnecessary complexity. |
| InterDigital | Yes | We are ok to discuss. As for a way forward, we think a compromise of allowing this to be attached to UE capability may be an acceptable way forward. |
| CMCC | Yes | We support to discuss and decide the adaptation layer over PC5.  Furthermore, we support to have the adaptation layer over PC5. |
| LG | Yes to discuss but, | We can discuss this issue during the meeting, but we think the adaptation layer over PC5 is unnecessary in this release. According to the WID objective, only single-hop is considered in this release. The adaptation layer over PC5 is valuable for multi-hop cases. We think the PC5 adaptation layer is not an essential function, so it’s better to focus on the scope of WID objective. |
| Spreadtrum | NO | This issue was discussed during SI phase and we think no further on-line discussion is needed. Furthermore, we don’t support adaptation layer over PC5. |
| Intel | Yes with comment | We understand the need for the adaptation layer as the mapping has to be done; this function can either be done at PDCP or a basic adaptation layer is defined with not much functionality other than 1:1 mapping. This ensures that the specification impact is limited to primarily specifying adaptation layer and it is also future-proof to support extensibility. Therefore, we see the following possible options:  Option-1: PC5 Adaptation layer with 1:1 mapping function and no adaptation layer header.  Option-2: No PC5 Adaptation layer and 1:1 mapping function supported at PDCP layer.  Option-3: PC5 Adaptation layer with N:1 mapping function. |

**Proposal 2:** Send LS to SA2 to inform them of the final protocol stack of L2 UE to Network relay.

**Question 2:** Is Proposal 2 agreeable?

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Futurewei | Yes |  |
| OPPO |  | No strong view: according to the experience at study phase, SA2 and RAN2 can always sync by reading agreement/minutes and so far the stack-figure in SA2 TR/spec have been aligned in that way. |
| MediaTek | Yes |  |
| Qualcomm | Yes | Informing SA2 is fine to us |
| Samsung | Yes but… | We assume that by ‘final protocol stack’ the rapporteur is referring to the stack once agreement on P1 is reached, and since this may not happen at this meeting, perhaps this proposal (P2) can wait? |
| vivo | Yes | If we can converge on P1 then it is OK to us to inform SA2. |
| Huawei, HiSilicon | Yes | This is SA2 related issue. We should treat this cross-WGs issue with high priority. |
| Xiaomi | Yes |  |
| Lenovo&MM | Yes |  |
| Nokia | No | Unless we have a specific question to SA2, no LS is needed. Normally WGs do not send LSs just for information about the progress. |
| Sharp | Yes |  |
| ZTE | Yes |  |
| Ericsson | Yes |  |
| InterDigital | Yes |  |
| CMCC | Yes |  |
| LG | Yes |  |
| Spreadtrum | Yes |  |
| Intel | Yes | Once we agree upon the end-to-end protocol stack, we can share with SA2. |

# Adaptation Layer over Uu

## Adaptation Layer Header

**Proposal 3:** For both DL and UL transmission of Uu radio bearers other than SRB0, identity information of a remote UE and its Uu radio bearer are included in the header of adaptation layer over Uu. FFS for SRB0.

**Question 3:** Is Proposal 3 agreeable?

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Futurewei | Yes |  |
| OPPO | Yes |  |
| MediaTek | Yes |  |
| Qualcomm | Yes, but… | We agree with the intention of proposal 3. But there is proposal from multiple companies (e.g. [9] [10] [12] in summary report) to make adaptation layer header configurable (similar to SDAP header). For example, it can be configured as absent if it is 1:1 bearer mapping with one Remote UE per Relay UE. We want moderator’s confirmation that Proposal 3 doesn’t preclude such configurability discussion, i.e. Proposal 3 is applicable for the case that Uu adaptation layer header is present. |
| Samsung | Yes but… | Same view as Qualcomm.  We raised the configurability issue in the pre-meeting discussion, but the rapporteur was of the view that the only reasonable proposal at this stage on the configurability of adaptation layer header is for “RAN2 to discuss …”. And that (apparently) a decision on this is ‘not urgent’ for this meeting. [This is now at odds with approach to Proposal 1, which is also “to discuss…”.]  Much like Qualcomm, we would like it captured that P3 does not preclude configurability. |
| vivo | Yes | We can discuss about the configurability and if it can be agreed then this proposal can be re-formulated as ‘*For both DL and UL transmission of Uu radio bearers other than SRB0, identity information of a remote UE and its Uu radio bearer are included in the header of adaptation layer (if configured) over Uu. FFS for SRB0*. |
| Huawei, HiSilicon | Yes | For the concern of absent of adaption header, it is separate issue which is not impacted by this proposal. For sure, the proposal only applies to the case with adaptation header. |
| Xiaomi | Yes |  |
| Lenovo&MM | Yes but | For both DL and UL, identity information of a remote UE and its bearer are included in the header of adaptation layer over Uu. And, the receiving node can identify the remote UE’s bearer based on the one-to-one bearer mapping configuration. Therefore, bearer ID could be optional in the header. |
| Nokia | Yes |  |
| Sharp | Yes |  |
| ZTE | Yes |  |
| Ericsson | Yes | We don’t think to make adaptation layer to be configurable is needed. As an easy solution, it is sufficient to assume that adaptation layer is always supported. |
| InterDigital | Yes |  |
| CMCC | Yes |  |
| LG | Yes |  |
| Spreadtrum | Yes |  |
| Intel | Yes | We think that the minimum specification impact solution is to always utilize adaptation layer upon initiation of L2 relaying even in a 1:1 case as mapping is anyways needed. |

**Proposal 3a:** The radio bearer ID in the adaptation layer header is the Uu radio bearer ID of the remote UE.

**Question 3a:** Is Proposal 3a agreeable?

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Futurewei | Yes |  |
| OPPO | No | As commented in reflector, we understand there are some inconsistency   * The “Uu radio bearer ID of the remote UE” will be configured by network to remote UE * The “radio bearer ID in the adaptation layer header” will be configured by network to relay UE, **in case the adaptation layer is not configured at PC5 hop** (see reply to Q1)   so seems P3a is to mandate network behavior, i.e., to mandate network when providing the two configurations (to remote and to relay UE), to ensure the consistency in-between, why that is important? And what is the harmful result if the two configurations are independent of each other?  To respond the Q from MTK: we understand it is beneficial if the adaptation layer is configured at PC5 hop, but if it is not, i.e., UE ID only appear at Uu hop, there is no such issue of “ID transition function” at all.  To respond the Q from QC: the Q is not about “Network to configure **relay** UE bearer ID in adaptation layer?” it is about “Network to configure **remote** UE bearer ID in adaptation layer”, i.e., as in P3c, “**Relay** UE is configured with mapping tables between PC5 RLC IDs, **remote UE Uu radio bearer IDs** (determined by UE ID and radio bearer ID), and Uu RLC bearer IDs”, so in case the adaptation layer is not used at PC5 hop, the **relay** UE may get the configuration from network on the **remote** UE Uu bearer ID, which to us does not necessarily to be the same bearer ID NW configures to **remote** UE – since otherwise, we are trying to restrict NW configuration which is not needed. |
| MediaTek | Yes | For OPPO’s reply, it is not clear why the network should provide the inconsistent configuration to Remote UE and Relay UE with regard to the “radio bearer ID” for the same radio bearer of Remote UE.  In our understanding, if the consistent configuration is provided along with the relaying transmission path from Remote UE to gNB (across the Relay UE) for the “radio bearer ID”. This ID can be populated at all of the nodes within the relaying transmission path. Then no ID transition function is needed (i.e. no additional mapping table is needed) when the adapt layer is parsed/reassembled. |
| Qualcomm | Yes | Because Uu bearer ID is only 5bit (i.e. up to 32), it seems no much room to consider its optimization for payload size reduction. We don’t fully understand OPPO’s concern on mandate NW behavior. Did we discuss Network to configure relay UE bearer ID in adaptation layer? We are not aware of it. Maybe, some clarification is appreciated. |
| Samsung | Yes |  |
| vivo | Yes | Reusing the E2E Uu bearer ID is the simplest way to us. |
| Huawei, HiSilicon | Yes | For OPPO’s comments, we may call that “simplify NW implementation” rather than “mandate NW configuration”. |
| Xiaomi | Yes | We think this proposal is the simplest solution. |
| Lenovo&MM | Yes |  |
| Nokia | Yes, but comment | It is acceptable, but using a local ID may be better, provides more flexibility in the future |
| Sharp | Yes |  |
| ZTE | Yes |  |
| Ericsson | Yes | Regarding OPPO’s comments, we share the same views as MTK and QC, don’t understand why the NW needs to provide different configuration for the same Uu RB.  Regarding MTK’s comments, even with adaptation layer in PC5 interface, which just means that relay UE doesn’t need to recode the adaptation layer header (made by remote UE), but mapping table between RM UE RB ID and Uu RLC channels/bearers are still needed. |
| InterDigital | Yes | Consistency of the radio bearer ID can always be guaranteed by the network. This seems to be the simplest solution. |
| CMCC | Yes |  |
| LG | Yes |  |
| Spreadtrum | Yes | It is feasible and more flexible to use local ID which is different from the Uu RB ID, but we think Uu RB ID is the simplest and most straight-forward solution.  Meanwhile, we also think PC5 RLC ID is a feasible solution if only 1:1 bearer mapping between Uu RB and PC5 RLC channel is supported. |
| Intel | Yes |  |

**Proposal 3b:** The UE ID in the adaptation layer header is a local, temporary remote UE ID. FFS whether the local, temporary remote UE ID is assigned by the remote UE, the relay UE, or the serving gNB of the relay UE.

**Question 3b:** Is Proposal 3b agreeable?

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| **Company** | **Yes/No** | **Comments** |
| Futurewei | Yes |  |
| OPPO | Yes with comment | we are fine with P3b.  And we wonder if we can make a further step to remove the candidate of “assigned by the remote UE” from the table, since that requires the remote UE to either use the full length of PC5 ID (24-bit) which may cause overhead concern, or the Uu ID (TMSI?) which may cause security concern, if considering the truncated ID may be collide with the ID assigned by other remote UE, and further schemes are needed to solve the collision. |
| MediaTek | Yes |  |
| Qualcomm | Yes | Same view as OPPO to preclude candidate of “assigned by the remote UE”. We can further discuss whether it is assigned by gNB or relay UE. |
| Samsung | Yes |  |
| vivo | Yes with comment | Agree with OPPO that “assigned by the remote UE” can be removed. |
| Huawei, HiSilicon | Yes | Share the view with OPPO to remove “by the remote UE”. |
| Xiaomi | Yes |  |
| Lenovo&MM | Yes | a local, temporary remote UE ID can be assigned by gNB. |
| Nokia | Yes |  |
| Sharp | Yes |  |
| ZTE | Yes |  |
| Ericsson | Yes | Perhaps we can remove remote UE and relay UE, it is beneficial to let gNB to assign the local ID, in order to avoid potential ID collision.  We see there is another issue, in case of local ID, is the local ID allowed to be reconfigured? For better security, I would say that reconfiguration of the local ID needs to be supported. In case of ID reconfiguration, how to handle coexistence PDUs with the old local ID and the new local ID? |
| InterDigital | Yes | We are also fine to remove “by the remote UE” and discuss whether it is locally assigned by the gNB or the relay UE. |
| CMCC | Yes | Agree with OPPO to remove “by the remote UE”. |
| LG | Yes |  |
| Spreadtrum | Yes |  |
| Intel | Yes |  |

**Proposal 3c:** Relay UE is configured with mapping tables between PC5 RLC IDs, remote UE Uu radio bearer IDs (determined by UE ID and radio bearer ID), and Uu RLC bearer IDs.

**Question 3c:** Is Proposal 3c agreeable?

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| **Company** | **Yes/No** | **Comments** |
| Futurewei | Yes |  |
| OPPO | No | it is suggested to reword the proposal in a way that  Relay UE is configured with mapping tables between PC5 RLC bearer IDs, remote UE Uu radio bearer IDs, ~~(determined by~~ remote UE ID ~~and radio bearer ID)~~, and Uu RLC bearer IDs.  so that we do not lose any possibility at the current stage. |
| MediaTek | Yes |  |
| Qualcomm | Yes | We agree with OPPO’s wording suggestion:   * 1st change: “PC5 RLC bearer IDs” * 2nd change: remote UE ID may be assigned by relay as Q3b suggested |
| Samsung | No | This level of information in the mapping table seems only needed when N:1 mapping is used on the PC5, which we never agreed (this is predicted on support of adaptation layer).  With 1:1 mapping on the PC5, at the Relay UE we only appear to need a mapping between PC5 RLC IDs and Uu RLC IDs (per Remote UE). Relay UE does not need to have knowledge of Uu radio bearer ID in the configuration table. |
| vivo | Yes |  |
| Huawei, HiSilicon | Yes, generally | Not agree with adding “remote UE ID” suggested by OPPO.  In addition, “(determined by UE ID and radio bearer ID)” should be removed, which is maintained by relay UE rather than configure to relay UE. |
| Xiaomi | Yes |  |
| Lenovo&MM | Yes | Bearer mapping will be associated with a specific UE in the dedicated RRC signalling. Therefore, remote UE ID is not needed as Oppo suggested. |
| Nokia | Yes, with comment | The current wording makes if dependable from 3a. Mapping table is needed between PC5 IDs and Uu adaptation layer IDs in general independently from the actual IDs selected for Uu adaptation layer. Configured is not the best word here either. We propose the following rewording:  Relay UE knows the mapping between PC5 RLC bearer IDs, remote UE Uu adaptation layer radio bearer IDs, and Uu RLC bearer IDs |
| Sharp | Yes |  |
| ZTE | Yes |  |
| Ericsson | Yes | Agree with OPPO’s suggestion. In addition, don’t agree with 2nd change proposed by Qualcomm. In our mind, remote UE ID is needed, since there may be multiple remote UEs connecting to the same relay UE. In this case, Uu RB ID and PC5 RLC ID may be repeated among different UE pairs. |
| InterDigital | Yes | Ok with the suggested changes by OPPO. |
| CMCC | Yes | Comments from OPPO are acceptable for us. |
| LG | Yes |  |
| Spreadtrum | Yes |  |
| Intel | Yes | We are fine with the wording suggestion from OPPO. |

**Proposal 4:** Send LS to SA3 to check whether there is security issue for disclosing in the adaptation layer, temporary remote UE identifier, configured by the serving gNB or by the relay UE.

**Question 4:** Is Proposal 4 agreeable?

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| **Company** | **Yes/No** | **Comments** |
| Futurewei | Yes |  |
| OPPO | No | Our reading of the proposal is it is self-contradictory, i.e., if “temporary remote UE identifier” is used, there is no concern of “security issue for disclosing”..  If P3b is agreed in this meeting, i.e., a local/temp ID is used in adaptation layer, there is no need to go to S3. |
| MediaTek | Yes | We see no harm to send LS to SA3 (e.g. for information) |
| Qualcomm | Yes |  |
| Samsung | No | We agree with OPPO. |
| vivo |  | No strong view: if RAN2 agrees that a local remote UE ID is used, no LS to SA3 is needed. |
| Huawei, HiSilicon | No | Agree with OPPO.  At least, this should not be a “check LS”. It should just one “for information LS”. If any issue identified by SA3, they can information us. (there would not be any issue if use the local/temp ID.) |
| Xiaomi | No | Seems there is no security issue by using local id. |
| Lenovo&MM | No |  |
| Nokia | No | If we use a temporary local ID, then this is not necessary as it does not reveal any information about the Remote UE ID or service. |
| Sharp | Yes |  |
| ZTE | No |  |
| Ericsson | Yes | We think RAN2 shall send LS to SA3 for checking security concern. Even with the local or temporary ID, there may be still security concern if the local or temporary ID is not updated or reconfigured for a very long time. a fake UE may still be possible to launch an attach towards relay UE using the local ID. I think SA3 has better knowledge in this domain. In the LS, ***RAN2 can ask if there is still security concern based on local ID if local ID is not updated/reconfigured in time.*** |
| InterDigital | No | We see no issue with exposing a temporary ID, therefore no need to send an LS to SA3. |
| LG | Yes |  |
| Spreadtrum | No |  |
| Intel | Yes | We can check with SA3 whether there is any special handling to be considered even if it is local/temporary ID as it is a new architecture. |

# Other proposals

There’d be limited time available in this meeting on this agenda item. The guidance in WID and from chairman is to prioritize topics that may require coordination with other groups. If there is any, companies are invited to suggest other topics deemed to be important to be treated in this meeting.

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| **Company** | **Comments** |
| Qualcomm | As we indicated in Q3, there is proposal from multiple companies (e.g. [9] [10] [12] in summary report) to make adaptation layer header configurable (similar to SDAP header) and UE capability. For example, it can be absent if it is 1:1 bearer mapping with one Remote UE per Relay UE. We think it is an important issue, and prefer such discussion can be started for Uu adaptation layer right now. |
| Samsung | Same view as Qualcomm immediately above. |
| Huawei, HiSilicon | Not convinced that “1:1 bearer mapping with one Remote UE per Relay UE” is a typical scenario. |
| Nokia | We think that "1:1 bearer mapping with one Remote UE per Relay UE" is not a typical scenario; e.g. it means that a Relay UE can only support very limited amount of Remote UEs due to limitation on number of bearers |

# Conclusions

To be provided later …

# References

1. R2-2104505 Summary document for AI 8.7.4.2, Futurewei.