**3GPP TSG-RAN WG2 #113bis-e *R2-21xxxx***

**E-meeting, April 2021**

Agenda Item: 8.7.3

Source: Ericsson

Title: Summary of [602]

Document for: Discussion, Decision

# Introduction

This is to discuss the [602] as follows.

* [Post113bis-e][602][Relay] Definition of relay load criterion (Ericsson)

 Scope: Collect definitions of the relay load criterion and downselect candidates. Whether to use relay load as a criterion will not be discussed in this scope.

 Intended outcome: Report to next meeting

 Deadline: Long

For rapporteur to have enough time drafting summary report, we would like to have the following two phases:

* Phase 1: collect companies’ views by 2021-05-06 1000 UTC
* Phase 2: rapporteur will finalize summary report based on inputs of phase 1 by 2021-05-10 1000 UTC

# Discussion

The necessity of relay load has been initially discussed in [1], company views were summarized as the following.

* 14/25 companies (ZTE, QC, Ericsson, Sony, IDC, Sharp, MDK, Xiaomi, Vivo, FH, Apple, Kyocera, Philips, Convida) believe load indication would be beneficial, or are open to considering load as an additional AS criteria in case something simple can be specified.
* A number of other companies indicated their concern for being able to specify something simple with the limited time available.
* From the options for defining load provided in the question, it seems those with the most support are a, b, and f. These also seem to be the ones which can lead to the simplest solution. Rapporteur suggests RAN2 continue to discuss (e.g. based on contribution) whether load is considered as an additional AS criteria while downscoping the options to the most popular (a, b, and f) only.

*Proposal 1-1: RAN2 continue to discuss further whether to consider load as an additional AS criteria, based on specific details of using number of PC5 connections/remote UEs served by the relay and/or resource pool usage/capacity at the relay UE.*

The above proposal was not agreed due to lacking sufficient support. Therefore, the following discussions base on the outcome from [1] to further collect definition of load criterion from companies and perform possible down-selection.

## Selection criterion

From Rapporteur’s understanding, the definition of relay load criterion shall fulfil the following conditions

1. Simple and easy to compute
2. Reflecting performance that a remote UE could achieve if served by the relay UE candidate
3. Small spec change
4. low signaling overhead

Bullet a) is important to make sure that introduction of relay load criterion will not increase relay UE’s implementation complexity.

Fulfilling bullet b, remote UE will be able to determine if a relay UE candidate can meet remote UE’s performance requirements of the relay traffic. Relay UE’s capabilities and remote UEs’ capabilities can be considered accordingly. With Bullet c) and d), RAN2 puts least design efforts for defining relay load criterion.

**Q1-1: do companies agree that the definition of relay load criterion shall fulfil the following requirements?**

1. Simple and easy to compute
2. Reflecting performance that a remote UE could achieve if served by the relay UE candidate
3. Small spec change
4. Low signaling overhead
5. Other (consistent interpretation of relay load with different capability of the Relay UE taken into account)

|  |  |  |
| --- | --- | --- |
| Company | Requirements of relay load criterion | Comments |
| Ericsson | a,b,c,d, |  |
| InterDigital | a, b, c, d |  |
| Qualcomm | A,b,c,d,e | For e), we think it is important because some relay UE can serve a large number of remote UEs while others can only serve a small number. The relay load metric should be able to reflect the capability difference of relay UENote that although rapporteur seemed to mention that b) reflects capability of relay UE, b) is not quite clear to us. That is why we make it clear in e) |
| vivo | a,b,c,d |  |

## Definition of relay load criterion

Based on discussion outcome of clause 2.1, we list the most popular options which are indicated in [1] so that companies can do further evaluation and try to find a convergence among companies. In addition, companies are also welcomed to propose other options according to the requirements described in clause 2.1.

In this email discussion, Rapporteur refers the most popular options indicated in [1] (i.e., option a, b, and f) as Option 1, Option 2 and Option 3 in the below respectively.

**Option 1: Number of PC5 connections to Remote UEs currently being actively used for relaying**

**Option 2: Resource pool usage or capacity**

**Option 3: Number of remote UEs being served by the relay UE**

The above three options were not agreed in RAN2#113bis, mainly because that none of the options can reflect capabilities of relay UE and remote UEs which are being served by the relay UE. Therefore, the above options may not be able to indicate the real capacity or free bandwidth of relay UE candidate.

In addition, rapporteur would like to add an additional option, i.e.,

**Option 4** – **free bandwidth (or achievable bit rate) that relay UE can provide for relay traffic**.

In this option, a relay UE candidate can indicate how much bit rate or bandwidth a remote UE can achieve for its relay traffic if the remote UE connects to the relay UE candidate. This bit rate or bandwidth may be determined as the maximum bit rate/bandwidth of the relay UE candidate in Uu interface minus bit rate/bandwidth for relay traffic occupied by remote UEs which are being served by the relay UE in PC5 interfaces. This free bandwidth or achievable bit rate may be determined for UL relay traffic (i.e., from remote UE to gNB) and DL relay traffic (i.e., from gNB to remote UE) separately. In this option, relay UE candidate can estimate its maximum Uu bit rate/bandwidth based on implementation. It is feasible that relay UE candidate can perform estimation based on its radio channel quality or the historic UL grants or DL assignments. gNB may also provide assistance information (e.g. measure UL channel quality, and provide estimated UL bit rate to relay UE) accordingly.

In order to perform down-selection among the above options, Rapporteur would like to recommend companies to check whether each option can fulfill the requirements as described in clause 2.1.

**Q2-1: What requirements do companies believe that Option 1 is able to fulfil?**

1. Simple and easy to compute
2. Reflecting performance that a remote UE could achieve if served by the relay UE candidate
3. Small spec change
4. low signaling overhead
5. other (consistent interpretation of relay load with different capability of the Relay UE taken into account)

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| --- | --- | --- |
| Company | Requirements of relay load criterion | Comments |
| Ericsson | a, c, d |  |
| InterDigital | a, c, d | Number of PC5-RRC connections should be easy to implement and signaling overhead should be limited. The relationship between number of PC5-RRC connections and the actual load on the relay may not be one-to-one. Some PC5-RRC connections may occupy a large number of resources (both sidelink resources and relay buffering capacity), while others would occupy a small amount of resources.  |
| Qualcomm | A, c, d | It can’t reflect the capability difference of relay UE, although it is simple |
| vivo | a,c,d | The number of PC5-RRC connections is the most straightforward method for evaluation of load, but also a rough way as the capability of relay UE and the situation on each connection would be unknown. |

**Q2-2: What requirements do companies believe that Option 2 is able to fulfil?**

1. Simple and easy to compute
2. Reflecting performance that a remote UE could achieve if served by the relay UE candidate
3. Small spec change
4. low signaling overhead
5. other (consistent interpretation of relay load with different capability of the Relay UE taken into account)

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| --- | --- | --- |
| Company | Requirements of relay load criterion | Comments |
| Ericsson | a, c, d |  |
| InterDigital | a, b, c, d | If we stick to known metrics in SL, option 2 can be realized with either a CBR-like or CR-like metric (or average of this over time) which satisfies requirements a, c, and d. For requirement b, CR may be preferrable as it reflects the resource usage of the relay UE itself and has a direct relationship to how busy the relay is. CBR gives the overall load of the resource pool (which includes the usage of all other UEs including the relay). |
| Qualcomm | b) (others depend on exact form of metric) | It is not clear to us what is the form of metric for relay UE to calculate it. Proponent can provide a mathematical formula to help understanding. If without such detail, we can’t judge whether it is simple and what is spec impact |
| vivo | b | Option-2 can somehow reflect the performance in a perspective of resource usage but we agree with Qualcomm that it seems too general to consider what this metric can be like. |

**Q2-3: What requirements do companies believe that Option 3 is able to fulfil?**

1. Simple and easy to compute
2. Reflecting performance that a remote UE could achieve if served by the relay UE candidate
3. Small spec change
4. low signaling overhead
5. other (consistent interpretation of relay load with different capability of the Relay UE taken into account)

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| --- | --- | --- |
| Company | Requirements of relay load criterion | Comments |
| Ericsson | a, c, d |  |
| InterDigital | a, d | Similar to option 1, number of connected UEs may not directly indicate resource usage at the relay, since it depends on the services each remote UE uses. In addition, this may require larger spec impact to determine whether multiple PC5-RRC connections are associated with the same UE. |
| Qualcomm | A, c, d | It can’t reflect the capability difference of relay UE, although it is simple |
| vivo | a,d | The number of serving remote UE can be determined by the remote UE ID but this is a relatively rough method compared to option-1. It should anyway be the number of PC5-RRC connections and resource usage on each connection that matter. |

**Q2-4: What requirements do companies believe that Option 4 is able to fulfil?**

1. Simple and easy to compute
2. Reflecting performance that a remote UE could achieve if served by the relay UE candidate
3. Small spec change
4. low signaling overhead
5. other (consistent interpretation of relay load with different capability of the Relay UE taken into account)

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| --- | --- | --- |
| Company | Requirements of relay load criterion | Comments |
| Ericsson | a, b, c, d |  |
| InterDigital | b, d | While this achieves b, we see some challenges with how to compute the bit rate at the relay and how to specify it with minimal impacts.  |
| Qualcomm | b) (at least it doesn’t fulfil a and e) | First, we think Option 4 is not quite clear what is the form of metric to reflect it? Proponent can provide a mathematical formula to help understanding. If without, we can’t judge whether it is simple and what is spec impactOur first impression is that it is not easy for relay UE to calculate what is its free bandwidth (or achievable bit rate):* It is up to relay UE implementation and hard to specify.
* It may be power consuming for relay UE to calculate / update it time to time.
* Absolute free bandwidth/bit rate may not be useful metric because a large absolute value may be a small fraction of relay UE’s capability, which is not preferred for relaying.
 |
| vivo | b | Similar view as Qualcomm. The formula should be first provided for companies to review, otherwise there is no need to consider a factor which is actually hard to compute.  |

Based on above questions, it is recommended to do down-selection of the options.

**Q2-5: According to the requirements as discussed in clause 2.1, which option do companies prefer for defining relay load criterion?**

**Option 1: Number of PC5 connections to Remote UEs currently being actively used for relaying**

**Option 2: Resource pool usage or capacity**

**Option 3: Number of remote UEs being served by the relay UE**

**Option 4: free bandwidth (or achievable bit rate) that relay UE can provide for relay traffic**

**option 5: Leave to UE implementation**

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| --- | --- | --- |
| Company | Option | Comments |
| Ericsson | Option 4 |  |
| InterDigital | Option 2  | We prefer option 2, which in our opinion satisfies requirements a-d. |
| Qualcomm | Option 3 (if have to pick one among them) | We have concern on option 2/4 (at least for current unclear calculation metric) because both of them need relay UE to take its power to calculate capability/bandwidth timely and include it in discovery message (involving frequent NAS-AS interaction).Option 1/3 is at least simple, although we are not sure whether they are useful. Similarly, including such time-variant info in discovery may incur frequent NAS-AS interaction. Between them, option 3 is more simple and less NAS-AS interaction. |
| vivo | Option 5 | From the analysis above we could tell that option-1 to option-4 all have their pros and cons and the main problem is none of them is a comprehensive way and can appropriately reflect the load overall.Leaving to UE implementation would be another option which is flexible and can include all the options above. We prefer not to specify the concrete criterion which can be anyway hard to converge among companies, but instead to discuss about how the remote UE would know this relay load by relay UE, e.g., an indication of high/medium/low. |

1. xxxxx.

# Conclusion

We have the following proposal:

[Proposal 1 xxxxx.](#_Toc70023351)

3.1 For chair notes (proposal in priority order)

# Reference

[1] [R2-2104414](file:///C%3A%5CUsers%5Cmtk16923%5CDocuments%5C3GPP%20Meetings%5C202104%20-%20RAN2_113bis-e%2C%20Online%5CExtracts%5CR2-2104414%20-%20%5B610%5D%5BRelay%5DAS_Criteria_reselection_summaryV2.docx) Summary of [AT113bis-e][610][Relay] AS criteria for relay (re)selection (InterDigital) InterDigital discussion

# Appendix