**3GPP TSG-RAN WG2 Meeting #115-e R2-210xxxx**

**Online, Aug 16th – 27th, 2021**

**Agenda Item: 8.12.3.2**

**Source: Huawei, HiSilicon**

**Title: Summary of [AT115-e][110][RedCap] RRM relaxation**

**Document for: Discussion and decision**

# Introduction

This document summarizes the following offline discussion.

* [AT115-e][110][RedCap] RRM relaxation (Huawei)

Initial scope: Continue the discussion on the proposals from [R2-2107211](file:///C:\Data\3GPP\Extracts\R2-2107211%20RRM%20measurement%20relaxation%20for%20RedCap%20UE.doc) and [R2-2107748](file:///C:\Data\3GPP\Extracts\R2-2107748%20RRM%20relaxation%20for%20RedCap%20UEs.docx)

Intended outcome: Summary of the offline discussion with e.g.:

* + - List of proposals for agreement (if any)
    - List of proposals that require online discussions
    - List of proposals that should not be pursued (if any)

Initial deadline (for companies' feedback): Monday 2021-08-23 10:00 UTC

Initial deadline (for rapporteur's summary in R2-2108894): Monday 2021-08-23 16:00 UTC

Proposals marked "for agreement" in R2-2108894 not challenged until Tuesday 2021-08-24 0800 UTC will be declared as agreed via email by the session chair (for the rest the discussion will further continue online).

# Contact from companies

|  |  |
| --- | --- |
| Company | Name and email address |
| Fraunhofer | Gustavo Wagner Oliveira da Costa  gustavo.wagner.oliveira.da.costa@iis.fraunhofer.de |
| Ericsson | Mattias Bergström  Mattias.a.bergstrom@ericsson.com |
| ZTE | LiuJing  liu.jing30@zte.com.cn |
| KDDI | Li Yanwei  ya-li@kddi.com |
| Xiaomi | Rao Shi  shirao@xiaomi.com |
| CATT | Pierre Bertrand (pierrebertrand@catt.cn) |
| Huawei, HiSilicon | Yiru Kuang, kuangyiru@huawei.com |
| vivo | Chenli (chenli5g@vivo.com) |
| Sharp | Lei Liu (lei.liu@cn.sharp-world.com) |
| CMCC | Min Wu  wumin@chinamobile.com |
| OPPO | Haitao Li (lihaitao@oppo.com) |
| Thales | Volker Breuer (volker.breuer@thalesgroup.com) |
| Nokia | Jussi Koskinen  jussi-pekka.koskinen@nokia.com |
|  |  |

# Discussion

## Beam level criterion

* Option 1: Proposal in [1]: Beam-level criterion is adopted for Rel-17 stationary criterion.
* Option 2: Proposal in [2]: Do not introduce beam change based criterion in Rel-17.
* Option 3: Compromised solution, to introduce the network configuration for beam-level criterion, and it is up to network implementation to decide whether to use beam-level criterion as Rel-17 stationary criterion (in addition to i.e. SSearchDeltaP\_stationary/TSearchDeltaP\_stationary criterion).

**Q1-1 Which option above do companies support in Rel-17?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1, 2, 3?** | **Comments** |
| Fraunhofer | 1 |  |
| Ericsson | 2 | Let's not talk about optimizations before we have the basics sorted out. |
| ZTE | 2 | We suggest not to consider beam-based criterion in Rel-17 because:   1. Usually, the cell level RSRP will change when UE moves, beam results change without cell level RSRP change is a very rare case as we indicated in [2], so we think using cell-level based criterion is sufficient. 2. Beam level results are more sensitive than cell level results, using beam level results may easily cause misjudgment, so UE will have less chance to trigger RRM relaxation. 3. RAN2 already agreed cell level based low mobility criterion and not-at-cell-edge criterion, so there are already three combinations:  * Only low mobility is configured, and UE fulfills; * Both criteria are configured, and UE only fulfills low-mobility one; * Both criteria are configured, and UE fulfills both.   If beam-based criterion is introduced, then it can also combine with not-at-cell-edge (and/or low-mobility criterion), so it may produce much more cases. Considering the heavy workload in RAN4, most likely, RAN4 cannot finish studying /specifying relaxation methods for all cases. |
| KDDI | 2 | The UE’s movement is very random, so it is hard to make a decision based on the either the beam level measurement result or the change of the number of beams |
| Xiaomi | 2 | We think beam criterion is not necessary, the reason is that even if the beam criterion is not introduced, UE still can stay in a stable coverage which does not make much impact on UE experience. |
| CATT | 2 | We are OK to postpone this technique to a later release. |
| Huawei, HiSilicon | 1 or 3 | For REDCAP, we focus on the “stationary UE” so a stricter and more accurate criterion to identify “stationary UE” is preferred. For companies’ concern on fluctuation and unreliability issue, L3 filtering can be used for beam measurement which is the similar as cell level RSRP/RSRQ acquisition. |
| vivo | 2 | We see no extra benefit of introducing Beam-level criterion on top of cell level criterion based on RSRP/RSRQ.  On one hand, the change of Beam-level quality may not be caused by UE mobility, on the other hand, beam change may not cause cell re-selection (e.g. UE moving around the gNB). |
| Sharp | 2 | Finish the RSRP/RSRQ based method first. |
| OPPO | 2 | Agree with ZTE. |
| Thales | 2 | Finish the RSRP/RSRQ method first, other proposals are optimization to be left for later. |
| Nokia | 1&3 | If the beams change (i.e. UE moves or rotates), the UE should not assume to have stable coverage as it should be aware neighbour cell qualities that may vary -> UE should exit the RRM relaxing. |
| NTTDOCOMO | 1 or 3 | See benefits to introduce beam-change based method as a complement in addition to RSRP/RSRQ method for stricter evaluation. |

If the beam-level criterion for stationary criterion in Rel-17 is supported, the details of defining beam-level criterion can be:

* Option 1: Proposal in [1]: For beam-change based criterion, it is determined based on whether quality change of beam(s) for a period of time is lower than a threshold.
* Option 2: Proposal in [3]: use Doppler shift of UE’s best beams from its serving cell instead of beam change counts.
* Option 3: Proposal in [4]: beam-change evaluation method which takes Number of serving beams into account.
* Option 4: Other…

**Q1-2 If beam-level criterion is supported in Rel-17, which option above do companies support for defining beam-level criterion?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1, 2, 3 or other?** | **Comments** |
| Fraunhofer | 2 | Doppler shift can be a more robust measure than change count or quality variation |
| Huawei, HiSilicon | 1 | As analysed in [1], it is difficult to identify whether UE is moving or not by evaluating the number of switched beams that is calculated based on a certain threshold. The quality variation of the beam(s) is a relative value, and it is not related to the distance between UE and gNB. Hence, it will be more accurate to evaluate “stationary” criterion. |
| Nokia | 1 | The beam change evaluation method can use the existing measurements that UE would do anyway e.g. the L3 RRM. Thus no extra measurements would need to be specified for the beam change based evaluation |
| NTTDOCOMO | 1 or 3 | See benefits in either evaluating the beam quality variation [1] or change of Number of serving beams in a certain period of time. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

## R17 not-at-cell-edge threshold for IDLE/INACTIVE

In RAN2#114-e, RAN2 made the following agreements on Rel-17 not-at-cell-edge criterion in RRC\_IDLE/INACTIVE:

|  |
| --- |
| Agreement:  1. When NW configures Rel-17 RRM relaxation for RRC\_IDLE/INACTIVE, Rel-17 stationary criterion is mandatory, and Rel-17 not-at-cell-edge criterion is optional configuration.  2. Continue discussion on Rel-17 not-at-cell-edge criterion in RRC\_IDLE/INACTIVE within two options:  - Option 1) Reuse Rel-16 not-at-cell-edge criterion with the same thresholds (i.e., SSearchThresholdP / SSearchThresholdQ)  - Option 2) Reuse Rel-16 not-at-cell-edge criterion with the different thresholds |

The Rel-17 not-at-cell-edge criterion in RRC\_IDLE/INACTIVE can be:

* Option 1: Proposal in [1]: Reuse Rel-16 not-at-cell-edge criterion with the same thresholds, when configured together with the R17 stationary criterion.
* Option 2: Proposal in [2]: Introduce separate Rel-17 not-at-cell-edge threshold, and the new threshold is only associated with Rel-17 stationary criterion (if configured).

**Q2 Which option above do companies support for Rel-17 not-at-cell-edge criterion in RRC\_IDLE/INACTIVE?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1 or 2?** | **Comments** |
| Fraunhofer | 1 | We do not see the benefit on adding a separate threshold |
| Ericsson | 1 | We assume 1 means that we don’t add anything new but rely on existing spec. |
| ZTE | 2 | RAN2 already agreed to reuse low mobility criterion with separate thresholds for Rel-17 UEs, so network can configure stricter low-mobility thresholds in order to determine stationary UEs. If Option 2 is supported, then network can configure a lower not-at-cell-edge threshold for stationary UEs, so they can have more chance to do RRM relaxation.  In addition, we think separate thresholds bring more flexibility to network deployment, if network wants to use single threshold, network can configure them to the same value. |
| KDDI | 1 | We suggest to reuse the same threshold as Rel-16 |
| Xiaomi | 1 | Introducing separated threshold is redundant as the signal quality can be varied, two different values are difficult to distinguish. Therefore reusing the same Rel-16 not-at-cell-edge is enough. |
| CATT | 2 | We prefer a clean separation of R16 and R17 triggers |
| Huawei, HiSilicon | 1 | The measurement result is not an accurate and fixed value, and may vary within a certain range, we do not see much gain to define a new R17 threshold. |
| vivo | 2 | In RRC\_IDLE/INACTIVE, Rel-17 not-at-cell-edge criterion can only be configured along with Rel-17 stationary criterion. As mentioned by ZTE, Rel-17 stationary criterion is expected to be stricter than Rel-16 low mobility criterion. It is reasonable to allow looser Rel-17 not-at-cell-edge criterion than Rel-16 to allow more stationary UEs (which do not fulfill the R16 not-at-cell-edge criterion) to perform RRM relaxation. |
| Sharp | 2 | More flexible. |
| OPPO | 2 | In our understanding, since stationarity criterion is more stringent than low-mobility criterion, it seems reasonable to combine the stationarity criterion with a looser not-at-cell-edge criterion compared to Rel-16 not-at-cell-edge criterion. When both Rel-17 stationarity criterion and Rel-17 not-at-cell-edge criterion are configured and both criteria are fulfilled, whether UE shall relax measurement as legacy (i.e. stop measurement with a minimum measurement time interval of 1 hour) or based on new relaxation method is up to RAN4. |
| Thales | 1 | We don’t see much benefit in adding additional Rel.-17 set of thresholds. |
| Nokia | 2 | Beam level RSRP condition could be introduced |
| NTTDOCOMO | 1 | Prefer combining exsiting threshold\_P/Q and beam-change based method for stricter evaluation. |

## Stationarity criterion for CONNECTED

In RAN2#114-e, RAN2 made the following agreements on Rel-17 not-at-cell-edge criterion in RRC\_IDLE/INACTIVE:

|  |
| --- |
| Agreement:  1. An RSRP/RSRQ based stationarity criterion (Working Assumption: the same as in idle/inactive) can be configured for UEs in RRC Connected. If the criterion is met, this is reported to the network (FFS how/when). It is FFS whether, based on this, besides possibly reconfiguring RRM measurements (up to network implementation), the network can enable RRM measurement relaxation (FFS whether same method as in Idle/Inactive) |

For the configuration of stationarity criterion in RRC\_CONNECTED, how the network provide the configuration of stationarity criterion to the UE in RRC\_CONNECTED?

* Option 1: Dedicated signaling, e.g. RRCReconfiguration message;
* Option 2: Broadcast signaling, e.g. using configuration broadcast for RRC\_Idle/Inactive;
* Option 3: Combining dedicated signaling and broadcast signaling;
* Option 4: Other…

**Q3-1 Which option above do companies support for configuration of stationarity criterion in RRC\_CONNECTED?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1, 2, 3 or other?** | **Comments** |
| Fraunhofer | 3 | A broadcast signalling should suffice in most situations but for the sake of flexibility it would be good if the network can override the parameters for specific UEs via dedicated signaling |
| Ericsson | 1 | In CONNECTED mode the UE has a dedicated connection with the network, there is no need to add broadcast signalling for CONNECTED UEs. We don’t expect it to be a lot of overhead to signal these thresholds compared to other configurations the NW provides to the UE with dedicated signalling. |
| ZTE | 1 | First, we don’t think the configurations provided for IDLE/INACTIVE UEs can be reused for Connected UEs, because the performance impact in connected mode will be considered more seriously. If network broadcasts two set of thresholds in system information, it takes more public resources (especially because SIB is periodical transmitted).  For RRC\_CONNECTED UEs, we think the signalling overhead of Option 1 is not much, and network is able to configure different parameters for different UEs (e.g. based on service type).  Option 3 is not necessary, because using one method is sufficient. |
| KDDI | 1 | Share the same view as ZTE |
| Xiaomi | 1 | Since UE perform RRM measurements based on measurement configuration in RRC\_CONNECTED, it is straightforward to reuse such a framework to provide the configuration of stationary criterion (e.g. put the criterion into trigger event.) |
| CATT | 2 | The same configuration broadcasted for RRC\_Idle/Inactive is also used in RRC\_Connected. The stationarity status is independent of the RRC state. |
| Huawei, HiSilicon | 1 or 3 | Dedicated signalling should be used for configuration of stationarity criterion in RRC\_CONNECTED. Option 3 may also be considered if the configuration of stationarity criterion in RRC\_CONNECTED is the same as the stationarity criterion in RRC\_Idle/Inactive, the gNB can indicate whether UE can use stationarity criterion in RRC\_Idle/Inactive in dedicated signalling, instead of send the same configuration again. |
| vivo | 3 | Firstly, broadcast signaling can reduce the overhead. Besides, broadcast signaling can allow UE to evalute the criteria before entering RRC\_CONNECTED state, and allows NW to configure connect UE to perform RRM relaxation after entering RRC\_CONNECTED.  Moreover, there is no need to have restriction on the flexibility for network configuration. |
| Sharp | 1 or 3 | It depends on the detailed parameters/thresholds discussion. If some parameters some parameters could be same, Option 3 can be used. If all of parameters of idle/inactive stationary criterion and connected criterion could be different, Option 1 can be used. |
| CMCC | 1 | For gNB, the channel quality criteria for RRM relaxation could be optionally configured via RRC reconfiguration in RRC connected mode for more accurate evaluation on the channel quality for RRM relaxation. |
| OPPO | 1 | Option1 could provide more flexibility for network implementation. Network could configure different UEs with different parameters for stationary /not-cell-edge criteria, e.g, based on the UE’s mobility attribute |
| Thales | 1,3 | Broadcast If the network uses same RSRP/RSRQ based stationarity criterion as in idle, the network can indicate this in broadcast and RRM measurement relaxation could be configured by the gNodeB immediately when entering RRC\_Connected. If stationarity requirement is different in connected, dedicated signalling should be preferred. Once met RRM relaxation can be configured by the network. |
| Nokia | 1 | It would be straight forward to use dedicated signalling. Furthermore CONNECTED mode relaxation criteria can be expected to be more conservative compared to IDLE/INACTIVE relaxation criteria. |
| NTTDOCOMO | 1 | In RRC\_CONNECTED, it is straightforward to send configuration of stationarity criterion in RRC dedicated signalling. |

If the configured stationary criterion is met by the UE, UE can report it to the network, so that the network can decide whether to enable the RRM relaxation to the UE, then how the UE reports it to the network in RRC\_CONNECTED?

* Option 1: Reuse UEAssistanceInformation message for the report, e.g. introduce new field to indicate whether stationary criterion is met or not;
* Option 2: Reuse RRM measurement reporting mechanism;
* Option 3: Define a new RRC message for the report;
* Option 4: Other…

**Q3-2 Which option above do companies support to report whether the stationarity criterion is met or not by the UE in RRC\_CONNECTED?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1, 2, 3 or other?** | **Comments** |
| Fraunhofer | 2 | Reusing the RRM measurement report mechanism seems more natural since the object of relaxation are the RRM measurement themselves. Also, this would create the opportunity to associate the relaxation with particular measurement objects. For example, as part of RRM relaxation report the UE could report the headroom on certain measurement objects (how far the UE is from reporting it) to assist the network to decide if that particular measurement object can be relaxed or not. |
| Ericsson | 1 | The RRM measurement framework is used to provide RRM measurements to the network.  What we are discussing here is a report of assisting data that the UE may have for the network in order to configure the UE in a certain way. For that purpose we have the UE assistance information framework.  We therefore assume that the simplest approach is to use the UE assistance information. |
| ZTE | 2 | We think it is simpler to reuse RRM measurement reporting mechanism, as we indicated in [2], we can define a new event, formulate TsearchDeltaP\_stationary as TTT, reuse *ReportOnleave* to trigger UE report when the criterion is not met any more. And network can use *reportAmount* and *reportInterval* to control UE’s reporting behaviour.  The current UAI mechanism is a bit complex and still has several open issues to be solved (see offline 14), so we think using Option 2 is simpler and reduces the specification effort. |
| Xiaomi | 2 | If we adopt RRM measurement configuration framework to provide the stationary criterion, then reusing MeasurementReport mechanism is straightforward and reasonable as MeasurementReport could be triggered by events.  If so, the triggered measId within MeasurementReport can implicitly indicate that the criterion is fulfilled since the measId is linked to an event (e.g. stationary criterion) within ReportConfig. And more details can be further discussed if introduced. |
| CATT | 1 | The UAI framework can address well this feature. |
| Huawei, HiSilicon | 1 | UE can use existing UAI to report whether the criterion is met or not. It is very easy to extend UAI for this but if using measurement reporting option, we need to review full measurement procedure. Simple bits in UAI is enough which consumes less power for transmitting UAI due to no large message size compared with measurement reporting including measurement report. |
| vivo | 2 | The most straightforward and simple solution is to reuse the measurement report mechanism. Meanwhile, the mechanism for the report of fulfilled criteria is quite similar as current measurement report: criteria->event, TsearchDeltaP->TTT.  For example, a new measurement event can be introduced for the report of fulfilled criteria. |
| Sharp | 2 | Existing control parameters can be reused and more information could be carried if necessary. |
| CMCC | 2 | Once UE finds out that its channel quality meets the criteria, it has to send the notification to gNB using RRM measurement reporting mechanism and the RRM relaxations could be performed in UE automatically. |
| OPPO | 2 | It is the most straightforward way. New measurement event(s) for stationary/not-cell-edge criteria can be introduced. When the stationary/not-cell-edge criteria is fulfilled, UE shall trigger a measurement report. |
| Thales | 1 | Agree with Ericson and Huawei. It is an information whether, the stationarity requirement is met (1bit). For this we should use the UE assistance information message. |
| Nokia | 2 | Legacy measurement reporting seems straightforward. |
| NTTDOCOMO | 2 | The criteria satisfied notification could be sent to gNB using measurement reporting mechanism. |

## LS to RAN4

Based on WID, RAN2 only focus on defining RRM relaxation criteria, and the RAN4 will define RRM relaxation methods. [2] suggests to send RAN2’s conclusions to RAN4.

**Q4-1 Do companies agree to send LS to RAN4 to inform RAN2 conclusions for RRM relaxation in both RRC\_IDLE/INACTIVE and RRC\_CONNECTED?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Fraunhofer | Yes (but) | We agree to send an LS regarding the conclusions on RRC\_IDLE/INACTIVE, but for RRC\_CONNECTED it may be still be a bit premature as there are less agreements and more FFS. |
| Ericsson | Yes | Perhaps RAN4 can start working at least on the IDLE/INACTIVE relaxation. See comment on CONNECTED below. |
| ZTE | Yes | We think it’s time to inform RAN4 about our conclusion, and provide guidance to their discussion on RRM relaxation methods. |
| KDDI | Yes |  |
| Xiaomi | Yes |  |
| CATT | Yes |  |
| Huawei, HiSilicon | Yes |  |
| vivo | Yes | We think it is better to send an LS to RAN4 to inform our conclusion, and request RAN4 to work on RRM relaxation method for idle/inactive/connected. |
| Sharp | Yes |  |
| CMCC | Yes |  |
| OPPO | Yes |  |
| Thales | Yes |  |
| Nokia | Yes, but | LS needs to be sent, but it remains to be seen when. It depends on the progress in this meeting. LS can be sent also later. |
| NTTDOCOMO | Yes |  |

**Q4-2 If the answer for Q4-1 is yes, which content(s) to be included in the LS?**

1. **Agreed RAN2 conclusions;**
2. **“For RRC\_IDLE/INACTIVE, RAN4 is asked to study and define corresponding R17 RRM relaxation method” proposed in [2];**
3. **“For RRC\_CONNECTED, RAN4 is asked to study whether additional RRM relaxation method is needed. If yes, please specify it.” proposed in [2];**
4. **Other…**

|  |  |  |
| --- | --- | --- |
| **Company** | **Content(s)** | **Comments** |
| Fraunhofer | 1,2,4 | Regarding 3. the RRM relaxation method needs to match the criteria (for an harmonic overall solution). We think that we should discuss other criteria before asking RAN4 to specify the method. As pointed in our contribution (R2-2107145) we think that including a new criterion based on measurements of other cells (non-serving) is needed to prevent certain handover failures and network degradation. We suggest we discuss that before asking RAN 4 to specify the methods.  4 – we should kindly request that RAN 4 whether certain methods should not be used in RRC\_CONNECTED. In particular, we have concerns regarding the existing Rel16 method of stopping measurements for 1 hour. In our view this should not be applicable to RRC\_CONNECTED because it will prevent the UE to know it should leave RRM relaxation timely. |
| Ericsson | 1, 2 | Regarding 3, we have not yet decided how RRM relaxation in CONNECTED should be achieved. We describe in our paper [R2-2108275](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_115-e/Docs//R2-2108275.zip) that there can be done in two different ways:   1. define a new RRC measurement mode that the UE can be put in to, e.g. the network would tell the UE "please enable RRM relaxation". 2. rely on network configuration, e.g. network can deconfigure/reconfigure RRM measurements   This discussion needs to be sorted out before we involve RAN4. |
| ZTE | 1,2,3 | For CONNECTED UEs, RAN2 already agreed the network implementation based approach. But we don’t think RAN2 is able to discuss other relaxation methods, and whether IDLE/INACTIVE methods can be reused for CONNECTED UEs.  So it is better to inform RAN4 what has been agreed in RAN2, and let them to discuss and decide whether additional methods are needed. |
| KDDI | 1,2,3 |  |
| Xiaomi | 1,2,3 | We are OK for these. |
| CATT | 1 | We can fine-tune the LS after we have concluded the agreements. |
| Huawei, HiSilicon | 1, 2, 3 | Information 2/3 may help RAN4 to correctly understand RAN2 status. |
| vivo | 1,2,3 | For connected UE, we think RAN4 should discuss and decide which additional methods are needed. |
| Sharp | 1,2,3 | And we have sympathy with Fraunhofer’s comments on stopping measurement time in RRC\_CONNECTED. Maybe gNB could control the stopping measurement time. |
| CMCC | 1,2,3 |  |
| OPPO | 1,2,3 |  |
| Thales | 1,2, (3) | Whether to include 3 also depends on the progress/outcome of the current discussions around the RRM relaxation in RRC\_CONNECTED. |
| Nokia | 1,2,3 | See our comments for the previous question. |
| NTTDOCOMO | 1,2,3 | OK with these. |

# Conclusions

*To be added…*

# References

1. R2-2107211, RRM measurement relaxation for RedCap UE, Huawei, HiSilicon.
2. R2-2107748, RRM relaxation for RedCap UEs, ZTE Corporation, Sanechips.
3. R2-2107218 RRM relaxations for RedCap UEs, Qualcomm Incorporated.
4. R2-2107754 RRM Relaxation for RedCap UE, NTT DOCOMO INC.