**3GPP TSG-RAN WG2 Meeting #116-e R2-2111345**

**Online, 1~12 November 2021**

**Agenda item: 8.12.3.2 RRM Relaxations**

**Source: Qualcomm Incorporated**

**Title: Report of [AT116-e][111][RedCap] RRM Relaxations**

**Document for: Discussion and decision**

1. Introduction

This document is to report the outcome of the following email discussion at RAN2#116-e Meeting:

* [AT116-e][111][RedCap] RRM relaxation (Qualcomm)

Initial scope: Continue the discussion on remaining aspects of RRM relaxation

Initial 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): Friday 2021-11-05 0900 UTC

Initial deadline (for rapporteur's summary in R2-2111345): Friday 2021-11-05 1800 UTC

Proposals marked "for agreement" in R2-2111345 not challenged until Monday 2021-11-08 1000 UTC will be declared as agreed via email by the session chair (for the rest the discussion will further continue offline until the CB session in Week2).

**Note:**

*This offline discussion is based on proposals from a set of contributions (listed in the References section) selected by the session chair. If there is a topic that you think is important but is not included in this document, you may suggest it in Section 6 “Any other issues to discuss”.*

2. Contact Information

|  |  |
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3. Discussion

## 3.1 Issues related to configuration

RAN2 have agreed to introduce both stationarity criterion and not-at-cell-edge (NACE) criterion for R17 RRM relaxation. While the stationarity criterion is mandatory if any R17 RRM relaxation is configured, the R17 NACE criterion is optional and has to be jointly configured with the stationary criterion.

Based on the above agreements, it is reasonable to assume that UE should not be allowed to relax its RRM measurements if both stationarity criterion and R17 NACE criterion are configured but UE meets only the R17 NACE criterion [4]. The rapporteur would like to confirm whether this is indeed a common understanding among companies.

**Q1:** Do you agree that UE is not allowed to relax its RRM measurements if both stationarity criterion and R17 NACE criterion are configured but UE meets only the R17 NACE criterion?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| OPPO | Yes |  |
| ZTE | Yes | R17 RRM relaxation requires UE to at least fullfil the stationarity criterion. |
| Apple | Yes |  |
| Ericsson | Yes |  |
| MediaTek | Yes |  |
| Nokia | Yes |  |
| Qualcomm | Yes |  |
| Futurewei | Yes | R17 NACE criterion is intended for a stationary UE. For a moving UE, R16 NACE criterion with tighter thresholds can be configured. |
| Intel | Yes |  |
| Huawei, HiSilicon | Yes | NACE criterion is addition on top of stationarity criterion, stationarity criterion should always be fulfilled for RRM measurement in RRC\_idle/inactive state. |
| Sharp | Yes |  |
| Xiaomi | Yes | Rel-17 RRM relaxation is to mainly focus on UE mobility. |
| LG | Yes | We agree that the UE should be stationary to perform R17 RRM relaxation. |
| Sequans | Yes |  |
| DENSO | Yes | We do not anticipate any use of R17 NACE other than the stationary criterion support. |
| Samsung | Yes |  |
| CATT | Yes |  |
| Spreadtrum | Yes |  |
| Fraunhofer | Yes | Since NACE will not be introduced for RRC\_CONNECTED, it should be made clear this refers to idle/inactive. |

When both stationary criterion and R17 NACE criterion are configured, there are two possible scenarios for UE to evaluate whether it may perform relaxation:

* Case 1: Both stationary criterion and R17 NACE criterion are configured, and UE meets both criteria;
* Case 2: Both stationary criterion and R17 NACE criterion are configured, and UE meets only the stationary criterion.

In Case 1, it is clear that UE may apply or request RRM relaxations, as have been agreed. On the other hand, it is not clear whether UE may apply or request RRM relaxations or not in Case 2.

In [2] and [4], it is proposed that a new indication (e.g. combineRelaxedMeasCondition-r17) can be introduced to control whether UE is allowed to perform RRM relaxation in Case 2. On the other hand, it is argued in [3] that there is no need to introduce such an indication. You may respective arguments in those two contributions.

**Q2**: Do you think it is necessary to introduce a new indication (e.g. combineRelaxedMeasCondition-r17) to control whether UE is allowed to perform RRM relaxation when both stationary criterion and R17 NACE criterion are configured but only the stationary criterion is met?

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| --- | --- | --- |
| Company | Yes/No | Comments |
| OPPO | Yes | This is similar to Rel-16 RRM relaxation and we think we could follow the same way as that in Rel-16 RRM relaxation, i.e., when both Rel-17 stationary criterion and Rel-17 not -cell-edge criterion are configured, whether UE is allowed to relax neighour cell measurement requirements if only Rel-17 stationary criterion is fulfilled is configurable by network. We think it is more flexible. In this way, in the case both Rel-17 stationary criterion and Rel-17 not -cell-edge criterion are configured and combineRelaxedMeasCondition-r17 is not configured, stationary UEs may also benefit from RRM relaxation. |
| ZTE | Yes | We prefer to support this flexibility. |
| Apple | Yes |  |
| MediaTek | Depends on RAN4 | When stationary and NACE conditions are both configured, a combine flag is only useful if RAN4 agree that RRM relaxation level is different for the two cases below:  Case 1: only stationary criteria is fulfilled  Case 2: both stationary and NACE criteria are fulfilled |
| Nokia | No | If both stationary criterion and R17 NACE criterion are configured then both criterias needs to be met in order that relaxation is allowed. NW can configure only stationary criterion and this seems sufficient and we see no benefit for introducing combineRelaxedMeasCondition-r17. |
| Qualcomm | Yes | Agree with OPPO |
| Futurewei | - | The answer depends on whether the UE can do more relaxation when both are fulfilled than when only the stionarrity criterion is fulfilled. Need RAN4 inputs on this. |
| Intel | No | Agree with Nokia. |
| Huawei,HiSilicon | Yes | Similar as Rel-16. |
| Sharp | Yes | Depends on whether the relaxation method is different from the one when both criteria are met. |
| Xiaomi | Yes, but | We agree to introduce such a indication as similar as Rel-16.  But some details should be clarified that in Rel-16, if combineRelaxedMeasCondition is not configured, UE can perform either low mobility criterion or not-at-cell-edge criterion. For combineRelaxedMeasCondition-r17, if not configured, we only can perform stationary criterion. Therefore the description for this indication is different. |
| LG | No | We do not think the combination indication is needed. We think the UE can perform RRM relaxation if all the configured conditions are met. |
| Sequans | Yes | Prefer the flexibility and similarity to R16 (assuming RAN4 can define different relaxations) |
| DENSO | Yes | If the same method as Rel-16 RRM relaxation is followed, it could be possible to cover both the case where only the stationary is satisfied and the case where both the stationary and NACE are satisfied. |
| Samsung | No | What we understand about this new indication,  1) When this new indication is set, UE performs RRM relaxation only when both stationary and NACE criteria are fulfilled.  2) Otherwise (i.e., When this new indication is unset), UE performs RRM relaxation when stationary criterion is fulfilled.  In case 2), we "assume" to use the same RRM measurement method no matter whether NACE criteria fulfilled or not. Under this assumption, this new indication is not needed, since NW is able to configure both cases without this indication (i.e., For case 1 NW can configure both criteria, and for case 2 NW can configure only stationary criterion).  However, as mentioned by MediaTek, we are fine to ask RAN4 whether this assumption is valid. |
| CATT | Depends on RAN4 | We agree with MediaTek. As a recall, in RAN2#113bis-e, RAN2 Vice-Chair captured the following note regarding the agreement for supporting of not-at-cell-edge criterion on top of stationary criterion:  *Vice-Chair observes that there is a general understanding that, if RAN4 will decide not to specify a different R17 relaxation mechanism based on the combined criterion (R17 stationarity criterion/criteria together with a not-at-cell-edge criterion), depending on whether not-at-cell-edge criterion is met or not, RAN2 will have to reconsider this agreement.* |
| Spreadtrum | Yes | It is flexible, but depends on RAN4. |
| Fraunhofer | Yes | Not strictly necessary, but it is useful to have the flexibility. |

## 3.2 Issues related to signaling

At RAN2#115-e, RAN2 agreed that

Agreements via email - from offline 110:

1. Do not introduce beam change based criterion in Rel-17.
2. The network provides the configuration of stationarity criterion to the UE via dedicated signalling (e.g. RRCReconfiguration message) in RRC\_CONNECTED.

A remaining issue is whether relaxation criteria can be configured by broadcast, in addition to dedicated signaling. In [3], it is argued that configuration by broadcast (e.g. in system information) should be supported as well. Whereas [4] and [5] argue that relaxation criteria can be configured by only dedicated signaling.

**Q3**: Which of the following two options for configuring relaxation criteria in RRC Connected do you support?

* Option 1: Relaxation criteria are configured by only dedicated signaling;
* Option 2: Relaxation criteria can be configured by either dedicated signaling or broadcast.

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| --- | --- | --- |
| Company | Option 1/2 | Comments |
| OPPO | Option 1 | We think dedicated signalling is sufficient for RRC connected mode, which is similar to the current RRC connected mode measurement configuration |
| ZTE | Option 1 | We think using dedicated signalling is sufficient.  We understand companies who support Option 2 want to reduce the signalling overhead of dedicated RRC, and they think a common configuration can be reused for both IDLE/INACTIVE and CONNECTED UEs. However, only two parameters are introduced in dedicated RRC, so the overhead is negligible.  On the other, most likely network will configure different thresholds for RRC\_CONNECTED UEs, because of the concern of handover performance impact. |
| Apple | Op1 is ok |  |
| MediaTek | Option 1 |  |
| Nokia | Option 1 |  |
| Qualcomm | No strong view | We can follow the majority |
| Futurewei | Option 1 | The dedicated signaling can be as simple as one flag bit plus an optional IE. The flag bit indicates whether the relaxation criteria for RRC\_CONNECTED for that UE are exactly same as the broadcasted relaxation criteria for RRC\_IDLE/RRC\_INACTIVE or not. If the flag bit is true, the optional IE is not included in the dedicated signaling and the UE copies the broadcasted relaxation criteria for RRC\_IDLE/RRC\_INACTIVE and uses them for RRC\_CONNECTED; if false, the optional IE is included in the dedicated signaling to provide the relaxation criteria for RRC\_CONNECTED for that UE. The NW can set the flag bit differently for different UEs. |
| Intel | Option 1 | RAN2 already agreed “Do not introduce nor reuse not-at-cell-edge threshold for R17 RRC\_CONNECTED UEs.”. Therefore the handling on RRM\_Relaxation criterion is already different for RRC\_IDLE and RRC\_CONNECTED RedCap UEs. We have to define how to handle the criterion defined in broadcast signalling for RRC\_CONNECTED UEs if R17 not at cell edge is broadcasted in system information. In addition, the threshold for RRC\_CONNECTED and RRC\_IDLE could be different, and if broadcast signalling is used, we may have to introduce additional set of threshold for RRC\_CONNECTED.  This would increase the signalling overhead a lot since the network has to send it periodically no matter whether there is RedCap UEs in the cell or not . Considering RAN2 already agreed to introduce dedicated signalling to configure criterion for RRC\_CONNECTED, we do not see the need to introduce broadcast signalling for RRC\_CONNECTD UE. |
| Huawei,HiSilicon | Option 1/2 | No strong view. Option 2 works if the principle of using broadcast is defined clearly, e.g. if the threshold to be configured in RRC\_connected state is the same as the threshold broadcast in SI, the threshold broadcast in SI can be used without additional dedicated configuration. |
| Sharp | No strong view | We are fine to follow the majority. |
| Xiaomi | Option 1 | Same view as ZTE. |
| LG | Option 1 | We think dedicated signaling is enough. Measurement configuration in connected mode should be UE-specific. |
| Sequans | Option 1 | Agree with ZTE, though could go with option 2 as well |
| DENSO | Option 2 | For example, for multiple sensors installed in a factory, broadcast settings may be effective. |
| Samsung | Option 1 |  |
| CATT | Option 2 | We see not reason why it should not be possible for a UE in Connected to reuse the configuration broadcasted in the cell, if NW does not configure any via dedicated signaling. |
| Spreadtrum | Option 1 | Agree with ZTE. |
| Fraunhofer | No strong view | We are fine to follow the majority |

At RAN2#114-e, RAN2 agreed that UE in RRC Connected informs network when it meets configured relaxation criteria. Network then decides whether/how to enable RRM relaxations for the UE.

Agreements:

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)

The motivation behind the above agreement is that RRM relaxations in RRC Connected should be under full control of network. Then an issue which has not been discussed yet is whether UE needs to report to network when it no long meets the relaxation criteria. The answer to this question may depend how network enables relaxation ([1][4]). For example, if network enables relaxation by reconfiguring UE’s measurement configuration, then UE definitely needs to report to network when it no longer meets the relaxation criteria. On the other hand, if network enables relaxation by providing UE with a scaling factor to its measurement parameters (e.g. measurement periodicity), then perhaps UE can exist relaxation by itself (i.e. fallback to its default measurement configuration without involving network).

**Q4:** Do you think UE should report to network when it no longer meets relaxation criteria?

* Option 1: Not needed;
* Option 2: UE should report to network when it no longer meets relaxation criteria;
* Option 3: Depends on how network enables/disables UE’s relaxation (e.g. by reconfiguring UE’s measurement configuration vs configuring a scaling factor for UE’s measurements, etc).

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| --- | --- | --- |
| Company | Option 1/2/3 | Comments |
| OPPO | Option 2 | Since RRM measurement relaxtion should be under control of NW, NW needs to be aware of whether the criterion is met or NOT. |
| ZTE | Option 2 | Network needs to know this information to update the RRM relaxation strategy. |
| Apple | Op2 |  |
| Ericsson | Option 2 | It is critical that the NW knows when relaxation must be stopped so as to not hurt system performance. |
| MediaTek | Option 2 |  |
| Nokia | Option 2 |  |
| Qualcomm | Option 2 |  |
| Futurewei | Option 2 | The NW should be informed of the change asap. |
| Intel | Option 2 | It should be fullly controled by network. The network should be aware of situation. |
| Huawei,HiSilicon | Option 2 | The RRM relaxation in RRC\_connected state is fully under NW control. |
| Sharp | Option 2 |  |
| Xiaomi | Option 2 | We think this is important and more details is that when UE report leaving criterion, it is recommended that UE should directly use normal measurements. Otherwise it is required that network configures another configuration (i.e. normal measurement) to UE. Therefore the details should be FFS. |
| LG | Option 2 | The measurement in the connected mode should be fully under network control, so whenever the UE enters/leaves relaxation criteria, it should be reported to the network and the network re-configures the measurement configuration. |
| Sequans | Option 2 | Agree with above. |
| DENSO | Option 2 | We agree with OPPO. |
| Samsung | Option 2 |  |
| CATT | Option 2 |  |
| Spreadtrum | Option 2 |  |
| Fraunhofer | Option 2, but | It is really important that the UE can leave relaxation timely. Therefore, if possible the UE should immediately restart regular measurement rate and only then report. Exiting the RRM relaxation immediately when the condition is not fulfilled anymore is in the interest of both the network and the UE. |

The issue of how UE may inform network was discussed in RAN2#114-e and RAN2#115-e without conclusion, because companies’ views were split between two approaches:

* Option 1: UE sends its report by UAI. The details of this approach may be found in, e.g. [1][2][3][4];
* Option 2: Reuse RRM measurement framework by defining new measurement reports for the event. The details of this approach may be found in, e.g. [5].

Please note that if companies agree UE should inform network when it no longer meets the relaxation criteria as well, then ideally, this signaling method we choose should work for both events (i.e. UE has met the criteria AND UE no longer meets the criteria).

**Q5**: Which of the two options above do you think UE should use to inform network when it has met the relaxation criteria and when it no longer meets the criteria (if Option 2/3 in Q4 is agreed)?

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| Company | Option 1/2 | Comments |
| OPPO | Option 2 | Option 2 is a more straightforward way. New measurement event(s) for stationary criterion can be introduced. When the configured stationary criterion is fulfilled, UE shall trigger a measurement report. |
| ZTE | Option 1 | We used to support Option 2, but after careful consideration, we think Option 1 is more suitable, because UE only needs to indicate whether criterion is met or not, there is no need to report RRM results to network side, then Option 1 is sufficient. |
| Apple | Op1 |  |
| Ericsson | Option 1 | The RRM measurement framwork is for reporting RRM measurements. The fulfillment of the RRM relaxation criteria is more of a UE assistance information, hence the UAI framework is a good fit (which also is simple to implement as shown in R2-2110564. |
| MediaTek | Option 1 | Not a strong preference – option 1 looks simple. |
| Nokia | Option 2 | We slightly prefer measurement reporting because it would natural to define entry and exit conditions for this reporting. |
| Qualcomm | Option 1 | We share the same view as Ericsson. |
| Futurewei | Option 1 |  |
| Intel | Option 2 | Measurement related configuration should be configured via RRM measurement framework no matter whether measurement report is needed or not; It can provide sufficient flexibility to support it as following:   * + - * *Hysteresis, timeToTrigger* can be reused in order to avoid pingpong/frequent reporting;       * *rsType* can be used to indicate what RS should be used for measurement;   We do not see the need to introduce similar mechanism again outside of RRM configuration |
| Huawei,HiSilicon | Option 1 | UAI will not carry the measurement results and Meas Id compared with Measurement Report message, so it is a simpler and less overhead method. |
| Sharp | Option 2 | Option 2 is easier to report entering or leaving stationarity and is future proof. |
| Xiaomi | Option 2 | Now we analyse measurement report:  First measurement report is more match to measurement event if we put criterion into measurement event. Second, if only 1 bit is required, we think the measID (which is bind to a event) can indicate. Third, when UE is no longer to meet criterion, measurement report should be responsible to inform UE that this is a leaving report.  There are indeed some enhancement for measurement report...  But if majority want to use UAI, then we suggest the criterion should not be put into measurement event, we can design it as similar as S-measure mechanism today(which is not related to measurement report). |
| LG | Option 2 | We prefer to reuse RRM measurement framework. As the measurement configuration by the network is based on measurement report, it is reasonable to indicate that the UE enters/leaves stationary state in the measurement report. |
| Sequans | Option 1 | For simplicity and to save overhead. As for future proofing, we can always define a new measurement report; it is not necessary to complicate things that much ahead of time with no clear future need |
| DENSO | Option 1 | We think UAI is sufficient if the UE only needs to report the stationary state to the NW. |
| Samsung | Option 1 | We prefer more simple approach |
| CATT | Option 1 | Agree with above views that we would need to define a measurement object although UE only needs to report meet/not meet which UAI is well suited for. |
| Spreadtrum | Option 2 | We slightly prefer Option 2, as it is easy to use measurment event defining entry and leaveing conditions. |
| Fraunhofer | Option 2 | The goal of RRM relaxation is to decide whether measurements are needed or not, based on measurements. Thus, reusing the RRM measurement framework keeps the whole feature together. Option 1 would imply a UAI signaling may trigger an RRM measurement re-configuration. This may complicate testing.  In addition to that, other RRM relaxation criteria may be introduced in future releases. The RRM measurement framework can support any conceivable criteria, whereas for UAI for each new addition it would be a new standardization process. In other words, option 2 is future proof, but option 1 is not. |

Another issue related to UE reporting is whether any restriction should be imposed on how often UE may report. In [3], it is proposed that a prohibit timer can be introduced to ensure that UE does not send more reports claiming to be stationary while the timer is running. In [4], it is proposed that UE sends its report only once when RRM relaxation criteria are fulfilled or are not long fulfilled. Multiple reporting is not supported and prohibit timer is not used.

**Q6**: Do you think any mechanisms (e.g. prohibit timer) should be used to ensure UE does not report too often that it has met the relaxation criteria or it no longer meets the relaxation criteria (if Option 2/3 in Q4 is agreed)? The exact mechanism(s) can be FFS.

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| --- | --- | --- |
| Company | Yes/No | Comments |
| OPPO | No | If we reuse measurement reporting framework, we don’t have such issue. |
| ZTE | No | The indication should be very simple: {fulfilled, not fulfilled}, there is no complex status (unlike overheating), so UE only needs to inform network when status is reversed (fulfilled-> not fulfilled, not fulfilled -> fullfiled), network knows UE’s status after receiving the indication, no need to send it multiple times. |
| Apple | No |  |
| Ericsson | Yes | Prohibit timers is already part of the UAI-framework, we assume they should be used also for this. Even if this may turn out to just be a bit, the same motivation holds for this report as for the other reports (see examples below). Namely, the network need to be able to control the reporting the UE does. Sure well-behaving UEs may not be a problem, but the network must be able to safeguard against not-so-well-behaving UEs.  We dont see this as controversial, but rather just a way we usually do things...  A few examples:  1> if configured to provide overheating assistance information:  2> if the overheating condition has been detected and T345 is not running; or  2> if the current overheating assistance information is different from the one indicated in the last transmission of the *UEAssistanceInformation* message including *overheatingAssistance* and timer T345 is not running:  3> start timer T345 with the timer value set to the *overheatingIndicationProhibitTimer*;  3> initiate transmission of the *UEAssistanceInformation* message in accordance with 5.7.4.3 to provide overheating assistance information;  1> if configured to provide its preference on DRX parameters of a cell group for power saving:  2> if the UE has a preference on DRX parameters of the cell group and the UE did not transmit a *UEAssistanceInformation* message with *drx-Preference* for the cell group since it was configured to provide its preference on DRX parameters of the cell group for power saving; or  2> if the current *drx-Preference* information for the cell group is different from the one indicated in the last transmission of the *UEAssistanceInformation* message including *drx-Preference* for the cell group and timer T346a associated with the cell group is not running:  3> start the timer T346a with the timer value set to the *drx-PreferenceProhibitTimer* of the cell group;  3> initiate transmission of the *UEAssistanceInformation* message in accordance with 5.7.4.3 to provide the current *drx-Preference*;  1> if configured to provide its preference on the maximum aggregated bandwidth of a cell group for power saving:  2> if the UE has a preference on the maximum aggregated bandwidth of the cell group and the UE did not transmit a *UEAssistanceInformation* message with *maxBW-Preference* for the cell group since it was configured to provide its preference on the maximum aggregated bandwidth of the cell group for power saving; or  2> if the current *maxBW-Preference* information for the cell group is different from the one indicated in the last transmission of the *UEAssistanceInformation* message including *maxBW-Preference* for the cell group and timer T346b associated with the cell group is not running:  3> start the timer T346b with the timer value set to the *maxBW-PreferenceProhibitTimer* of the cell group;  3> initiate transmission of the *UEAssistanceInformation* message in accordance with 5.7.4.3 to provide the current *maxBW-Preference*; |
| MediaTek | No |  |
| Nokia | No | With measurement reporting entry and exit condition there is no issue. There is no need to send the same report multipple times. |
| Qualcomm | No | The use of this UAI for RRM relaxation is different from other UAIs, which allow UE to indicate preference among a range of values and parameters (e.g. UAI for power savings). But this UAI is binary, i.e. out of its own interest, UE only needs to send it once and then does not need to send it more. |
| Futurewei | No | The UE should report only once when the status regarding the fulfillment is toggled. No prohibit timer is needed. |
| Intel | Yes | If measurment events is used, Hysteresis, timeToTrigger and measurement exit condition, etc can be reused in order to avoid pingpong/frequent reporting; But do not need to introduce new thing.  If UAI is used, measurement related mechanism has to be introduced. |
| Huawei,HiSilicon | Yes | To avoid frequently report, UE only reports to network when UE changes its stationarity. |
| Sharp | Yes |  |
| Xiaomi | Yes | No matter measurement report or UAI, we understand this question is to avoid frequent report, i.e. UE fulfilling and leaving criterion frequently. But it is noted that we should only restrict the fulfilling criterion rather than leaving criterion. |
| LG | No | Such additional mechanisms are not needed. UE just reports whenever it enters/leaves stationary state. |
| Sequans | Yes | Each indication (criteria met/not met) should be sent only once. However, sending too frequent indications due to ping-pong in the status of meeting the criteria should be prevented as well. |
| DENSO | Yes |  |
| Samsung | No | UE needs to report only when its stationarity change. No need to send the same report repeatedly. Besides, if prohibit timer is used, UE may not report its changed stationarity to NW, resulting in wrong configuration from NW. (e.g., While UE is moving, NW configures relaxed RRM measurement) |
| CATT | Yes | We share the same view as Ericsson. Prohibit timer is a key feature of UAI preventing UE flooding the NW with reports. This could happen in this situation if the UE is at the boundary of meet/no meet and switches back and forth from one state to the other. |
| Spreadtrum | No | No need to use this timer if measurment event is used. |
| Fraunhofer | No | We agree with OPPO. This issue only needs to be discussed if UAI mechanism is chosen (another advantage of reusing measurement reporting). Still, if UAI is chosen there should be no prohibit timer when exiting relaxation (see [3]) in order to avoid unnecessary radio or handover failures. |

In [2], it is proposed that when UE enters RRC Connected from RRC Idle/Inactive and UE has either previously successfully fulfilled the relaxation criteria or is performing relaxed measurements, it can provide that information to network. Such information may help network decide whether/how to configure relaxation criteria for the UE.

**Q7**: Do you think such information is useful for UE to provide during its transition from RRC Idle/Inactive to RRC Connected?

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | No | This is a non-essential optimization. Considering the limited time left in R17, we propose to focus on essential issues first. The optimization can be considered in later release. |
| ZTE | No | We see no hurry in informing network the RRM relaxation status in idle/inactive, and mostly likely different thresholds will be configured for RRC\_CONNECTED UEs, so such information may not useful after UE enters RRC\_CONNECTED. |
| Apple | No |  |
| Ericsson | No. Current framework sufficently good? | If the UE enters connected and gets configured with reporting of RRM relaxation reporting, the UE can send the report if it fulfills the conditions. If the UE looks back to the time when the UE was in IDLE when evaluating this, that is perfectly fine. So what is proposed above seems to just be an optimization, which we shouldnt do. |
| MediaTek | No |  |
| Nokia | Yes | We think that this is useful, in some cases where NW allows, the UE would be able to continue relaxation in RRC connected without re-evaluating whether condtion is met or not. This would save UE battery. |
| Qualcomm | No | Agree with the comments above. |
| Futurewei | No strong view but incline to No | We need to be mindful that some NW may not want UEs in RRC\_CONNECTED to perform any RRM relaxation at all. So, it may be wasteful for the UE to provide such information. |
| Intel | No | The information used for IDLE/INACTIVE could be different from RRC\_CONNECTED. |
| Huawei,HiSilicon | No | The relaxation threshold for RRC\_Connected is different with relaxation threshold for RRC\_Idle/Inactive generally, so such information may not be useful. The UE still needs to further check the relaxation criteria for RRC\_Connected if RRM relaxation is enable by the NW. |
| Sharp | No | Agree with ZTE and Huawei |
| Xiaomi | No | This make things complicated and we are not expecting that the configuration between RRC\_IDLE/INACITVE and RRC\_CONNECTED are always same. We see no hurry to do the relaxation. |
| LG | Yes | As the network does not know the UE’s previous stationarity in RRC\_IDLE/INACTIVE, if it is informed that the UE fulfilled the relaxation criteria, the network can directly provide measurement relaxation for RRM relaxation. If not, the network might provide normal measurement configuration, and then re-configure the measurement configuration if the UE reports its stationarity. It brings additional signalling and the UE should consume additional power for the measurement. |
| Sequans | No | Since the indication is minor and the thersholds are different, It is an unnecessary and probably unuseful optimization. |
| DENSO | No | We think it is enough to report entering / leaving the stationary state. |
| Samsung | No | We do not see clear benefit of it. |
| CATT | Yes | We think it is useful information for the NW to know, and that UE already has. Especially for RRC resume procedure, NW can configure RRM relaxation upon the RRC resume procedure complete immediately |
| Spreadtrum | No |  |
| Fraunhofer | No | In our view, the usefulness of such information depends on network implementation. It may not be used at all. |

In [5], it is proposed that to allow UE to continue relaxing its RRM measurement after its RRC connection is released, NW can indicate to the UE via dedicated RRC signaling whether and which criteria for RRM relaxation is considered satisfied after leaving RRC\_CONNECTED state.

**Q8**: Do you think such an indication is useful when UE transitions from RRC Connected to RRC Idle/Inactive?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | No | See our comments to Q7. |
| ZTE | No | Similar comments to Q7. |
| Apple | No |  |
| Ericsson | No | UE can look back in time, based on implementation. No need for additional signalling. |
| MediaTek | No |  |
| Nokia | Yes | The UE should be allowed to continue relaxation in idle/inactive in case the relaxation criteria was met in connected in case criteria is same or stricter in connected |
| Qualcomm | No | We also think it is an non-essential optimization. |
| Futurewei | No |  |
| Intel | No | The criterion and the RRM relaxation used in RRC\_CONNECTED are different for RRC IDLE and INACTIVE. |
| Huawei,HiSilicon | No | If the UE leaves RRC\_CONNECTED state, it follows the configuration in SI. |
| Sharp | No |  |
| Xiaomi | No | Similar as Q7 |
| LG | No | When the UE enters RRC\_IDLE the UE performs cell selection, so the new serving cell may not be supporting RRM relaxation. |
| Sequans | No |  |
| DENSO | No | If a UE in RRC\_CONNECTED is in the steady state and transition to RRC\_IDLE / RRC\_INACTIVE in that state, we think that the UE may continue in the stationary state even if there is no indication from the NW. |
| Samsung | No |  |
| CATT | No |  |
| Spreadtrum | No |  |
| Fraunhofer | No |  |

In [1], it is proposed that if a UE in RRC Connected detects that it is stationary or has low mobility but it is not configured with any RRM relaxation criterion yet, UE may send UE Assistance Information to request network to configure relaxation criteria for it to evaluate.

**Q9**: Do you support allowing UE in RRC Connected to send UE Assistance Information to request network to configure it with relaxation criteria?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| OPPO | No |  |
| ZTE | No |  |
| Apple | No |  |
| Ericsson | No | So we have already agreed that the UE can be configured with a criteria for the UE to report that the UE fulfills RRM relaxation criteria.  This proposal is that the UE can report that it wants to get configured with the reporting for the RRM relaxation criteria? But such reporting functionality would of course (like any UL reporting) have to be configured by the network  But what if that (second-level) reporting-functionality is not configured? Should the UE request that it wants to get configured with the second-level reporting? I.e. a **third-level** reporting saying that the UE wants to be configured to be allowed to send a report which indicates that the UE wants to configured with reporting that indicated that the UE wants to be configured with reporting for fulfillment of RRM measurement relaxation?  But what if that (third-level) reporting is not configured?  You see where we are going...  [QC] There seems to be some misunderstanding of the proposal. What is proposed is that if UE detects it is stationary or has low mobility but network does not configure it with any R17 relaxation criteria, it can use UAI to request network to configuration relaxation criteria for it. It is not about UE requesting to be able to report it has met relaxation criteria. |
| MediaTek | No |  |
| Nokia | No | It is sufficient that network knows if the UE supports relaxation. NW can then enable relaxation for such UE. |
| Qualcomm | Proponent |  |
| Futurewei | No strong view but incline to No | If we understand the scenario correctly, the UE (in RRC\_CONNECTED) observes that it has fulfilled the stationarity criterion broadcasted for RRC\_IDLE/RRC\_INACTIVE and therefore sends UAI to inform the NW (and implicitiyl request the NW to configure an R17 relaxation criterion for RRC\_CONNECTED to evaluate).  We need to be mindful that some NW may not want UEs in RRC\_CONNECTED to perform any RRM relaxation at all. So, it may be wasteful for the UE to automonously send the UAI. |
| Intel | No | It is optimization. Do not see why the UE needs to request the network. It should be network decision whether to relax UE measurements. If allowed, then the network will configure the criterion to the UE. |
| Huawei,HiSilicon | No | The NW decides the configuration for RRM relaxation based on UE capability, if the NW does not allow the UE to perform RRM relaxation, the UAI for request does not provide more useful information to the NW, anyway the configuration is up to NW implementation. |
| Sharp | No | Not sure how the UE decides whether it is stationary or has low mobility even without gNB’s criterion configuration. |
| Xiaomi | No |  |
| LG | No | The network is already aware of UE’s measurement reports, so it is network’s decision how to configure the measurement configuration. So the request is not needed. |
| Sequans | No | This seems related to Q6. Allowing this would just complicate things without giving the NW additional information. |
| DENSO | Yes | Since the UE saves power, it may be meaningful for the UE to be able to request the configuration from the NW. |
| Samsung | No |  |
| CATT | No |  |
| Spreadtrum | No | Whether performs RRM relaxation in Connected is controlled by the network and it will decide the related configuration based on UE capability. |
| Fraunhofer | No | From complexity point of view, it is better to assume that if the network does not configure RRM relaxation for a UE which is capable of doing that, it is because the network does not want to allow relaxation at all. |

## 3.3 Methods for enabling/disabling relaxations

In RRC Connected, after network receives UE’s report that it has met relaxation criteria, network can have different ways to enable relaxation. For example, network can do so by reusing the existing RRM measurement framework, i.e. it can reconfigure UE’s measurement configuration [3]. With this approach, when UE no longer meets the relaxation criteria, UE has to inform network of its new status so that network can reconfigure UE back to its default measurement configuration.

Additional methods may be possible too. For example, in [5] it is proposed that in addition to reconfiguring UE’s measurement configuration, network may also configure UE with a scaling factor to give UE longer measurement intervals or stop measurement for some time. With this approach, UE may autonomously fallback to its default measurement configuration when it no longer meets the relaxation criteria.

**Q10**: From RAN2’s perspective, which option do you think should be supported for network to enable/disable UE’s relaxation?

* Option 1: Reuse the existing RRM measurement framework (no spec impact);
* Option 2: Network enables relaxation by configuring additional parameters (e.g. scaling factors) for UE to apply to its measurement configuration.
* Option 3: Both Option 1 and 2 can be supported.

|  |  |  |
| --- | --- | --- |
| Company | Option 1/2/3 | Comments |
| OPPO | Option 1 and other options | We agree to use option 1 as baseline. Besides, we propose to introduce dynamic network control of RRM measurement relaxation via MAC CE , which could also reduce signalling overhead due to RRC reconfiguration and be faster than RRC signaling. |
| ZTE | Option 1 | Unless Option 1 is proved to be insufficient, we see no need to spend time to discuss other solutions, especially because it is hard to reach consensus among the proposed various solutions. |
| Apple | Op1 |  |
| Ericsson | Option 1 | Agree with ZTE. |
| MediaTek | Option 1 |  |
| Nokia | Option 1 and depends on RAN4 | RAN4 should define how the relaxation is achieved in case criterion is met and reported to the nw. NW should be able to allow / disallow relaxations after the UE has reported whether the condition is met or not. |
| Qualcomm | Option 1 and depent on RAN4 | Agree with Nokia |
| Futurewei | Option 1 |  |
| Intel | Option 1 | Depends on RAN4 decision on what RRM relaxation would be for CONNECTED Ues. In general, we think existing way is sufficient. |
| Huawei,HiSilicon | Depent on RAN4 | If the RRM relaxation needs to be specified, it should first be discussed in RAN4. Generally we don't think additional parameters needs to be introduced, the NW can adjust the measurement configuration, e.g. configures a new SMTC with longer measurement period, which can be used when UE meets the stationary criteria. |
| Sharp | Depend on RAN4 |  |
| Xiaomi | Option 1 | For RRC\_CONNECTED, we recommend RRM measurement framework. |
| LG | Option 1 | Reusing the existing RRM measurement framework is simple approach. |
| Sequans | Option 1 and depends on RAN4 | Agree with Nokia |
| DENSO | Option 3 |  |
| Samsung | Up to RAN4 | RAN4 should decide it. |
| CATT | Option 1 |  |
| Spreadtrum | Option 1 |  |
| Fraunhofer | Option 3 | Option 1 is definitely the baseline. So why considering also scaling factors?  The main advantage of introducing scaling factors is, as described “With this approach, UE may autonomously fallback to its default measurement configuration when it no longer meets the relaxation criteria.” As argued in our contribution, as well as other contributions, leaving RRM relaxation timely is essential for RRC\_CONNECTED mode.  A second advantage is that the scaling factors may be applied separately to different measurement objects. This would open the possibility to relax less important measurements while keeping more important measurements. (see answer to section 3.5) |

## 3.4 Misc issues

RAN2 have not made any official agreements on UE behaviors when both R16 and R17 relaxation criteria are configured. In [3] and [5], it is argued that there is no need to specify complex rules saying what UE should do when R16 and/or R17 criteria are fulfilled, etc. It should be left to UE implementation to select either R16 or R17 relaxations.

**Q11**: Do you agree that it is up to UE implementation how to apply relaxations when both R16 and R17 relaxation criteria are configured and UE meets both criteria?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| OPPO | No | If RAN2 decide to specify more relaxed RRM measurement method for stationay UEs compared with that for R16 low mobility UEs, for UEs who meets both R16 and R17 relaxation criteria, we see no motivation for these UEs to apply R16 relaxation instead of R17 relaxation. |
| ZTE | Yes | Current 38.304 uses “may“ to describe UE behaivour, so it is not mandatory behaviour, thus when both R16 and R17 criteria are configured and fullfiled, we think it is up to UE to decide which RRM relaxation method is taken.  Then descriptions in TS38.304 can be simple (no need to care the order).  1> If xx criterion is fullfiled,  2> the UE may choose to perform relaxed measurements for balabala.... |
| Apple | Yes |  |
| Ericsson | Wait for RAN4 | After discussions with our RAN4 colleauges, we should perhaps wait to see exactly what type of relaxation they come up with.  We also have this agreement:  2. Postpone the following discussion until RAN4 defines RRM relaxation method for Rel-17:  When NW configures both R16/R17 relaxation criteria and the UE fulfills both, UE performs:  - Option 1) UE performs Rel-17 RRM relaxation method  - Option 2) It is up to UE implementation to select either Rel-16 or Rel-17 relaxation operation |
| MediaTek | Yes | So long as RAN4 requirements are met, the level of measurement relaxation when multiple criteria are fulfilled should be left to the UE’s implementation. |
| Nokia | No | The UE shall meet RAN4 requirements and it cannot be left up to UE implementation. |
| Qualcomm | Yes |  |
| Futurewei | Yes |  |
| Intel | Yes | It can be left up to UE implmentation. But we may change if RAN4 has different view. |
| Huawei,HiSilicon | Yes | We would like to clarify this is talking about RRM relaxation in RRC\_idle/inactive state. |
| Sharp | Yes |  |
| Xiaomi | Wait for RAN4 |  |
| LG | Yes | We do not need to specify this. |
| Sequans | Yes | Agree with Intel (can be agreed from RAN2 POV), HW |
| DENSO | Yes |  |
| Samsung | Wait for RAN4 | Agree with Ericsson |
| Fraunhofer | Yes |  |
| CATT | Wait for RAN4 | Per RAN2#114-e agreement:   1. Postpone the following discussion until RAN4 defines RRM relaxation method for Rel-17:   When NW configures both R16/R17 relaxation criteria and the UE fulfills both, UE performs:  - Option 1) UE performs Rel-17 RRM relaxation method  - Option 2) It is up to UE implementation to select either Rel-16 or Rel-17 relaxation operation |
| Spreadtrum | Yes |  |

R17 RRM relaxation criteria only depend on whether UE is stationary or has low mobility. They actually do not depend on certain reduced radio or upper-layer capabilities. Therefore, it is proposed in [1] and [4] that R17 RRM relaxation can be applied to both RedCap and non-RedCap UEs. However, [2] argues that R17 RRM relaxation should not be applied to non-RedCap UEs, because R16 “low mobility” and “not-at-cell-edge” relaxation criteria are already introduced for non-RedCap UEs.

**Q12**: Do you think R17 RRM relaxation can be applied to both RedCap and non-RedCap UEs?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| OPPO | Yes |  |
| ZTE | Yes | Same as eDRX, it is beneficial to apply R17 RRM relaxation to R17 non-RedCap UE. |
| Apple | Yes |  |
| Ericsson | Yes | "Yes" would result in fewer words/conditions in the spec. So "Yes" seems simpler. |
| MediaTek | Yes |  |
| Nokia | No | According to work item R17 RRM relaxation is only for RedCap UEs. |
| Qualcomm | Yes |  |
| Futurewei | - | We need to be care that many non-RedCap UEs may be stationary only temporaily. We certainly want to be cautious about extending the RRM relaxation for UEs in RRC\_CONNECTED to non-RedCap UEs. |
| Intel | Yes | Do not see the issue to apply it for non-RedCap Ues. |
| Huawei,HiSilicon | No | For non-RedCap UEs, R16 “low mobility” and “not-at-cell-edge” are already introduced. So far, we have not seen the scenarios and requirements that non-RedCap UEs needs R17 RRM relaxation. |
| Sharp | Yes |  |
| Xiaomi | Yes |  |
| LG | No | Basically we think it is up to RAN4 discussion, however, from RAN2 perspective, we do not need to include non-RedCap UEs because we have assumed the R17 RRM relaxation for RedCap UEs for extreme power saving. |
| Sequans | Yes | We don’t see a reason to further restrict. This may depend on RAN4 as well. |
| DENSO | Yes | We think that there is no technical difference in measurement or reporting between stationary state and low mobility state. |
| Samsung | Yes |  |
| CATT | Yes |  |
| Spreadtrum | Yes |  |
| Fraunhofer | Yes | A typical smartphone will often spend 8-12 hours in a location before the user move again. This is a great opportunity to save battery of those devices too. |

3.5 Any other issues to discuss

If you think there is an issue that is important but is not included in this document, please describe it in the table below.

|  |  |
| --- | --- |
| Company | Issue |
| OPPO | In Rel-16, a parameter highPriorityMeasRelax is used to control whether measurements on high priority frequencies can be relaxed beyond " Thigher\_priority\_search" when only low mobility criterion is configured and fulfilled, and when Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ.  For Rel-17 RRC idle/inactive mode RRM relaxation, when only Rel-17 stationary criterion is configured and fulfilled, and when Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, considering that Rel-17 stationary criterion is more stringent than Rel-16 low-mobility criterion, it seems reasonable to introduce more relaxed RRC measurement requirements for NR inter-frequency or inter-RAT frequency of higher priority frequencies for this case compared to K2\* Thigher\_priority\_search. However, this is fully up to RAN4. If RAN4 specifies new RRM relaxation method for higher priority frequencies, we think we should introduce a separate highPriorityMeasRelax-17 indication for R17 stationary UEs. In this way, network could control whether to allow measurements on high priority frequencies to be relaxed to K2\* Thigher\_priority\_search for low mobility UEs and/or to an even longer time interval (depending on the new RRM relaxation method) for stationary UEs in a more flexible way. |
| Fraunhofer | In RRC\_CONNECTED mode it is essential to attain mobility performance and at the same time relax measurements often, to maximize UE energy saving. These 2 goals can only be accomplished together if we define more targeted relaxation, where some measurements which are less important can be relaxed whereas those measurements which are more important for performance are not relaxed.  There are several contributions with proposals on that area:  R2-2109497 (OPPO) to relax bad beams more aggressively or not measure them at all. This is sensible for stationary devices as those beams are only measured to be discarded and it is not often that they will become good beams. The good beams instead are measured often and the performance can be attained.  R2-2109575 (Thales) proposes to configure inter frequency/RAT and intra-frequency separately. It also points as FFS whether relaxation should apply to all neighbor cells or a subset.  R2-2109588 (ours – Fraunhofer) proposes to allow relaxation in some neighbor cells whereas measurements of other cells (more important for performance) are not relaxed  R2-2110230 (LG) observes that it is beneficial that the UE report which frequency or cell has low quality, in order to relax those measurements.  Thus, we propose to have further discussion on how to achieve partial relaxation where measurements on some beams/cells/frequencies are more relaxed than others. |
|  |  |
|  |  |
|  |  |

1. Conclusion

TBD

1. References
2. R2-2109450, Remaining issues on RRM relaxation, Qualcomm Incorporated.
3. R2-2109579, RRM measurement relaxation for RedCap UE, Huawei, HiSilicon.
4. R2-2110564, Details on RRM relaxation, Ericsson.
5. R2-2109893, Further discussion on RRM relaxation for RedCap UE, ZTE Corporation, Sanechips.
6. R2-2109744, RRM relaxation for neighboring cell for RedCap UEs, vivo, Guangdong Genius.