**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?

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| Company | Yes/No | Comments |
| OPPO | Yes |  |
| ZTE | Yes | R17 RRM relaxation requires UE to at least fullfil the stationarity criterion. |
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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. |
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## 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. |
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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. |
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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. |
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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. |
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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. |
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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?

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| **Company** | **Yes/No** | **Comments** |
| OPPO | No | See our comments to Q7. |
| ZTE | No | Similar comments to Q7. |
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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?

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| Company | Yes/No | Comments |
| OPPO | No |  |
| ZTE | No |  |
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## 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.

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| 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. |
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## 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?

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| 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.... |
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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?

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| Company | Yes/No | Comments |
| OPPO | Yes |  |
| ZTE | Yes | Same as eDRX, it is beneficial to apply R17 RRM relaxation to R17 non-RedCap UE. |
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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.

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| 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. |
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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.