**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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| --- | --- |
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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. |
| Apple | Yes |  |
| Ericsson | Yes |  |
| MediaTek | Yes |  |
| Nokia | Yes |  |
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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. |
| 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. |
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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. |
| Apple | Op1 is ok |  |
| MediaTek | Option 1 |  |
| Nokia | Option 1 |  |
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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. |
| 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 |  |
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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. |
| 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. |
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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. |
| 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. |
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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. |
| 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. |
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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. |
| 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 |
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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 |  |
| 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... |
| MediaTek | No |  |
| Nokia | No | It is sufficient that network knows if the UE supports relaxation. NW can then enable relaxation for such UE. |
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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. |
| 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. |
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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.... |
| 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. |
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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. |
| 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. |
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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.