**3GPP TSG-RAN WG4 Meeting #94-e R4-20xxxxx**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item:** 8.7.3 & 8.7.3.1

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**Title:** Email discussion summary for RAN4#94e\_ #55\_NR\_UE\_pow\_sav\_RRM

**Document for:** Information

# Introduction

The documents in agenda items 8.7.3 and 8.7.3.1 contains the following topic and sub-topics under the topic:

* Topic #1: RRM measurement relaxation (AI 8.7.3.1)
	+ RRM measurement relaxation
	+ EMR impact in power saving mode
	+ RRM impact due to cross-slot scheduling power saving technique
* Topic #2: Impact on demod requirement due to MIMO layer adaption

# Topic #1: RRM measurement relaxation

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000152 | Vivo | Proposal 1: Use option 1 for scenario 1 and 2Proposal 2: Consider a scaling factor 6 to extend measurement interval when UE is at power saving mode.Proposal 3: RRM relaxation on different inter frequency layers could be treated separatelyProposal 4: Reducing number of inter frequency layers is not considered within this WIProposal 5: Following current logic in specification, applying same measurement requirement (either at relaxed mode or normal mode) for all inter frequency layer, no matter its priority when Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ. |
| R4-2000157 | Vivo | **ACTION:** RAN4 kindly asks RAN2 to investigate the possibility of introducing thresholds particularly for inter-frequency RRM measurement relaxation for UE power saving purpose. |
| R4-2000157 | Vivo | Observation 1: No matter how TdeltasearchP and SdeltasearchP are configured, ‘low-mobility’ criterion is not able to precisely differentiate whether the handheld UE is actually in low-mobility or not.Observation 2: If option 2 is adopted for ‘low-mobility’ scenario, there is some risk in UE paging reception and access ability after a valid paging, if power saving gain needs to be ensured.Observation 3: Due to grip, gesture, random rotation and body shadowing, the RSRP fluctuation of handheld UEs is much more severe than that of NB-IoT UEs.Observation 4: For ‘not-at-cell-edge’ scenario, if SintrasearchP and/or SnonintrasearchP are configured as more than 20dB, there is room and power saving gain for the second level RSRP thresholds. |
| R4-2000575 | CATT | Proposal 1: For scenario #1 and #2, option1 is proposed to define RRM measurement relaxation for UE power saving in NR.Proposal 2: If the measurement relaxation criteria are met, the measurement period can be extended to 4 times to achieve power saving gain.Proposal 3: When Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, if the relaxation criterions are fulfilled, no relaxation of the current measurement delay requirement is expected for inter-frequency measurement with higher priority.Proposal 4: When Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, if the relaxation criterions are fulfilled, the relaxed requirement for the frequency layer of higher priority shall have the same Tmeasure,NR\_Inter\_relax as those for the frequency layer of equal/lower priority.Proposal 5: Reducing the number of carriers to be measured cannot save power consumption.Proposal 6: For overlapping carriers, it is up to UE implementation whether to relax RRM measurement for fast CA/DC setup. Proposal 7: For non-overlapping carriers, there is no impact on EMR in power saving mode.Proposal 8: When UE receives DCI command with the configuration of cross-slot scheduling and active BWP switch, the active BWP switch delay should be Max(TBWPswitchDelay, K0/K2), where K0/K2 is the configured scheduling offset for cross-slot scheduling.Proposal 9: When UE receives DCI command with the configuration of cross-slot scheduling and TCI state switch, the TCI state switch delay should be Max(*timeDurationForQCL*, K0/K2), where K0/K2 is the configured scheduling offset for cross-slot scheduling. |
| R4-2000642 | CMCC | Proposal 1: It is proposed to adopt option 1 for scenario 1 and scenario 2 for RRM measurement relaxationProposal 2: It is proposed that the delay requirements in scenario 1 and 2 can be extended by 2 times for RRM measurement relaxation.Proposal 3: It is proposed that UE is not allowed to relax the RRM measurement requirement for inter-frequency measurement with higher priority. Proposal 4: if reducing number of frequency layer is considered in idle/inactive mode, it is proposed that UE only measure one carrier in each band. |
| R4-2000963 | LG Electronics Inc. | ***Proposal 1***: Define single relaxation method for scenario#1 and #2.***Proposal 2***: Use option 1 for scenario#1 and #2 to guarantee UE mobility***Observation 1***: Applying measurement relaxation to all neighbour cells or frequency layers could degrade UE mobility performance.***Observation 2***: The EMR frequency layer should be excluded from frequency layers using relaxed measurement mode.***Proposal 3***: Per-carrier based measurement relaxation should be considered to avoid UE mobility performance and EMR for power saving. |
| R4-2000989 | OPPO | Proposal 1: Do not introduce RRM measurement relaxation by reducing the number of frequency layer to be measured.Proposal 2: Support Option 1 that RRM measurement by relaxing measurements period with longer intervals for UE power saving for all scenarios.Proposal 3: Define a fixed scaling factor by N for RRM measurements with longer intervals for UE power saving in RRC\_idle/inactive state, e.g., N=2. |
| R4-2001343 | Nokia, Nokia Shanghai Bell | 1. RAN4 defines requirements for UE relaxation of UE measurements and reduction of the number of carriers the UE is required to monitor under the power saving WI.
2. Regard the option that UE is not required to meet the intra-frequency and inter-frequency neighbor cell measurement requirements as a special case of relaxed measurements.
3. Introduce RSRP/RSRQ serving cell measurement accuracy requirements for idle and inactive modes.
4. Option 3 can be applied for inter-frequency measurements, if Low Mobility and Not at Cell Edge conditions are fulfilled.
5. Option 3 can be applied for inter-frequency measurements if Not at Cell Edge condition is fulfilled.
6. Option 4 can be applied for inter-frequency measurement, if Low Mobility condition is fulfilled.
7. Option 5 can be applied for intra-frequency measurements for all power saving conditions.
8. UE power saving solution shall include a solution for flexible relaxation of UE inter-frequency measurements.
9. Introduce carrier specific search thresholds to facilitate better UE power savings.
10. Measurements on EMR carriers should not be relaxed if T331 is running.
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| R4-2001344 | Nokia, Nokia Shanghai Bell | **ACTION:** RAN4 kindly requests RAN2 to introduce carrier specific inter-frequency/RAT measurement search thresholds. |
| R4-2001654 | Huawei, HiSilicon | Proposal 1: UE is required to meet the relaxation measurement including serving cell and neighbour cells for scenario #1 and #2.Proposal 2: The extension factor for relaxed measurement can be configured by network for scenario #1 and #2.Proposal 3: Reducing the inter-frequency layers for measurement in idle mode can not bring power saving gain.Proposal 4: In scenario #1 and #2, the measurement result derived from relaxation measurement can still be applied in EMR.Proposal 5: In scenario #3, when UE is configured with EMR, UE will perform relaxation measurements. |
| R4-2001753 | Ericsson | **Observation:** The existing NR-DC interruption requirements related to DRX transitions, between active and non-active, and from non-DRX to DRX, can be reused when secondary DRX group is applied in NR CA operation involving FR1 and FR2.  |
| R4-2001753 | Ericsson | **ACTION:** RAN4 respectfully asks RAN2 to take the above information into consideration in future work. |
| R4-2001754 | Ericsson | **Proposal #1:** UEs operating in scenarios 1 and 2 are not required to meet the existing intra-frequency and inter-frequency neighbour cell measurement requirements.**Proposal #2:** If option 1 is selected, UEs operating in scenario 2 are less relaxed than in scenario 1 due to its high mobility.**Observation #1:** Existing procedures already contains tools to configure the number of frequency layers to be measured. **Proposal #3:** RAN4 shall not define new requirements for reducing the number of frequency layers to be measured. **Proposal #4:** Measurements of higher priority carriers shall not be relaxed in high mobility scenarios (scenario #2). **Proposal #5:** No RRM impact due to cross-slot scheduling using K0/K1 are received within the 1st three symbols. |
| R4-2001794 | MediaTek | Proposal 1: RAN4 to discuss the performance matrices and simulation assumptions that can be used to evaluate the scaling value of RRM measurement relaxation in IDLE mode, e.g., re-selection delay or serving cell quality before UE conducts the re-selection.Observation 1: Power consumption per unit time will not be changed when number of frequency layer to be measured is reduced.Proposal 2: For UE who supports both the IDLE mode RRM relaxation and EMR, UE shall also be allowed to relax the measurement period of the EMR carriers. |
| R4-2002137 | Qualcomm | Observation 1: Since UE must always monitor serving cell quality, there should not be any issue if UE stops performing intra-frequency and inter-frequency neighbour measurements if its mobility is low.Proposal 1: Select option 2 for scenario #1, i.e., low mobility scenario. Select option 1 for scenario #2, i.e., away from cell edge and high mobility scenario.Proposal 2: UE is not allowed to relax or enter any relaxed measurement modes, e.g. option 1 or option 2, if UE is configured with early measurement reporting (EMR) and T331 timer is running. |

## Open issues summary

### RRM measurement relaxation

**Issue 1-1: RRM measurement relaxation for scenario#1(Low mobility scenario)**

* Option 1: RRM measurement relaxation with longer intervals (Vivo, CATT, CMCC, LGE, OPPO, Huawei, Nokia)
* Option 2: UE is not required to meet the intra-frequency and inter-frequency measurement requirements (Ericsson, Qualcomm)
* Recommended WF
	+ Agree option 1

**Issue 1-2: If option 1 agreed, how to extend the measurement interval for scenario#1?**

* Option 1: 2 times (CMCC, OPPO)
* Option 2: 4 times (CATT)
* Option 3: 6 times (Vivo)
* Option 4: Up to network configuration (Huawei)
* Option 5: System level simulation (MediaTek)
* Recommended WF
	+ Need more discussion

**Issue 1-3: RRM measurement relaxation for scenario#2 (Not in cell-edge scenario)**

* Option 1: RRM measurement relaxation with longer intervals (Vivo, CATT, CMCC, LGE, OPPO, Huawei, Qualcomm)
* Option 1a: For intra-frequency measurement: option 1; for inter-frequency measurement: option 2 (Nokia)
* Option 2: UE is not required to meet the intra-frequency and inter-frequency measurement requirements (Ericsson)
* Recommended WF
	+ Agree option 1

**Issue 1-4: If option 1 agreed, how to extend the measurement interval for scenario#2?**

* Option 1: 2 times (CMCC, OPPO)
* Option 2: 4 times (CATT)
* Option 3: 6 times (Vivo)
* Option 4: Up to network configuration (Huawei)
* Option 5: System level simulation (MediaTek)
* Recommended WF
	+ Need more discussion

**Issue 1-5: RRM measurement relaxation threshold for inter-frequency measurement**

* Option 1: Introduce carrier specific search thresholds for measurement relaxation (Vivo, Nokia, LGE)
* Option 2: Up to RAN2’s decision (CATT)
* Recommended WF
	+ Need more discussion

**Issue 1-6: RRM measurement relaxation for inter-frequency layer with higher priority**

* Option 1:
	+ Option 1a (CATT, vivo, CMCC)
		- When Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, no relaxation of the current measurement delay requirement is expected for inter-frequency measurement with higher priority.
	+ Option 1b (CATT, vivo)
		- When Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, if the relaxation criterions are fulfilled, the relaxed requirement for the frequency layer of higher priority shall use the same relaxed measurement requirement as those for the frequency layer of equal/lower priority.
* Option 2: Measurements of higher priority carriers shall not be relaxed in high mobility scenarios (scenario #2) (Ericsson)
* Recommended WF
	+ Need more discussion

**Issue 1-7: RRM measurement relaxation by reducing the number of frequency layer to be measured**

* Option 1: Do not introduce RRM measurement relaxation by reducing the number of frequency layer to be measured. (Vivo, CATT, OPPO, Huawei, Ericsson, MediaTek)
	+ Reducing number of inter frequency layers is not considered within this WI (Vivo)
	+ Reducing the number of carriers to be measured cannot save power consumption (CATT)
	+ Do not introduce RRM measurement relaxation by reducing the number of frequency layer to be measured. (OPPO)
	+ Reducing the inter-frequency layers for measurement in idle mode can not bring power saving gain. (Huawei)
	+ RAN4 shall not define new requirements for reducing the number of frequency layers to be measured. (Ericsson)
	+ Power consumption per unit time will not be changed when number of frequency layer to be measured is reduced. (MediaTek)
* Option 2: if reducing number of frequency layer is considered in idle/inactive mode, it is proposed that UE only measure one carrier in each band. (CMCC)
* Option 3: RAN4 defines requirements for UE relaxation of UE measurements and reduction of the number of carriers the UE is required to monitor under the power saving WI. (Nokia)
* Recommended WF
	+ Agree option 1.

### EMR impact in power saving mode

**Issue 2-1: EMR impact in power saving mode**

* Option 1: Whether EMR frequency layer shall be relaxed or not is up to UE’s implementation. (CATT)
	+ For overlapping carriers, it is up to UE implementation whether to relax RRM measurement for fast CA/DC setup, for non-overlapping carriers, there is no impact on EMR in power saving mode.
* Option 2: EMR frequency layer shall not be relaxed. (LGE, Nokia, Qualcomm)
	+ The EMR frequency layer should be excluded from frequency layers using relaxed measurement mode. (LGE)
	+ Measurements on EMR carriers should not be relaxed if T331 is running. (Nokia)
	+ UE is not allowed to relax or enter any relaxed measurement modes, e.g. option 1 or option 2, if UE is configured with early measurement reporting (EMR) and T331 timer is running. (Qualcomm)
* Option 3: EMR frequency layer shall be relaxed. (Huawei, MediaTek)
	+ In scenario #1 and #2, the measurement result derived from relaxation measurement can still be applied in EMR. In scenario #3, when UE is configured with EMR, UE will perform relaxation measurements. (Huawei)
	+ For UE who supports both the IDLE mode RRM relaxation and EMR, UE shall also be allowed to relax the measurement period of the EMR carriers. (MediaTek)
* Recommended WF
	+ Need more discussion

### RRM impact due to cross-slot scheduling power saving technique

**Issue 3-1: RRM impact due to cross-slot scheduling power saving technique**

* Option 1: have RRM impact on DCI based delay requirement. (CATT)
	+ When UE receives DCI command with the configuration of cross-slot scheduling and active BWP switch, the active BWP switch delay should be Max(TBWPswitchDelay, K0/K2), where K0/K2 is the configured scheduling offset for cross-slot scheduling.
	+ When UE receives DCI command with the configuration of cross-slot scheduling and TCI state switch, the TCI state switch delay should be Max(timeDurationForQCL, K0/K2), where K0/K2 is the scheduling offset for cross-slot scheduling.
* Option 2: no RRM impact (Ericsson)
* Recommended WF
	+ Need more discussion

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| CATT | Sub topic 2.2.1: RRM measurement relaxationIssue 1-1: Support option1Mobility performance is one of important aspect which should be considered for NR UEs. In some case, NR UEs in power saving mode may enter normal mode, UE can use the neighbor cell measurement measured during power saving mode for potential cell reselection. If UEs drop the neighbor cell measurement during power saving mode, the mobility performance will not be guaranteed when UEs enter from power saving mode to normal mode.Issue 1-2: 4 times4 times is proposed based on the outcome of evaluation captured in 38.840. Since in SI phase, the similar system level evaluation has been carried out by RAN1, so there is no need to have another system level simulation. In addition, there is no time to have system level simulation.Issue 1-3: Support option1The same reason as issue 1-1.Issue 1-4: 4 timesThe same reason as issue 1-2.Issue 1-5: Up to RAN2’s decisionWe think it is RAN2’s job, RAN4 can discuss and analysis whether there is power saving gain can be achieved by reducing frequency carrier to be measured, but cannot decide to introduce the carrier specific threshold for inter-frequency measurement. Issue 1-6: Support option 1.In good coverage, the higher priority frequency measurements are already at their lowest rate, i.e. every 60s for each frequency layer. And the power saving gain is limit to further relax the measurement interval from 60s to a larger value. Thus, there is no relaxation for the higher priority frequency layers.In bad coverage case, since in Rel-15 legacy requirement, the measurement delay requirement for higher, equal and lower frequency layer are the same. So, in relaxation mode, we think the same relaxed requirements shall be have for higher, equal and lower frequency layer.Issue 1-6: Support option 1.Since the measurement requirements for inter-frequency layer are scaling with the number of carriers configured to be measured. And the UE power will not be increased with the same measurement interval for multiple carriers.Sub topic 2.2.2: EMR impact in power saving modeIssue 2-1: Support option 1.Whether UE is allowed to enter power saving mode is up to UE implementation. According to the running CR 38.304, the UE may relax choose to perform relaxed measurements if RRM measurement relaxation criterion is met. It is not mandatory. Thus, it is up to UE implementation whether to relax RRM measurement for fast CA/DC setup. If the UE wants to achieve fast CA/DC setup, it will not relax RRM measurement for early measurement reporting. Otherwise, it can relax RRM measurement for power saving.Sub topic 2.2.3: RRM impact due to cross-slot scheduling power saving techniqueIssue 3-1: Support option 1.Since the DCI decoding time can be longer to be parsed for power saving purpose, and the DCI decoding time is one part of delay requirements for BWP switching and TCI state switching. So the configurable value of K0/K2 will impact DCI based delay requirements, i.e. DCI based BWP switching delay and DCI based TCI switching delay. |
| Huawei, HiSilicon | Sub topic 2.2.1Issue 1-1: support Option 1 for scenario #1. It is risky to abandon the neighbor cell measurement as the UE may be around the cell edge area.Issue 1-2: support option 4. As network may have different preference in different scenario, the flexible method is that the extension factor is configured by network. For example, network can configure different relaxation factor for different scenario. Or the relaxation factor can also consider the UE mobility degree or location etc. Issue 1-3: Option 1 for scenario #2 as the UE with high speed may move to the cell edge and the handover judgment shall be based on the timely measurement results.Issue 1-4: same as Issue 1-2.Issue 1-5: agree with option 2. RAN2 had discussed the new threshold, whether the threshold is carrier specific is still FFS. Ran 4 can wait the conclusion in RAN2.Issue 1-6: Agree with option 1a and option 1b. RAN2 had agreement on the higher priority frequency that is “Whether higher priority frequencies can be relaxed is up to network configuration. FFS on how the configuration is done.” The criteria (when) of relaxation of higher priority frequency was decided by RAN2. RAN4 focus on how to relax the measurement.Issue 1-7: support Option 1.Sub topic 2.2.2Issue 2-1: support option 3. The motivation of EMR is to provide more information for network. This implies that EMR is not urgent and is like best effort. Then power saving shall not be subject to EMR. Sub topic 2.2.3Issue 3-1: The impact of cross slot scheduling on BWP switching was discussed in RAN1 for several meetings. No conclusion or consensus was made so far. In our understanding, the relaxed PDCCH processing time is related with minimum K0 when the minimum K0 is indicated to be larger than 0. The delta (compared with the normal BWP switching delay )due to minimum K0 shall be *TminK0 - TnormalPDCCHprocessing.* How to deduce the deltashall be carefully considered. |
| LG | Sub topic 2.2.1: RRM measurement relaxationIssue 1-1: support option 1If option 2 is considered, UE mobility performance could be impact. So UE needs to measure with longer interval during power saving mode.Issue 1-3: support option 1Similar reason with Issue 1-1, and we prefer the same UE behaviour for scenario#1 and #2.Issue 1-5: support option 1It would be RAN2’s scope. However, it could be critical issue for UE mobility performance depending on UE location if measurement relaxation applies all frequency layers when the UE meets the power saving mode conditions. Therefore, RAN4 needs to inform RAN2 that per-carrier based measurement relaxation should be considered.Issue 1-6: support option 1Based on RAN2 agreement, highPriorityMeasRelax could be configured by network, and ‘*How to relax measurement for higher priority frequency is up to RAN4 decision.*’. I think that RAN4 needs to discuss how to relax measurement for higher priority frequency, especially when Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ.Sub topic 2.2.2 : EMR impact in power saving modeIssue 2-1 : support option 2EMR has specific purpose for fast CA/DC setup, so it should be excluded from relaxed measurement mode at least while T331 timer is running. After expiring T331, it’s up to RAN2 decision.RAN2 has already agreed EMR issue; no relaxation for EMR while T331 timer is running. RAN4 does not need to discuss on this issue. |
| vivo | Sub topic 2.2.1: RRM measurement relaxationIssue 1-1: Support option1As analyzed in our contribution, option ‘low-mobility’ criterion is not able to precisely differentiate whether the handheld UE is actually in low-mobility or not and the RSRP fluctuation of handheld UEs is much more severe than that of NB-IoT UEs. Using option 2 for this scenario will have cause a few problems such as downgrade paging reception performance, limited power saving gain etc.Issue 1-2: 6 timesWe suggest to use the same factor as IncMon of LTE Rel-12 to get a reasonable power saving gain. Please note that the IncMon is already an implemented feature in LTE, and the mobility performance is not seriously, even though there is no restriction of ‘low mobility’ or ‘not-in-cell-edge’.Issue 1-3: Support option1Option 1 provides a good tradeoff between idle/inactive state mobility performance and UE power saving. One issue of option 2 is that a UE is possible to enter the relaxed stage when it stays around cell edge. Under this scenario a UE does not have the chance to either perform any neighbour cell measurement or collect enough samples from neighbour cell measurement for cell reselectionIssue 1-4: 6 timesThe same reason as issue 1-2.Issue 1-5: Suggest RAN2 to introduce thresholds for inter frequency layer RRM relaxationIssue 1-6: Support option 1.We suggest to follow procedures of the current specification for higher priority frequency layer measurement. If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, then the UE shall search for inter-frequency layers of higher priority at least every Thigher\_priority\_search , i.e., without any relaxation. If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, when a UE is no relaxed stage, uses relaxed measurement requirement for inter frequency measurement for all frequency layers; when a UE is at normal stage, use normal stage measurement requirement for all frequency layers.Issue 1-7: Support option 1.We think, for the power saving purpose, reducing number of frequency layers will not bring benefit for this purpose. Sub topic 2.2.2: EMR impact in power saving modeIssue 2-1: Out of WI scope. Can be solved by implementation.We think this topic is out of the current WI. Its priority shall be low and can be addressed after all topics in 2.2.1, which are included in the current WI, are finished.Sub topic 2.2.3: RRM impact due to cross-slot scheduling power saving techniqueIssue 3-1: wait for RAN1 conclusion.The related issue is being discussed in RAN1 email thread [100e-NR-UE\_pow\_sav-Cross\_Slot-02], and RAN4 should wait for RAN1 conclusion. |
| OPPO | Sub topic 2.2.1: RRM measurement relaxationIssue 1-1: support option 1. UE mobility performance will not be guaranteed for option 2.Issue 1-3: support option 1. Prefer the same UE behaviour for scenario#1 and #2.Issue 1-2 and 1-4: support option 1. Prefer a fixed scaling factor, without additional network signalling for power saving mode.Issue 1-5: support option 2. It depends on RAN2’s decision.Issue 1-6: support option 1a. Agree with Huawei the criteria (when) of relaxation of higher priority frequency was decided by RAN2. RAN4 focus on how to relax the measurement. Suggest to consider different relaxed measurement requirements for the frequency layers of higher priority and those of equal/lower priority. Issue 1-7: support option 1Sub topic 2.2.2 : EMR impact in power saving modeIssue 2-1: support option 2. UE is not allowed to relax EMR frequency layer, if UE is configured with early measurement reporting (EMR) and T331 timer is running. |
| CMCC | Sub topic 2.2.1: RRM measurement relaxationIssue 1-1: We support option 1Issue 1-2: We support option 1, network configuration (option 4) is a little bit complex for this feature. System level simulation (Option 5) is time consuming, we don’t think RAN4 have time to run the simulation.Issue 1-3: We support option 1 (same as scenario 1)Issue 1-4: We support option 1 (same as scenario 1). Issue 1-5: This belongs to RAN2 discussion. We support option 2.Issue 1-6: We support option 1Issue 1-7: Reducing number of frequency layer is in the power saving WI objective for RAN4. Clarification is needed on whether this issue belongs to RAN4 discussion or not. It seems that companies think there is no power saving from reducing number of frequency layer. However, reducing the number in a proper way is beneficial for mobility when UE is in power saving mode. Our proposal is to only measure one carrier in each band (option 2), which can help UE measure more useful carriers in a certain time period. Also this solution is good for network load balancing compared to the solution that reducing the measured frequency layer in system information. Sub topic 2.2.2 : EMR impact in power saving modeIssue 2-1: The feature of EMR seems conflict with power saving, which require UE to measure and report in order to configure CA/DC fast. We support option 2. EMR frequency layer shall not be relaxed. |
| Nokia | **Issue 1-1:** As RAN4 is not defining exactly when UE measures this must be addressing extension of the cell detection and measurement and evaluation time. It is not clear if this is only for intra-frequency or also inter-frequency and inter-RAT? This needs to be clarified before agreeable. In the end also inter-frequency/RAT measurement will impact UE power consumption and/or delays.**Issue 1-2:** If this is network configurable – which numbers are under consideration? Having some minimum requirements would ensure some minimum performance while it may also unnecessarily increase UE power consumption.**Issue 1-3:** same comment as for issue 1-1. Not at cell edge it is possible to re-use reduction of inter-frequency carrier measurement and hence have no UE requirements, while for intra-frequency having minimum delay requirements can be valuable e.g. for slow moving devices. Hence, we see the requirement could be different.**Issue 1-4:** more discussion and same comments as for issue 1-2.**Issue 1-5:** To enable a more gradual cell edge measurements - especially for NR measurements – to reduce the potential measurement delay we see from the minimum requirements for cell detection and measurements time and evaluation, that it can become risky for network to configure UE power saving if cell edge performance is degraded. **Issue 1-6:** Our understanding is that is already agreed in RAN2 and can be network configured. If all agree on this RAN4 does not need to discuss this further.**Issue 1-7:** The WI clearly states that reduction of number of carriers is one option to consider. Secondly, it is unclear to us why inter-frequency measurement reduction does not help in reducing the UE power consumption? In our view, any reduction of measurements on UE side would help reducing the UE power consumption. By enabling a more robust cell edge solution when power saving is in use will only ensure more use of the feature in the field.**Issue 2-1:** This will effectively exclude UE power feature if EMR is in use (and opposite of course). This would mean that if EMR is in use the UE power saving cannot be used, while if the EMR carrier are not relaxed the EMR and UE power saving feature can be used simultaneously. We do not see why the features should be designed sub-optimally such that they exclude each other.**Issue 3-1:** Agree with Option 2. |
| Apple | Issue 1-1: we support option 2. With low mobility, the similar approach as NB-IoT might be reused, and we prefer to allow UE to not meet the requirement in this case.Issue 1-3: Support option 1. Issue 1-5: we prefer to leave this mobility related threshold issue to RAN2 decision. Support option 2.Issue 1-6: for scenario 1 (low mobility), our preference is to not define the requirement for option 1a/b, and for scenario 2, we could go with option 1.Issue 2-1: we support option2 and don’t allow relaxation for dedicated measurement for EMR frequency when the T331 is running. |
| Ericsson | Issue 1-1, 1-2, 1-3, 1-4:Scenario#1 and scenario#2 need to be treated together since there is a lot of commonalities. It is important to note that the UE mobility behavior can differ significantly between these two scenarios. If option#1 is selected, then it is important the relaxation factor is smaller for scenario#2 since those UEs can be high-speed. Thus we have a similar view as Huawei that the relaxation can be different for the different scenarios. However, we would like to predefine the relaxation factor. For scenario#2, at most we can accept relaxation factor of 2. But for scenario 1, the relaxation factor can be larger and can be further discussed. In addition, if option 1 is selected, then the requirements are going to be different between scenario#1 and scenario#2, and scenario#3 where the UE is not required to meet the intra- and inter-frequency measurements. There should not be any hard transition between these relaxation states. When the UE is moving from scenario #1 or scenario #2 to scenario#3, the UE should fulfill the requirements corresponding to scenario#1 and scenario #2 for a certain time which can be further discussed. Issue 1-5:This topic shall be discussed in RAN2. Issue 1-6:Option 2.Issue 1-7:Option 1.Issue 2-1:Option 1 in R4-1915946 (agreed way forward) was related to whether any relaxation should be allowed. In this meeting, we make the compromise that the relaxation can be allowed in carriers other than EMR carriers if UE is configured with early measurement reporting (EMR) and T331 timer is running. In summary we support any of second and third bullets in option 2. Issue 3-1:This topic has been discussed in RAN1 and there is no impact on the DCI processing time. Thus no impact on the BWP/TCI state switching delays. |
| ZTE | Sub topic 2.2.1: RRM measurement relaxationIssue 1-1: Support option 1. As commented by company option 1 provide better mobility performance.Issue 1-2: Support option 4. One single value is not enough considering different deployment scenarios. The numbers can be further studied.Issue 1-3: Support option 1. Issue 1-4: Support option 4. Same reason as Issue 1-2. Issue 1-5: This is within RAN2 area. Support option 2.Sub topic 2.2.2 : EMR impact in power saving modeIssue 2-1: Support option 2. EMR frequency layer shall not be relaxed if T331 is running.Sub topic 2.2.3 : Issue 3-1: Since cross slot scheduling is being discussed in RAN1, we should wait for RAN1 conclusion before discussing impact on RRM requirements. |
| Intel | Issue 1-1: we support option 1. It is not safe for UE to simply drop all the measurement. Issue 1-2: we support option 4. Considering timeline of this work item, we don’t think system level simulation is realistic, although it can provide more convincing justifications. However, it is not preferred to decide the scaling factor without comprehensive evaluation, since the scaling factor has significant impact on mobility performance. Thus we suggest to go with option 4. Operator can adjust the scaling factor for different scenarios.Issue 1-3: we support option 1.Issue 1-4: we support option 4. The reason is the same with above mentioned in issue 1-2.Issue 1-7: we support option 1. Reducing the number of frequency layer can just reduce the cell search/measurement delay for each other frequency layer. We don’t see considerable power saving.Issue 2-1: we support option 2. Measurement should not be relaxed while T331 timer is still running. |
| Mediatek | **Issue 1-1: RRM measurement relaxation for scenario#1(Low mobility scenario)**We support option 2**Issue 1-2: If option 1 agreed, how to extend the measurement interval for scenario#1?**We prefer to allow UE implementation (2/4/6), for network doesn’t know how fast UE move in IDLE mode.**Issue 1-3: RRM measurement relaxation for scenario#2 (Not in cell-edge scenario)**We support option 1**Issue 1-4: If option 1 agreed, how to extend the measurement interval for scenario#2?**We prefer to allow UE implementation (2/4/6), for network doesn’t know how fast UE move in IDLE mode.**Issue 1-5: RRM measurement relaxation threshold for inter-frequency measurement**We support option 2. **Issue 1-6: RRM measurement relaxation for inter-frequency layer with higher priority**We prefer the following principles:* When Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ: We prefer to adopt relaxation requirement for inter-frequency measurement with higher priority.
* When Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ: We prefer to adopt relaxation requirement for inter-frequency measurement with higher priority, equal, and lower priority.

**Issue 1-7: RRM measurement relaxation by reducing the number of frequency layer to be measured**We agree option 1, this belongs to the RAN2 scope.  |

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| Qualcomm | Issue 1-1: we support option 2. With low mobility, UE is not required to meet the intra-frequency and inter-frequency measurement requirements.Issue 1-3: we support option 1.Issue 1-4: we support option 3 (6 times).Issue 1-5: we support option 2. This proposal will introduce signalling and should be decided in RAN2.Issue 1-6: RAN2 already agreed that “Whether higher priority frequencies can be relaxed is up to network configuration. FFS on how the configuration is done” (source: R2-1916375). The configuration should be decided in RAN2.Issue 1-7:Support option 1 and agree with the recommended WF.Issue 2-1: we support option 2. |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
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| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | **Status summary**  |
| **Issue 1-1:**RRM measurement relaxation for scenario#1(Low mobility scenario) | *Tentative agreements: further discussion is needed**Candidate options:**Option 1: RRM measurement relaxation with longer intervals (Vivo, CATT, CMCC, LGE, OPPO, Huawei, Nokia, ZTE, Intel)**Option 2: UE is not required to meet the intra-frequency and inter-frequency (Ericsson, Qualcomm, MediaTek, Apple)**Recommendations for 2nd round: Decide one option between option 1 and option 2* |
| **Issue 1-2:**If option 1 agreed, how to extend the measurement interval for scenario#1? | *Tentative agreements: further discussion is needed* *Candidate options:**Option1: Fixed value (2/4/6 times) (CATT, CMCC, OPPO, Vivo)**Option2: configurable value (Huawei, ZTE, Intel)**Recommendations for 2nd round: Decide the scaling factor is a fixed value or a configurable value.*  |
| **Issue 1-3:**RRM measurement relaxation for scenario#2(Not in cell-edge scenario) | *Tentative agreements: Option 1 (RRM measurement relaxation with longer intervals)**The above tentative agreement is based on majority view as follows:** *Option 1: RRM measurement relaxation with longer intervals*

*(Vivo, CATT, CMCC, LGE, OPPO, Huawei, Apple, ZTE, Intel, MediaTek, Qualcomm)** *Option 1a: For intra-frequency measurement: option 1; for inter-frequency measurement: option 2*

*(Nokia)** *Option 2: UE is not required to meet the intra-frequency and inter-frequency*

*(Ericsson)**Candidate options:**Recommendations for 2nd round: further discuss issue 1-4* |
| **Issue 1-4:**If option 1 agreed, how to extend the measurement interval for scenario#2? | *Tentative agreements: further discussion is needed**Candidate options:**Option1: Fixed value (2/4/6 times) (CATT, CMCC, OPPO, Vivo, Qualcomm)**Option2: configurable value (Huawei, ZTE, Intel)**Recommendations for 2nd round: Decide the scaling factor is a fixed value or a configurable value.*  |
| **Issue 1-5:**RRM measurement relaxation threshold for inter-frequency measurement | *Tentative agreements: Option 2 (Up to RAN2’s decision)**The above tentative agreement is based on majority view as follows:** *Option 1: Introduce carrier specific search thresholds for measurement relaxation*

*(Vivo, Nokia, LGE)** *Option 2: Up to RAN2’s decision*

*(CATT, Huawei, OPPO,CMCC, Apple, Ericsson, ZTE, MediaTek, Qualcomm)**Candidate options:**Recommendations for 2nd round: no further discussion if option 2 is agreed.* |
| **Issue 1-6:**RRM measurement relaxation for inter-frequency layer with higher priority | *Tentative agreements: Option 1**The above tentative agreement is based on majority view as follows:** *Option 1: (CATT, Vivo, CMCC, Huawei, LGE, OPPO, Apple, MediaTek)*
	+ - *When Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, no relaxation of the current measurement delay requirement is expected for inter-frequency measurement with higher priority.*
		- *When Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, if the relaxation criterions are fulfilled, the relaxed requirement for the frequency layer of higher priority shall use the same relaxed measurement requirement as those for the frequency layer of equal/lower priority.*
* *Option 2: (Ericsson)*
	+ - *Measurements of higher priority carriers shall not be relaxed in high mobility scenarios (scenario #2)*

*Candidate options:**Recommendations for 2nd round: no further discussion if option 1 is agreed.* |
| **Issue 1-7:**RRM measurement relaxation by reducing the number of frequency layer to be measured | *Tentative agreements: Option 1**The above tentative agreement is based on majority view as follows:** *Option 1: (CATT, Vivo, Huawei, OPPO, Ericsson, MediaTek, Intel, Qualcomm)*
	+ - *Do not introduce RRM measurement relaxation by reducing the number of frequency layer to be measured.*
* *Option 2:(CMCC)*
	+ - *if reducing number of frequency layer is considered in idle/inactive mode, it is proposed that UE only measure one carrier in each band*
* *Option 3: (Nokia)*
	+ - *RAN4 defines requirements for UE relaxation of UE measurements and reduction of the number of carriers the UE is required to monitor under the power saving WI.*

*Candidate options:**Recommendations for 2nd round: no further discussion if option 1 is agreed.* |
| **Issue 2-1:**EMR impact in power saving mode | *Tentative agreements: Option 2**The above tentative agreement is based on majority view as follows:** *Option 1: (CATT)*
	+ - *up to UE’s implementation*
* *Option 2: (LGE, Nokia, Qualcomm, CATT, OPPO, CMCC, Apple, Ericsson, ZTE, Intel)*
	+ - *EMR frequency layer shall not be relaxed if T331 is running*
* *Option 3:(Huawei, MediaTek)*
	+ - *EMR frequency layer shall be relaxed*

*Recommendations for 2nd round: no further discussion if option 2 is agreed.* |
| **Issue 3-1:**RRM impact due to cross-slot scheduling power saving technique | *Tentative agreements: further discussion is needed**Candidate options:**Option 1: have RRM impact on DCI based delay requirement (CATT, Huawei)**Option 2: no RRM impact (Ericsson, Nokia)**Option 3: wait for RAN1 conclusion (Vivo, ZTE, )**Recommendations for 2nd round: further discussion on above options* |
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*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

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| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: Impact on demod requirement due to MIMO layer adaption

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000787 | Apple | **Proposal 1:** reuse the existing delay and interruption requirements of legacy BWP switching to case 2 (Only the number of maximum MIMO layer is changed in the BWP before and after MIMO layer adaption).**Proposal 2:** RAN4 shall consider whether UE still needs to meet 4Rx demod requirement on those 4Rx-mandated bands when network configures the max\_MIMO\_layer\_num=2 to UE for power saving.In our understanding, there might be three options to address this issue from standardization perspective,**Option 1:** Add applicability for demod requirement to state that 4Rx demod requirement is not applicable for UE with max\_MIMO\_layer\_num =2; and so does the test case**Option 2:** set the max\_MIMO\_layer\_num =4 in the all related test cases applied for 4Rx-mandated bands**Option 3:** Do not recommend this max MIMO layer adaptation feature for power saving and still make 4Rx demod requirements applicable in all the cases irrespective of the configured number of MIMO layers. |

## Open issues summary

### Impact on demod requirement due to MIMO layer adaption

**Issue 1-1: Impact on 4Rx demod requirement due to MIMO layer adaption feature**

* Proposal from Apple:

RAN4 shall consider whether UE still needs to meet 4Rx demod requirement on those 4Rx-mandated bands when network configures the max\_MIMO\_layer\_num=2 to UE for power saving.

In our understanding, there might be three options to address this issue from standardization perspective,

* + Option 1: Add applicability for demod requirement to state that 4Rx demod requirement is not applicable for UE with max\_MIMO\_layer\_num =2; and so does the test case
	+ Option 2: set the max\_MIMO\_layer\_num =4 in the all related test cases applied for 4Rx-mandated bands
	+ Option 3: Do not recommend this max MIMO layer adaptation feature for power saving and still make 4Rx demod requirements applicable in all the cases irrespective of the configured number of MIMO layers.

We are open to discuss the above options or others to make the max MIMO layer adaptation feature useful in power saving scope.

* Recommended WF
	+ Need more discussion

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| XXX | Sub topic 3.2.1: Impact on demod requirement due to MIMO layer adaptionSince this issue related to demod discussion, so it can be deferred to next meeting.  |
| vivo | Sub topic 3.2.1: Impact on demod requirement due to MIMO layer adaption**Issue 1-1: prefer option 2.**We may need to understand the motivation. In Rel. 15, max\_MIMO\_layer\_num is already configurable and can be configured at per-UE level. However, in the demod test cases, there was no explicit configuration of max\_MIMO\_layer\_num. In our understanding, this means by default max\_MIMO\_layer\_num should be configured the same as UE capability, i.e. UE max supported number of MIMO layers.For Rel. 16 power saving WI, the enhancement is that max\_MIMO\_layer\_num can be configured at per-BWP level. Therefore, we prefer option, i.e. set the max\_MIMO\_layer\_num =4 in the all related test cases applied for 4Rx-mandated bands. |
| CMCC | Sub topic 3.2.1: Impact on demod requirement due to MIMO layer adaptionIssue 1-1: We don’t think this is an issue. The purpose of demodulation test is ensure the proper baseband implementation. MIMO layer adaptation of power saving will not impact the UE demodulation performance. And for the three options, we don’t see big difference. From our understanding, option 2 follows the existing applicability rule of demodulation requirements, so we support option 2. |
| Nokia | sub topic 3.2.1: We would like to understand why UE Tx related power savings are not considered when adapting from 4-layer MIMO to 2-layer MIMO? |
| Apple | Sub-topic 3.2.1: we can accept option 2. So far the demod test for 2Rx and 4Rx has different side condition of SNR, and max MIMO layer configuration is not clarified in the test setup, so our concern is if max MIMO layer num is configured as 2 for 4Rx case with RANK 1/2, UE has no chance but has to keep the 4Rx antenna ON to pass the test and then the power saving gain from this max MIMO layer adaptation from 4 to 2 is gone. |
| Ericsson | There is no TU for discussing demodulation requirements in this meeting. Thus, this topic shall not be discussed in this meeting, and it shall be discussed in the Demodulation e-mail thread instead, not in the RRM thread.  |
| Mediatek | Agree on Ericsson’s view. |

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| Qualcomm | Sub-topic 3.2.1: We can accept option 2.  |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
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| YYY | Company A |
| Company B |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | **Status summary**  |
| **Issue 1-1:**Impact on 4Rx demod requirement due to MIMO layer adaption feature | *This issue shall be discussed in Demod session, and there is no TU for Demod in this meeting.**Recommendations for 2nd round: No further discussions on this issue in RRM email thread.* |

*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
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### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

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| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |