**3GPP TSG-RAN WG2 Meeting #113e draft R2-2102020**

**Electronic Meeting, 25th Jan – 5th Feb 2021**

**Source: ZTE Corporation**

**Title: Offline [110][REDCAP] – RRM Relaxations**

**Agenda item:**  **8.12.3**

**Document for:** **Discussion and Decision**

# Background

This document is to kick off the following email discussion:

* [AT113-e][110][REDCAP] RRM relaxations (ZTE)

Scope: Continue the discussion on RRM relaxations based on the proposals in [R2-2100569](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2100569%20Report%20of%20Email%20discussion%5B155%5D%5BREDCAP%5D%20RRM%20relaxations.docx) marked as "continue in offline 110". Also discuss possible evaluations to be added in the Annex.

The intention of this offline is to describe options in the TR and, whenever applicable/possible, also provide some recommendations (i.e. p7 and p10 in [R2-2100569](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2100569%20Report%20of%20Email%20discussion%5B155%5D%5BREDCAP%5D%20RRM%20relaxations.docx))

Initial intended outcome: Summary of the offline discussion with e.g.:

* + - List of proposals for agreement
		- List of proposals that require online discussions
		- Corresponding TP for the TR

Initial deadline (for companies' feedback): Monday 2021-02-01 11:00 UTC

Initial deadline (for rapporteur's summary in R2-2102020): Monday 2021-02-01 17:00 UTC

Proposals marked "for agreement" in R2-2102020 not challenged until Tuesday 2020-02-02 10:00 UTC will be declared as agreed by the session chair. For the rest the discussion will continue online.

# Contact information

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| --- | --- |
| Company  | Email address |
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# Discussion on remaining proposals

Regarding the proposals in the summary of email disc [1], after first online session, RAN2 has made following agreements.

Agreements:

1. Irrespective of RRC state, whether to enable/disable RRM relaxation function for Redcap UEs is within network’s control.
2. The following enhancements for triggering neighbour RRM relaxation in RRC\_IDLE/RRC\_INACTIVE are endorsed for inclusion in the TR. Among these solutions, -Enhancement #1, #2, #3 and #5 can be considered as higher priority. Exact TP and whether some amendments are needed/ further enhancements need to be added can be further discussed:
* Enhancement 1: Introduce additional SsearchDeltaP\_stationary threshold to support 2 level speed evaluation (i.e. stationary, low mobility);
* Enhancement 2: Take into account of beam switching in low mobility evaluation;
* Enhancement 3: UE determines its stationary property based on subscription information (e.g. USIM);
* Enhancement 4: Introduce an additional SsearchDeltaP\_correction threshold and configure the UE to use it if only it detects that it observes higher received signal power variation that do not violate stationarity i.e., rotating around itself, dynamically changing multipaths;
* Enhancement 5: Introduce additional TSearchDeltaP\_stationary to support 2-level stationarity (i.e. fixed location vs low mobility);
1. The following enhancements for neighbour RRM relaxation methods in RRC\_IDLE/RRC\_INACTIVE are endorsed for inclusion in the TR. Exact TP and whether some amendments are needed/ further enhancements need to be added can be further discussed:
* Enhancement 1: UE can stop measurements on neighbor cells for T (T>>1) hours;
* Enhancement 2: Enabling further relaxation via reducing the number of monitored RS;
* Enhancement 3: UE only perform measurements on a number of dedicated intra-freq, inter-freq cells;
* Enhancement 4: Minimize the number of measured frequencies;
1. For neighbour cell RRM relaxation in RRC\_CONNECTED, “fixed or immobile UEs” are considered with higher priority than “slightly moving UEs”.

Due to limited time, the rest proposals (marked as “continue in offline 110”) will be further discussed in this document.

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| --- |
| General principle:**Proposal 1:** For measurement relaxation methods, RAN2 can discuss preferable solutions, but RAN4 should be consulted before making the final decision. Neighbour cell RRM relaxation in RRC\_CONNECTED:**Proposal 7**: Compared to RRC\_IDLE/INACTIVE, RRM relaxation in RRC\_CONNECTED can be considered with low priority if the time is limited in WI. **Proposal 8:** Capture in TR the following solutions for triggering neighbour RRM relaxation in RRC\_CONNECTED. • Solution 1: UE reports “stationary” property to network in Msg5; • Solution 2: Network provides (e.g. low mobility, not-at-cell-edge) evaluation parameters to UE via dedicated signalling; • Solution 3: AMF sends “stationary” indication to gNB (based on UE subscription); • Solution 4: UE reports “stationary” in UE Assistance Information to network;**Proposal 9:** Capture in TR the potential solutions for neighbour cell RRM relaxation methods in RRC\_CONNECTED. The exact mechanism, if any, should be decided by RAN4. From RAN2’s perspective, other solutions are not precluded (e.g. network does not configure measurements for mobility purpose, UE only performs measurement on single RS type). *Serving cell RRM relaxation in RRC\_IDLE/INACTIVE/CONNECTED***Proposal 10:** Irrespective of RRC state, serving cell RRM relaxation for Redcap UEs is not considered in Rel-17*.* |

Companies are invited to show your comments to above proposals:

**Q1.1: Do companies agree with above Proposal 1 (if no, please provide your comments)?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree****(Yes or No)** | **Comments** |
| Apple | Yes |  |
| Huawei, HiSilicon | Yes |  |
| vivo | Yes |  |

**Q1.2: Do companies agree with above Proposal 7 (if no, please provide your comments)?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree****(Yes or No)** | **Comments** |
| Apple | We are ok but | Pls note that C-DRX operation is part of RRC\_CONNECTED and RedCap UEs can benefit from relaxations here. |
| Huawei, HiSilicon | Yes |  |
| vivo | No | we have strong concern on this proposal. Based on the first round of email discussion, half of companies support this proposal, but half of companies do not support this proposal. I donot know how email rapporteur gets this conclusion based on such situation. Our understanding is that, in the SI phase, we should focus on the technique issue, list all possible solutions with pros and cons. But which part is high priority/which part is lower priority should be considered together with other features. This discussion could happen in RAN plenary when drafting WID. So we suggest not to waste time to discuss this kind of proposal. |

**Q1.3: Do companies agree with above Proposal 8 (if no, please provide your comments)?**

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| **Company** | **Agree****(Yes or No)** | **Comments** |
| Apple | Agree, and | We would like to bring up another potential property of atleast certain RedCap UEs in that instead of (or in addition to) the stationary property, there could be UEs whose mobility is localized, and reporting of this characteristic can also follow the same principles proposed in proposal 8. We understand more discussion on this is in questions 3.1/3.2 below. |
| Huawei, HiSilicon | Agree, but | In our understanding, it is up to network to decide whether to enable UE RRM measurement relaxation in RRC\_CONNECTED, the solutions in proposal 8, e.g. UE/AMF provide information to the gNB for triggering RRM measurement relaxation, and the gNB makes the decision. |
| vivo | Agree, but | We are open with the solutions. I assuming detailed triggering criteria could be discussed in WI phase. The solutions listed here are just for assistance. In this way, we suggest to have a minor change: Capture in TR the following solutions for assistanting triggering neighbour RRM relaxation in RRC\_CONNECTED. |

**Q1.4: Do companies agree with above Proposal 9 (if no, please provide your comments)?**

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| **Company** | **Agree****(Yes or No)** | **Comments** |
| Agree |  |  |
| Huawei, HiSilicon | Yes |  |
| vivo | Yes |  |

**Q1.5: Do companies agree with above Proposal 10 (if no, please provide your comments)?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree****(Yes or No)** | **Comments** |
| Agree |  |  |
| Huawei, HiSilicon | Yes |  |
| vivo | No | Honestly, during the first round of email discussion, we did not see any technique reason for not supporting RRM relaxation in IDLE/INACTIVE mode. Companies’ reasons are mainly about the performance degrading in connected mode, e.g. HO failure or RLF.In our understanding, we should focus on the technique discussion on the feasibility and benefit in the SI phase. Whether to include this feature could be handled during the discussion on recommendation or WID drafting. Regarding the feasibility on RRM relaxation for serving cell for RedCap at least in idle/inactive mode, we think there is no technique issue. As I commented during online discussion, in legacy eDRX in LTE, there is no RRM requirement outside the PTW. It means that, RRM on serving cell is required to be performed only in PTW based on the requirement defined in RAN4. In this way, there is RRM relaxation on serving cell in eDRX case (more specifically, no RRM outside PTW, which is similar as Rel-16 RRM relaxation when both criteria are fulfilled for a period). If eDRX could be supported for NR, RRM relaxation for serving cell could be naturally supported. Thus, at least we should confirm the feasibility on RRM relaxation for serving cell in idle/inactive mode. If some companies really hate this feature, they could provide preference when discussing the recommendation or WID. But we donot accept such proposal without any technique reason.  |

# Discussion on draft TP

Based on agreements and the rest proposals of summary of email disc, rapporteur provides a draft TP in FTP folder for further discussion, it is drafted based on the latest endorsed TP [2]. In this section, companies are welcome to check the draft TP, and provide possible evaluations if any.

For easy discussion, we split the draft TP into 3 parts:

* **Part 1: Triggering condition for RRM relaxation in RRC\_IDLE and RRC\_INACTIVE**

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| 8.4.1.1 RRM relaxation in RRC\_IDLE and RRC\_INACTIVERel-16 NR RRM relaxation procedures are taken as a baseline to study further enhancements of neighbour cell RRM relaxation for Redcap UEs in RRC\_IDLE and RRC\_INACTIVE. For triggering neighbour cell RRM relaxation for RedCap UEs in RRC\_IDLE and RRC\_INACTIVE, based on Rel-16 triggering criterion, following enhancements can be considered:* **Enhancement 1:** Introduce additional SsearchDeltaP\_stationary threshold to support 2-level speed evaluation (i.e. stationary and low mobility), for example:
	+ Stationary: (SrxlevRef – Srxlev) < SSearchDeltaP\_stationary
	+ Low mobility: SSearchDeltaP\_stationary <= (SrxlevRef – Srxlev) < SSearchDeltaP\_low\_mobility

Pros:* From specification point of view, it is simple and straightforward enhancement based on Rel-16 mechanism;
* It supports 2 levels speed evaluation (i.e. stationary and low mobility), so it provides flexibility of designing different RRM relaxation levels for different mobility scenarios.

Cons:* Unclear whether UE’s mobility level can be accurately determined;
* Channel or link (RSRP/RSRQ) may change even if UE is purely stationary, thus it may not be a reliable way to distinguish between truly stationary and low mobility UE.
* **Enhancement 2:** Introduce additional TSearchDeltaP\_stationary to support 2-level speed evaluation (i.e. fixed location and low mobility).

Pros:* From specification point of view, it is simple and straightforward enhancement based on Rel-16 mechanism;
* It supports 2 levels speed evaluation (i.e. stationary and low mobility), so it provides flexibility of designing different RRM relaxation levels for different mobility scenarios.

Cons:* Unclear whether UE’s mobility level can be accurately determined.

Note: There can be synergies if Enhancement 1 is combined with Enhancement 2.* **Enhancement 3:** Take into account of beam switching in low mobility evaluation, for example:
	+ Stationary:
		- number of beam switch < N1 or
		- no beam switch and (SrxlevRef – Srxlev) < SSearchDeltaP\_stationary
	+ Low mobility:
		- number of beam switch < N2 or
		- SSearchDeltaP\_stationary <= (SrxlevRef – Srxlev) < SSearchDeltaP\_low\_mobility

Pros:* Using beam level measurement results can assess UE’s movement more accurately than cell measurement, because UE may move among beams but without changing the cell level results;
* Potentially good for detecting “circular motion” around base station.

Cons:* Unclear whether UE’s mobility level can be accurately determined;
* Beam level measurement results may fluctuate more than cell-level results, so it might cause misjudgement;
* **Enhancement 4:** UE determines its stationary property based on subscription information (e.g. USIM).

Pros:* It is simpler and faster than evaluating the quality of serving cell.

Cons:* Only applicable to limited scenarios, e.g. fixed-location devices;
* Channel or link (RSRP/RSRQ) may change (e.g. may be low) even if UE is fixed-location, RRM relaxation only depends on fixed-location information may impact the performance.
* **Enhancement 5:** Introduce an additional SsearchDeltaP\_correction threshold and configure the UE to use it if only it detects that it observes higher received signal power variation that do not violate stationarity, i.e. rotating around itself, dynamically changing multipath.

Pros:* Can be used to differentiate different stationary cases. E.g. stationary or stationary with rotating around itself.

Cons:* Covers only a very specific use case.
 |

Above context related to agreement 2, and also including the Pros/Cons analysis summarized in R2-2100569 (the bullets marked as FFS are not listed). Companies are asked to provide feedback on the above suggestion for baseline text and provide further evaluations, if needed.

**Q2.1: Do companies agree with above text proposal added to section 8.4.1?**

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| --- | --- | --- |
| **Company** | **Agree****(Yes or No)** | **Comments or TP suggestions** |
| Apple | Agree |  |
| Huawei, HiSilicon | Yes |  |
| vivo | Yes |  |

* **Part 2: RRM relaxation methods in RRC\_IDLE and RRC\_INACTIVE**

The draft TP is shown below:

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| For neighbour cell RRM relaxation methods for RedCap UEs in RRC\_IDLE and RRC\_INACTIVE, based on Rel-16 NR RRM relaxation methods, following enhancements can be considered:* **Enhancement 1:** UE can stop measurements on neighbour cells for T (T>>1) hours.

Pros:* It is useful to further reduce power consumption for truly stationary UEs.

Cons:* Not applicable to wearable devices;
* Based on evaluation scenario in TR, the gain compared to 1 hour measurement interval is not significant.
* **Enhancement 2:** Enabling further relaxation by reducing the number of monitored RS.

Pros:* Since UE only needs to measure specific beams, the power consumption can be reduced and the time period of measurement can be reduced.

Cons:* **Enhancement 3:** UE only perform measurements on a number of dedicated intra-frequency, inter-frequency cells.

Pros:* For stationary UEs, can avoid UE to measure all frequencies/cells broadcast.

Cons:* **Enhancement 4:** Minimize the number of measured frequencies.

Pros:* For stationary UEs, can avoid UE to measure all frequencies/cells broadcast.

Cons: |

Above context related to agreement 3, and also including the Pros/Cons analysis summarized in R2-2100569. Companies are asked to provide feedback on the above suggestion for baseline text and provide further evaluations, if needed.

**Q2.2: Do companies agree with above text proposal added to section 8.4.1.1?**

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| --- | --- | --- |
| **Company** | **Agree****(Yes or No)** | **Comments or TP suggestions** |
| Apple | agree |  |
| Huawei, HiSilicon | Yes, but | In our contribution R2-2101257, we propose another solution for neighboring cell RRM measurement relaxation in RRC\_IDLE/INACTIVE. In the case that measurement interval expanded with scaling factor of 3 times based on Rel-16 NR RRM relaxation method, the truly stationary UEs can further expand the measurement interval to 1 hour to reduce power. We also provided simulation results. Thus, we propose to add the following in the TP:* **Enhancement 5:** Expand the scenario of performing “stop measurement for 1 hour” for stationary UEs.

Pros:* It is useful to further reduce power consumption for truly stationary UEs.

Cons: |
| vivo | Yes |  |

* Part 3: RRM relaxation in RRC\_CONNECTED

The draft TP is shown below:

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| 8.4.1.2 RRM relaxation in RRC\_CONNECTEDFor neighbour cell RRM relaxation in RRC\_CONNECTED, “fixed or immobile UEs” are considered with higher priority than “slightly moving UEs”. For triggering neighbour cell RRM relaxation for RedCap UEs in RRC\_CONNECTED, following solutions can be considered:* **Solution 1:** UE reports “stationary” property to network in Msg5.

Pros:* Allows UE to report to network if it is temporarily stationary, so network can change its RRM configuration timely.

Cons:* Channel or link (RSRP/RSRQ) may change even if UE is purely stationary, so it may impact handover performance if UE cannot cancel RRM relaxing timely.
* **Solution 2:** Network provides (e.g. low mobility, not-at-cell-edge) evaluation parameters to UE via dedicated signalling.

Pros:* Reusing Rel-16 mechanism in Connected UEs, maximize the commonality with idle/inactive UEs;
* Network can set evaluation parameters to UE, so it is more reliable and impacts on performance can be reduced.

Cons:* Network needs to configure UE with additional parameters for RRC\_CONNECTED;
* Takes away the control from network in RRC\_CONNECTED to some extent.
* **Solution 3:** AMF sends “stationary” indication to gNB (based on UE subscription).

Pros:* The information is derived from UE subscription information, such fixed-location UE will not move, so performance impact can be minimized.
* It is useful in potentially reducing the amount of measurements, and can enable network to configure more power-efficient RRM in RRC\_CONNECTED.

Cons:* Only applicable to limited scenarios, e.g. fixed-location devices.
* Channel or link (RSRP/RSRQ) may change even if UE is purely stationary, so it may impact handover performance if UE cannot cancel RRM relaxing timely.
* **Solution 4:** UE reports “stationary” in UE Assistance Information to network.

Pros:* Allows UE to report to network if it is temporarily stationary, so network can change its RRM configuration timely.

Cons:* Channel or link (RSRP/RSRQ) may change even if UE is purely stationary, so it may impact handover performance if UE cannot cancel RRM relaxing timely.
* **Solution 5:** Network enables measurement relaxation based on UE’s measurement report.

Pros:* It keeps the control fully on network side.

Cons:* It relies on UE measurement reporting.

For neighbour cell RRM relaxation methods for RedCap UEs in RRC\_CONNECTED, the exact mechanism, if any, will be decided by RAN4. But from RAN2’s perspective, other solution are not precluded (e.g. network does not configure measurements for mobility purpose, UE only performs measurement on single RS type). |

Above context related to Proposal 8 and Proposal 9, and also including the Pros/Cons analysis summarized in R2-2100569. Companies are asked to provide feedback on the above suggestion for baseline text and provide further evaluations, if needed.

**Q2.3: Do companies agree with above text proposal added to section 8.4.1.2?**

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| --- | --- | --- |
| **Company** | **Agree****(Yes or No)** | **Comments or TP suggestions** |
| Apple | yes |  |
| Huawei, HiSilicon | Yes |  |
| vivo | Yes |  |

**Q2.4: Do companies have any other comments to the draft TP (uploaded in FTP folder)?**

|  |  |
| --- | --- |
| **Company** | **Comments or TP suggestions** |
| Huawei, HiSilicon | We provided the TP in our contribution R2-2101257, and suggest it can be discussed in the following clause. |
| vivo | We could provide the recommendation on the RRM relaxation part after we conclude the above open issues. |
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# Discussion on draft TP from contributions

During this meeting, there are two company contributions containing draft TP:

[R2-2100459](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2100459_TP%20for%20TR%2038875%20on%20evaluation%20for%20RRM%20relaxation.docx) TP for TR 38875 on evaluation for RRM relaxation vivo, Guangdong Genius discussion Rel-17 FS\_NR\_redcap

[R2-2101461](file:///C%3A%5CData%5C3GPP%5CRAN2%5CDocs%5CR2-2101461.zip) Localized mobility of some RedCap devices Apple Inc discussion Rel-17 FS\_NR\_redcap

[R2-2101257](file:///D%3A%5C%5CDocuments%5C%5C3GPP%5C%5Ctsg_ran%5C%5CWG2%5C%5CTSGR2_113-e%5C%5CDocs%5C%5CR2-2101257.zip%22%20%5Co%20%22D%3ADocuments3GPPtsg_ranWG2TSGR2_113-eDocsR2-2101257.zip) RRM measurement relaxation for RedCap UE Huawei, HiSilicon discussion Rel-17

For R2-2100459, it is requested to add simulation results to the TR, including the simulation results for serving cell RRM relaxation in RRC\_IDLE/INACTIVE, and the simulation results for RRM relaxation in RRC\_CONNECTED. Companies are welcome to show their view on the draft TP.

**Q3.1: Do companies agree to add the draft TP (R2-2100459) to TR?**

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| --- | --- | --- |
| **Company** | **Agree****(Yes or No)** | **Comments or TP suggestions** |
| Apple | Yes | We are ok with adding the results to the TR. |
| Huawei, HiSilicon | Yes |  |
| vivo | Yes | It was agreed that: Power consumption analysis can be put in an Annex of the TR. We are OK to include all reasonable simulation results in the TR. |

For R2-2101461, it proposes to agree on the use case of certain RedCap UEs whose mobility is localized for the lifetime of the UE. And this paper also suggests to capture below observation into the TR:

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| * **If the NW is aware of such mobility nature of the RedCap UE, the NW can use this information in allocating resources to the UE (for e.g. paging).**
* **The NW can configure a set of neighbour cells that are the cells likely to be used by the UE during it’s lifetime and the NW can configure the UE to inform the NW in case the UE moves out of these cells**
	+ **In addition, the NW can provide additional thresholds and control other aspects of the UEs mobility (in IDLE/INACTIVE for reselection and in CONNECTED mode for potential handover) to ensure that the UE does not reselect to cells that outside the configured set of neighbour cells.**
	+ **Alternatively, the NW can also prohibit the UE to reselect to other cells than the ones configured by the NW.**
* **The information about the localized mobility can be from the subscription or from the user configuration, and this information can be provided to the core network or can be limited to the RAN.**
 |

Per rapporteur understanding, these are feasible measures that can be considered, but strictly speaking, some bullets are not related to RRM relaxation (e.g. paging resource allocation). However, companies are welcome to show their views to this proposal.

**Q3.2: Do companies agree to add above text to TR? (may not be completely covered in clause 8.4 )**

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| --- | --- | --- |
| **Company** | **Agree****(Yes or No)** | **Comments or TP suggestions** |
| Apple  | Yes | We thank the rapporteur in including this as part of the discussion. |
| Huawei, HiSilicon | Yes |  |
| vivo | Yes |  |

For R2-2101257, it is requested to add simulation results to the TR, including the simulation results for power saving gain achieved by further expanding the measurement interval and reducing measurement time for neighboring cell RRM measurement relaxation in RRC\_IDLE/INACTIVE. Companies are welcome to show their view on the draft TP.

**Q3.3: Do companies agree to add the draft TP (R2-2101257) to TR?**

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| --- | --- | --- |
| **Company** | **Agree****(Yes or No)** | **Comments or TP suggestions** |
| Huawei, HiSilicon | Yes | Proponent. |
| vivo | Yes | We are OK to include all reasonable simulation results in the TR. |
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# Summary

TBD

# Reference

1. R2-2100569 Report of Email discussion[155][REDCAP] RRM relaxations ZTE Corporation, Sanechips discussion Rel-17 FS\_NR\_redcap

*endorsed TP*

1. R2-2100984 RAN2 update to TR38875 Ericsson discussion FS\_NR\_redcap