**3GPP TSG-RAN WG2 Meeting #115-e R2-2108894**

**Online, Aug 16th – 27th, 2021**

**Agenda Item: 8.12.3.2**

**Source: Huawei, HiSilicon**

**Title: Summary of [AT115-e][110][RedCap] RRM relaxation**

**Document for: Discussion and decision**

# Introduction

This document summarizes the following offline discussion.

* [AT115-e][110][RedCap] RRM relaxation (Huawei)

Initial scope: Continue the discussion on the proposals from [R2-2107211](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2107211%20RRM%20measurement%20relaxation%20for%20RedCap%20UE.doc) and [R2-2107748](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2107748%20RRM%20relaxation%20for%20RedCap%20UEs.docx)

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): Monday 2021-08-23 10:00 UTC

Initial deadline (for rapporteur's summary in R2-2108894): Monday 2021-08-23 16:00 UTC

Proposals marked "for agreement" in R2-2108894 not challenged until Tuesday 2021-08-24 0800 UTC will be declared as agreed via email by the session chair (for the rest the discussion will further continue online).

Initial scope: Continue the remaining proposals from [R2-2108894](file:///C%3A%5CData%5C3GPP%5CRAN2%5CInbox%5CR2-2108894.zip) and draft LS to RAN4

Intended outcome: LS and summary of the offline discussion with e.g.:

* + - List of proposals for agreement (if any)
		- List of proposals that require online discussions

Final deadline (for companies' feedback): Thursday 2021-08-26 1000 UTC

Final deadline (for rapporteur's summary in R2-2109133): Thursday 2021-08-26 1500 UTC

Proposals marked "for agreement" in R2-2109133 not challenged until Friday 2021-08-27 0300 UTC will be declared as agreed via email by the session chair (for the rest the discussion might continue online during the CB session).

# Contact from companies

|  |  |
| --- | --- |
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# Discussion for the first round

## Beam level criterion

* Option 1: Proposal in [1]: Beam-level criterion is adopted for Rel-17 stationary criterion.
* Option 2: Proposal in [2]: Do not introduce beam change based criterion in Rel-17.
* Option 3: Compromised solution, to introduce the network configuration for beam-level criterion, and it is up to network implementation to decide whether to use beam-level criterion as Rel-17 stationary criterion (in addition to i.e. SSearchDeltaP\_stationary/TSearchDeltaP\_stationary criterion).

**Q1-1 Which option above do companies support in Rel-17?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1, 2, 3?** | **Comments** |
| Fraunhofer | 1 |  |
| Ericsson | 2 | Let's not talk about optimizations before we have the basics sorted out. |
| ZTE | 2 | We suggest not to consider beam-based criterion in Rel-17 because:1. Usually, the cell level RSRP will change when UE moves, beam results change without cell level RSRP change is a very rare case as we indicated in [2], so we think using cell-level based criterion is sufficient.
2. Beam level results are more sensitive than cell level results, using beam level results may easily cause misjudgment, so UE will have less chance to trigger RRM relaxation.
3. RAN2 already agreed cell level based low mobility criterion and not-at-cell-edge criterion, so there are already three combinations:
* Only low mobility is configured, and UE fulfills;
* Both criteria are configured, and UE only fulfills low-mobility one;
* Both criteria are configured, and UE fulfills both.

If beam-based criterion is introduced, then it can also combine with not-at-cell-edge (and/or low-mobility criterion), so it may produce much more cases. Considering the heavy workload in RAN4, most likely, RAN4 cannot finish studying /specifying relaxation methods for all cases.  |
| KDDI | 2 | The UE’s movement is very random, so it is hard to make a decision based on the either the beam level measurement result or the change of the number of beams |
| Xiaomi | 2 | We think beam criterion is not necessary, the reason is that even if the beam criterion is not introduced, UE still can stay in a stable coverage which does not make much impact on UE experience. |
| CATT | 2 | We are OK to postpone this technique to a later release. |
| Huawei, HiSilicon | 1 or 3 | For REDCAP, we focus on the “stationary UE” so a stricter and more accurate criterion to identify “stationary UE” is preferred. For companies’ concern on fluctuation and unreliability issue, L3 filtering can be used for beam measurement which is the similar as cell level RSRP/RSRQ acquisition. |
| vivo | 2 | We see no extra benefit of introducing Beam-level criterion on top of cell level criterion based on RSRP/RSRQ.On one hand, the change of Beam-level quality may not be caused by UE mobility, on the other hand, beam change may not cause cell re-selection (e.g. UE moving around the gNB). |
| Sharp | 2 | Finish the RSRP/RSRQ based method first. |
| OPPO | 2 | Agree with ZTE. |
| Thales | 2 | Finish the RSRP/RSRQ method first, other proposals are optimization to be left for later.  |
| Nokia | 1&3 | If the beams change (i.e. UE moves or rotates), the UE should not assume to have stable coverage as it should be aware neighbour cell qualities that may vary -> UE should exit the RRM relaxing. |
| NTTDOCOMO | 1 or 3 | See benefits to introduce beam-change based method as a complement in addition to RSRP/RSRQ method for stricter evaluation.  |
| Qualcomm | 2 | Agree with ZTE. |
| Apple | 2 | In addition to ZTE comments (which we agree), the number of beams are dependant on the cell config and diff cells can have diff beam number and it is not reliable to decide UE mobility based on beam count. |
| Intel | 1/3 | Regarding the beam level criterion, to our understanding, analog beamforming is still possible for 1 RX antenna UE and the UE still see different beam environment. Therefore, we do see the benefit to support it.Normally the configuration is configured/enable by network. Therefore 3 should be traditional way to handle the configuration.  |
| Sequans | 2 | Agree with the reasons by ZTE that a beam-level criterion seems quite difficult to specify right now (not to mentioned the number of very different solutions presented e.g. in the next question). OK to leave open to consider if time allows. |
| Samsung | 2 | Agree with ZTE |
| MediaTek | 2 | Agree with ZTE |
| Chinatelecom | 2 | Agree with ZTE |
| BT | 2 | Focus on RSRP/RSRQ |
| Sony | Option 1/3 |  |
| DENSO | 2 | Measurements at the beam level can be less stable than measurements at the cell level (e.g. UE is between the beams). We think that cell level measurement is sufficient. |
| LG | 2 | The beam quality fluctuates very often, so the UE in stationary state may suddenly leave the stationary state if beam quality changes for a fleeting moment. |

Summary

24 companies provided views for Q1-1:

* 6/24 companies (Fraunhofer, Huawei, HiSilicon, Nokia, NTTDOCOMO, Intel, Sony) support Option 1
* 18/24 companies (Ericsson, ZTE, KDDI, Xiaomi, CATT, vivo, Sharp, OPPO, Thales, Qualcomm, Apple, Sequans, Samsung, MediaTek, Chinatelecom, BT, DENSO, LG) support Option 2
* 5/24 companies (Huawei, HiSilicon, Nokia, NTTDOCOMO, Intel, Sony) support Option 3

Based on the inputs, rapporteur suggests to follow the majority to support Option 1, i.e. do not introduce beam change based criterion in Rel-17.

Proposal 1 [For agreement] (18/24): Do not introduce beam change based criterion in Rel-17.

If the beam-level criterion for stationary criterion in Rel-17 is supported, the details of defining beam-level criterion can be:

* Option 1: Proposal in [1]: For beam-change based criterion, it is determined based on whether quality change of beam(s) for a period of time is lower than a threshold.
* Option 2: Proposal in [3]: use Doppler shift of UE’s best beams from its serving cell instead of beam change counts.
* Option 3: Proposal in [4]: beam-change evaluation method which takes Number of serving beams into account.
* Option 4: Other…

**Q1-2 If beam-level criterion is supported in Rel-17, which option above do companies support for defining beam-level criterion?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1, 2, 3 or other?** | **Comments** |
| Fraunhofer | 2 | Doppler shift can be a more robust measure than change count or quality variation |
| Huawei, HiSilicon | 1 | As analysed in [1], it is difficult to identify whether UE is moving or not by evaluating the number of switched beams that is calculated based on a certain threshold. The quality variation of the beam(s) is a relative value, and it is not related to the distance between UE and gNB. Hence, it will be more accurate to evaluate “stationary” criterion. |
| Nokia | 1 | The beam change evaluation method can use the existing measurements that UE would do anyway e.g. the L3 RRM. Thus no extra measurements would need to be specified for the beam change based evaluation |
| NTTDOCOMO | 1 or 3 | See benefits in either evaluating the beam quality variation [1] or change of Number of serving beams in a certain period of time.  |
| Qualcomm | 2 | Doppler shift is more robust than beam change count or quality change criterion. And it is readily available for UE, since UE has to measure it for QCL determination. |
| Intel | 3 | Taking into account the number for serving beam change should be the simple way.  |
| Sony | Option 3/ 4 | We have a proposal in R2-2108070 and somewhat aligned with option 3 that number of beams should be taken into account and we think this could still be reflected in delta threshold instead of defining a new mechanism. |
|  |  |  |
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Summary

Based on the inputs for Q1-1 and Proposal 1, rapporteur thinks that the details of beam-level criterion do not need to be discussed in Rel-17.

## R17 not-at-cell-edge threshold for IDLE/INACTIVE

In RAN2#114-e, RAN2 made the following agreements on Rel-17 not-at-cell-edge criterion in RRC\_IDLE/INACTIVE:

|  |
| --- |
| Agreement:1. When NW configures Rel-17 RRM relaxation for RRC\_IDLE/INACTIVE, Rel-17 stationary criterion is mandatory, and Rel-17 not-at-cell-edge criterion is optional configuration.2. Continue discussion on Rel-17 not-at-cell-edge criterion in RRC\_IDLE/INACTIVE within two options: - Option 1) Reuse Rel-16 not-at-cell-edge criterion with the same thresholds (i.e., SSearchThresholdP / SSearchThresholdQ) - Option 2) Reuse Rel-16 not-at-cell-edge criterion with the different thresholds |

The Rel-17 not-at-cell-edge criterion in RRC\_IDLE/INACTIVE can be:

* Option 1: Proposal in [1]: Reuse Rel-16 not-at-cell-edge criterion with the same thresholds, when configured together with the R17 stationary criterion.
* Option 2: Proposal in [2]: Introduce separate Rel-17 not-at-cell-edge threshold, and the new threshold is only associated with Rel-17 stationary criterion (if configured).

**Q2 Which option above do companies support for Rel-17 not-at-cell-edge criterion in RRC\_IDLE/INACTIVE?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1 or 2?** | **Comments** |
| Fraunhofer | 1 | We do not see the benefit on adding a separate threshold |
| Ericsson | 1 | We assume 1 means that we don’t add anything new but rely on existing spec.  |
| ZTE | 2 | RAN2 already agreed to reuse low mobility criterion with separate thresholds for Rel-17 UEs, so network can configure stricter low-mobility thresholds in order to determine stationary UEs. If Option 2 is supported, then network can configure a lower not-at-cell-edge threshold for stationary UEs, so they can have more chance to do RRM relaxation. In addition, we think separate thresholds bring more flexibility to network deployment, if network wants to use single threshold, network can configure them to the same value.  |
| KDDI | 1 | We suggest to reuse the same threshold as Rel-16 |
| Xiaomi | 1 | Introducing separated threshold is redundant as the signal quality can be varied, two different values are difficult to distinguish. Therefore reusing the same Rel-16 not-at-cell-edge is enough. |
| CATT | 2 | We prefer a clean separation of R16 and R17 triggers |
| Huawei, HiSilicon | 1 | The measurement result is not an accurate and fixed value, and may vary within a certain range, we do not see much gain to define a new R17 threshold. |
| vivo | 2 | In RRC\_IDLE/INACTIVE, Rel-17 not-at-cell-edge criterion can only be configured along with Rel-17 stationary criterion. As mentioned by ZTE, Rel-17 stationary criterion is expected to be stricter than Rel-16 low mobility criterion. It is reasonable to allow looser Rel-17 not-at-cell-edge criterion than Rel-16 to allow more stationary UEs (which do not fulfill the R16 not-at-cell-edge criterion) to perform RRM relaxation.  |
| Sharp | 2 | More flexible. |
| OPPO | 2 | In our understanding, since stationarity criterion is more stringent than low-mobility criterion, it seems reasonable to combine the stationarity criterion with a looser not-at-cell-edge criterion compared to Rel-16 not-at-cell-edge criterion. When both Rel-17 stationarity criterion and Rel-17 not-at-cell-edge criterion are configured and both criteria are fulfilled, whether UE shall relax measurement as legacy (i.e. stop measurement with a minimum measurement time interval of 1 hour) or based on new relaxation method is up to RAN4. |
| Thales | 1 | We don’t see much benefit in adding additional Rel.-17 set of thresholds. |
| Nokia | 2 | Beam level RSRP condition could be introduced |
| NTTDOCOMO | 1 | Prefer combining exsiting threshold\_P/Q and beam-change based method for stricter evaluation.  |
| Futurewei | 2 | Rel-16 not-at-cell-edge criterion can be a standalone criterion by itself. Therefore, when selecting the threshold for it, one has to be conservative so as to prevent certain moving UEs from performing RRM relaxation (otherwise, the network performance may be compromised by these UEs).On the other hand, Rel-17 not-at-cell-edge criterion is always combined with Rel-17 stationarity criterion. As long as the UE fulfils the Rel-17 stationarity criterion, there is much greater certainty regarding the UE’s mobility (comparing to Rel-16 low mobility criterion or when no mobility criterion needs to be fulfilled at all). Hence, the threshold selected for the Rel-17 not-at-cell-edge criterion can be relaxed to allow more UEs, including those that are stationary but otherwise would be deemed as being too risky to perform RRM relaxation if the UE isn’t stationary, to benefit from RRM relaxation. |
| Qualcomm | 2 | Agree with ZTE and vivo |
| Apple | 2 | Same views as Vivo. |
| Intel | 2 | To our understanding, the cell coverage could be different for redcap UE and non-RedCap UE, and therefore separate threshold is needed for not at cell edge threshold. |
| Sequans | 2 | Agree with ZTE, vivo. The additional flexibility can be useful with no real downsides. |
| Samsung | 2 | We assume Rel-17 RRM relaxation should not be dependant with Rel-16 RRM relaxation. Therefore, separate thresholds are needed. |
| MediaTek | 1 | Agree with others that we do not see a significant benefit associated with the introduction of a new threshold. The more complicated we make this feature; the lesser is the likelihood of its adoption in the field. |
| Chinatelecom | 2 | Agree with ZTE and vivo. |
| BT | 1 | Use existing specs for RedCap |
| Sony | Option 2 |  |
| DENSO | 1 | We think that not-at-cell-edge thresholds used for the stationary criterion and low mobility one can be the same. That is, we prefer option 1. |
| LG | 2 | We think the network should be able to configure different not-at-cell edge criterion for R16 criterion and R17 criterion, because the less strict condition can be configured for R17 criterion for RedCap UEs. |

Summary

25 companies provided views for Q2:

* 10/25 companies (Fraunhofer, Ericsson, KDDI, Xiaomi, Huawei, HiSilicon, Thales, NTTDOCOMO, MediaTek, BT, DENSO) support Option 1
* 15/25 companies (ZTE, CATT, vivo, Sharp, OPPO, Nokia, Futurewei, Qualcomm, Apple, Intel, Sequans, Samsung, Chinatelecom, Sony, LG) support Option 2

Based on the inputs, the companies supporting Option 1 do not see the benefit on adding a separate threshold, the companies supporting Option 2 think it brings more flexibility to network deployment. As there is no clear consensus on this issue, rapporteur suggests to have online discussions.

Proposal 2 [Online discussions]: RAN2 to discuss which option is to be supported for Rel-17 not-at-cell-edge criterion in RRC\_IDLE/INACTIVE:

* Option 1 (10/25): Reuse Rel-16 not-at-cell-edge criterion with the same thresholds, when configured together with the R17 stationary criterion.
* Option 2 (15/25): Introduce separate Rel-17 not-at-cell-edge threshold, and the new threshold is only associated with Rel-17 stationary criterion (if configured).

## Stationarity criterion for CONNECTED

In RAN2#114-e, RAN2 made the following agreements on Rel-17 not-at-cell-edge criterion in RRC\_IDLE/INACTIVE:

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| --- |
| Agreement: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) |

For the configuration of stationarity criterion in RRC\_CONNECTED, how the network provide the configuration of stationarity criterion to the UE in RRC\_CONNECTED?

* Option 1: Dedicated signaling, e.g. RRCReconfiguration message;
* Option 2: Broadcast signaling, e.g. using configuration broadcast for RRC\_Idle/Inactive;
* Option 3: Combining dedicated signaling and broadcast signaling;
* Option 4: Other…

**Q3-1 Which option above do companies support for configuration of stationarity criterion in RRC\_CONNECTED?**

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| --- | --- | --- |
| **Company** | **Option 1, 2, 3 or other?** | **Comments** |
| Fraunhofer | 3 | A broadcast signalling should suffice in most situations but for the sake of flexibility it would be good if the network can override the parameters for specific UEs via dedicated signaling |
| Ericsson | 1 | In CONNECTED mode the UE has a dedicated connection with the network, there is no need to add broadcast signalling for CONNECTED UEs. We don’t expect it to be a lot of overhead to signal these thresholds compared to other configurations the NW provides to the UE with dedicated signalling. |
| ZTE | 1 | First, we don’t think the configurations provided for IDLE/INACTIVE UEs can be reused for Connected UEs, because the performance impact in connected mode will be considered more seriously. If network broadcasts two set of thresholds in system information, it takes more public resources (especially because SIB is periodical transmitted).For RRC\_CONNECTED UEs, we think the signalling overhead of Option 1 is not much, and network is able to configure different parameters for different UEs (e.g. based on service type). Option 3 is not necessary, because using one method is sufficient.  |
| KDDI | 1 | Share the same view as ZTE |
| Xiaomi | 1 | Since UE perform RRM measurements based on measurement configuration in RRC\_CONNECTED, it is straightforward to reuse such a framework to provide the configuration of stationary criterion (e.g. put the criterion into trigger event.) |
| CATT | 2 | The same configuration broadcasted for RRC\_Idle/Inactive is also used in RRC\_Connected. The stationarity status is independent of the RRC state. |
| Huawei, HiSilicon | 1 or 3 | Dedicated signalling should be used for configuration of stationarity criterion in RRC\_CONNECTED. Option 3 may also be considered if the configuration of stationarity criterion in RRC\_CONNECTED is the same as the stationarity criterion in RRC\_Idle/Inactive, the gNB can indicate whether UE can use stationarity criterion in RRC\_Idle/Inactive in dedicated signalling, instead of send the same configuration again. |
| vivo | 3 | Firstly, broadcast signaling can reduce the overhead. Besides, broadcast signaling can allow UE to evalute the criteria before entering RRC\_CONNECTED state, and allows NW to configure connect UE to perform RRM relaxation after entering RRC\_CONNECTED.Moreover, there is no need to have restriction on the flexibility for network configuration.  |
| Sharp | 1 or 3 | It depends on the detailed parameters/thresholds discussion. If some parameters some parameters could be same, Option 3 can be used. If all of parameters of idle/inactive stationary criterion and connected criterion could be different, Option 1 can be used. |
| CMCC | 1 | For gNB, the channel quality criteria for RRM relaxation could be optionally configured via RRC reconfiguration in RRC connected mode for more accurate evaluation on the channel quality for RRM relaxation. |
| OPPO | 1 | Option1 could provide more flexibility for network implementation. Network could configure different UEs with different parameters for stationary /not-cell-edge criteria, e.g, based on the UE’s mobility attribute |
| Thales  | 1,3 | Broadcast If the network uses same RSRP/RSRQ based stationarity criterion as in idle, the network can indicate this in broadcast and RRM measurement relaxation could be configured by the gNodeB immediately when entering RRC\_Connected. If stationarity requirement is different in connected, dedicated signalling should be preferred. Once met RRM relaxation can be configured by the network. |
| Nokia | 1 | It would be straight forward to use dedicated signalling. Furthermore CONNECTED mode relaxation criteria can be expected to be more conservative compared to IDLE/INACTIVE relaxation criteria. |
| NTTDOCOMO | 1 | In RRC\_CONNECTED, it is straightforward to send configuration of stationarity criterion in RRC dedicated signalling. |
| Futurewei | 1, 3 | Option 1 is simple. However, we are also open to option 3 with the following refinement:* when the same stationarity criterion/threshold broadcasted for idle/inactive UEs is to be used by a connected UE, the dedicated signalling instructs the connected UE to use the broadcasted stationarity criterion/threshold without repeating the same configuration; and
* when a different stationarity criterion/threshold is to be used by a connected UE, the dedicated signalling conveys that different stationarity criterion/threshold to the UE.

In any case, we think the broadcast signalling should convey only one stationarity criterion, which is used at least for idle/inactive UEs. |
| Qualcomm | 3 | We see use cases in which either broadcast or dedicated signaling may be useful. |
| Apple | 3 | Do not see any reason why the NW cannot use common cofig for the entire cell. All options should be allowed for the NW. |
| Intel | 1 | Share the same view as Ericsson and ZTE. |
| Sequans | 1 | Dedicated configuration seems more suitable seeing the varying use cases for RedCap and the more stringent requirements in Connected (compared to Idle).We are OK to keep considering 3, e.g. as FFS, if a useful case is identified.  |
| Samsung | 1 | Agree with ZTE. |
| MediaTek | 1 | For the same reasons as ZTE |
| Chinatelecom | 1 | Agree with ZTE. |
| BT | 1 | Agree with ZTE |
| Sony | Option 1 |  |
| DENSO | 3 | There are useful cases for both broadcast and dedicated signals, allowing NW to make flexible choices. |
| LG | 1 | First of all, the configuration for connected mode should be separately configured from idle/inactive mode. There is no reason to make UE to additionally acquire system information during connected mode, so dedicated signalling is enough. If the dedicated signalling is provided, option 3 is not needed. |

Summary

26 companies provided views for Q3-1:

* 20/26 companies (Ericsson, ZTE, KDDI, Xiaomi, Huawei, HiSilicon, Sharp, CMCC, OPPO, Thales, Nokia, NTTDOCOMO, Futurewei, Intel, Sequans, Samsung, MediaTek, Chinatelecom, BT, Sony, LG) support Option 1
* 1/26 company (CATT) supports Option 2
* 9/26 companies (Fraunhofer, Huawei, HiSilicon, vivo, Sharp, Thales, Futurewei, Qualcomm, Apple, DENSO) supports Option 3

Based on the inputs, the majority of companies (25/26) support dedicated signalling (e.g. RRCReconfiguration message), only one company supports only broadcast signalling. Besides, some companies (9/26) support combination of dedicated signaling and broadcast signalling, however, the detailed way of using combination of dedicated signaling and broadcast signalling seems different based on companies understanding. There is understanding that either broadcast or dedicated signaling can be used, and the other understanding is that the network can indicate whether UE can use stationarity criterion in RRC\_Idle/Inactive in dedicated signalling and the configuration of threshold broadcast in RRC\_Idle/Inactive is used. Thus, rapporteur suggests to follow the majority to support dedicated signalling, and keep the combination of dedicated signaling and broadcast signalling as FFS.

Proposal 3 [For agreement] (25/26): The network provides the configuration of stationarity criterion to the UE via dedicated signalling (e.g. RRCReconfiguration message) in RRC\_CONNECTED.

Proposal 4 [Online discussions] (9/26): RAN2 to discuss whether dedicated signalling can be combined with broadcast signalling.

If the configured stationary criterion is met by the UE, UE can report it to the network, so that the network can decide whether to enable the RRM relaxation to the UE, then how the UE reports it to the network in RRC\_CONNECTED?

* Option 1: Reuse UEAssistanceInformation message for the report, e.g. introduce new field to indicate whether stationary criterion is met or not;
* Option 2: Reuse RRM measurement reporting mechanism;
* Option 3: Define a new RRC message for the report;
* Option 4: Other…

**Q3-2 Which option above do companies support to report whether the stationarity criterion is met or not by the UE in RRC\_CONNECTED?**

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| --- | --- | --- |
| **Company** | **Option 1, 2, 3 or other?** | **Comments** |
| Fraunhofer | 2 | Reusing the RRM measurement report mechanism seems more natural since the object of relaxation are the RRM measurement themselves. Also, this would create the opportunity to associate the relaxation with particular measurement objects. For example, as part of RRM relaxation report the UE could report the headroom on certain measurement objects (how far the UE is from reporting it) to assist the network to decide if that particular measurement object can be relaxed or not. |
| Ericsson | 1 | The RRM measurement framework is used to provide RRM measurements to the network.What we are discussing here is a report of assisting data that the UE may have for the network in order to configure the UE in a certain way. For that purpose we have the UE assistance information framework.We therefore assume that the simplest approach is to use the UE assistance information. |
| ZTE | 2 | We think it is simpler to reuse RRM measurement reporting mechanism, as we indicated in [2], we can define a new event, formulate TsearchDeltaP\_stationary as TTT, reuse *ReportOnleave* to trigger UE report when the criterion is not met any more. And network can use *reportAmount* and *reportInterval* to control UE’s reporting behaviour. The current UAI mechanism is a bit complex and still has several open issues to be solved (see offline 14), so we think using Option 2 is simpler and reduces the specification effort.  |
| Xiaomi | 2 | If we adopt RRM measurement configuration framework to provide the stationary criterion, then reusing MeasurementReport mechanism is straightforward and reasonable as MeasurementReport could be triggered by events.If so, the triggered measId within MeasurementReport can implicitly indicate that the criterion is fulfilled since the measId is linked to an event (e.g. stationary criterion) within ReportConfig. And more details can be further discussed if introduced. |
| CATT | 1 | The UAI framework can address well this feature. |
| Huawei, HiSilicon | 1 | UE can use existing UAI to report whether the criterion is met or not. It is very easy to extend UAI for this but if using measurement reporting option, we need to review full measurement procedure. Simple bits in UAI is enough which consumes less power for transmitting UAI due to no large message size compared with measurement reporting including measurement report. |
| vivo | 2 | The most straightforward and simple solution is to reuse the measurement report mechanism. Meanwhile, the mechanism for the report of fulfilled criteria is quite similar as current measurement report: criteria->event, TsearchDeltaP->TTT.For example, a new measurement event can be introduced for the report of fulfilled criteria. |
| Sharp | 2 | Existing control parameters can be reused and more information could be carried if necessary. |
| CMCC | 2 | Once UE finds out that its channel quality meets the criteria, it has to send the notification to gNB using RRM measurement reporting mechanism and the RRM relaxations could be performed in UE automatically. |
| OPPO | 2 | It is the most straightforward way. New measurement event(s) for stationary/not-cell-edge criteria can be introduced. When the stationary/not-cell-edge criteria is fulfilled, UE shall trigger a measurement report. |
| Thales | 1 | Agree with Ericson and Huawei. It is an information whether, the stationarity requirement is met (1bit). For this we should use the UE assistance information message. |
| Nokia | 2 | Legacy measurement reporting seems straightforward. |
| NTTDOCOMO | 2 | The criteria satisfied notification could be sent to gNB using measurement reporting mechanism. |
| Futurewei | 1 | We agree with Ericsson, Huawei, and Thales. |
| Qualcomm | 1 | We have the same comment as Ericsson and CATT |
| Apple | Ok with 1 or 2 | See no big difference. |
| Intel | 2 | Same view as ZTE. The natural way is to reuse RRM measurement mechanism, i.e. criterion is configured based on event as CHO, and report is based on measurement reporting.  |
| Sequans | 1 | The small amount of information makes 2 seem like overkill – we have not discussed sending any additional information except stationary criteria is met.However, we are fine to go with majority. |
| Samsung | 1 | In our understanding, both of two options can be used for the report. However, we prefer UAI with more simplicity.  |
| MediaTek | 2 | While both options can work, we prefer option 2 i.e. to use the RRM framework for RRM relaxations |
| Chinatelecom | 1 | When UE detects that it meets the stationarity criterion, reporting the information to the network in UE assistance information is simple. |
| BT | 1 or 2 |  |
| Sony | Option 1/ 2 |  |
| DENSO | 2 | We agree with ZTE. |
| LG | 2 | We propose to introduce new measurement report triggering condition, “stationary state”. Instead of not-at-cell edge criterion in connected mode, the network should know some neighbour cell measurement results to enable RRM relaxation with new measurement configuration when the UE reports its stationary state. (The network may relax the measurement on the neighbour cells whose measured quality is bad). |

Summary

25 companies provided views for Q3-2:

* 12/25 companies (Ericsson, CATT, Huawei, HiSilicon, Thales, Futurewei, Qualcomm, Apple, Sequans, Samsung, Chinatelecom, BT, Sony) support Option 1
* 16/25 companies (Fraunhofer, ZTE, Xiaomi, vivo, Sharp, CMCC, OPPO, Nokia, NTTDOCOMO, Apple, Intel, MediaTek, BT, Sony, DENSO, LG) support Option 2
* No company supports Option 3

Based on the inputs, the companies supporting Option 1 think UAI is simple and can address well this feature, the companies supporting Option 2 think RRM measurement reporting mechanism is simple and straightforward. As there is no clear consensus between Option 1 and Option 2, rapporteur suggests to have online discussions.

Proposal 5 [Online discussions]: RAN2 to discuss which option is to be supported for reporting whether the stationarity criterion is met or not by the UE in RRC\_CONNECTED:

* Option 1 (12/25): Reuse UEAssistanceInformation message for the report.
* Option 2 (16/25): Reuse RRM measurement reporting mechanism.

## LS to RAN4

Based on WID, RAN2 only focus on defining RRM relaxation criteria, and the RAN4 will define RRM relaxation methods. [2] suggests to send RAN2’s conclusions to RAN4.

**Q4-1 Do companies agree to send LS to RAN4 to inform RAN2 conclusions for RRM relaxation in both RRC\_IDLE/INACTIVE and RRC\_CONNECTED?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Fraunhofer | Yes (but) | We agree to send an LS regarding the conclusions on RRC\_IDLE/INACTIVE, but for RRC\_CONNECTED it may be still be a bit premature as there are less agreements and more FFS.  |
| Ericsson | Yes | Perhaps RAN4 can start working at least on the IDLE/INACTIVE relaxation. See comment on CONNECTED below. |
| ZTE | Yes | We think it’s time to inform RAN4 about our conclusion, and provide guidance to their discussion on RRM relaxation methods.  |
| KDDI | Yes |  |
| Xiaomi | Yes |  |
| CATT | Yes |  |
| Huawei, HiSilicon | Yes |  |
| vivo | Yes | We think it is better to send an LS to RAN4 to inform our conclusion, and request RAN4 to work on RRM relaxation method for idle/inactive/connected. |
| Sharp | Yes |  |
| CMCC | Yes |  |
| OPPO | Yes |  |
| Thales | Yes |  |
| Nokia | Yes, but | LS needs to be sent, but it remains to be seen when. It depends on the progress in this meeting. LS can be sent also later. |
| NTTDOCOMO | Yes |  |
| Futurewei | Yes |  |
| Qualcomm | Yes |  |
| Apple | Yes | See no reason not to send an LS to update RAN2 progress. |
| Intel | Yes |  |
| Sequans | Yes, but | Seems a bit premature for Connected. We can postpone sending the LS a bit if we make good progress on Connected this meeting, or send another LS for connected in the future. |
| Samsung | Yes | LS may be sent later with more RAN2's progress. |
| MediaTek | Yes, but | We agree with others that discussions on Connected mode are premature to be included in this LS. |
| Chinatelecom  | Yes  |  |
| BT | Yes |  |
| Sony | Yes |  |
| DENSO | Yes |  |
| LG | Yes | RAN4 needs to define the method of performing measurement relaxation in each case:* Only stationarity criterion is configured, and the UE fulfils the stationarity criterion.
* Both stationarity criterion and not-at-cell edge criterion are configured, and UE fulfils both criteria.
* Both stationarity criterion and not-at-cell edge criterion are configured, and UE only fulfils the stationarity criteria.
 |

Summary

26 companies provided views for Q4-1:

* All companies support to send LS to RAN4 to inform RAN2 conclusions for RRM relaxation, but there is some additional comments:
	+ Fraunhofer: For RRC\_CONNECTED it may be still be a bit premature as there are less agreements and more FFS
	+ Ericsson: Perhaps RAN4 can start working at least on the IDLE/INACTIVE relaxation.
	+ Nokia: it remains to be seen when. It depends on the progress in this meeting. LS can be sent also later.
	+ Sequans: Seems a bit premature for Connected.
	+ Samsung: LS may be sent later with more RAN2's progress.
	+ MediaTek: Discussions on Connected mode are premature to be included in this LS.

Based on the inputs, all companies support to send LS to RAN4 to inform the RAN2 conclusions, however, 4 companies think it is premature for RRC\_CONNECTED, 3 companies think the LS can be sent later with more RAN2's progress. Rapporteur understands that since all the companies agree to send the LS and the main concern comes from the RRC\_CONNECTED, at least the LS can be sent to RAN4 to inform them to start working on the IDLE/INACTIVE relaxation. The detailed contents of LS is discussed in Q4-2.

Proposal 6 [For agreement] (26/26): To send LS to RAN4 to inform RAN2 conclusions for RRM relaxation.

**Q4-2 If the answer for Q4-1 is yes, which content(s) to be included in the LS?**

1. **Agreed RAN2 conclusions;**
2. **“For RRC\_IDLE/INACTIVE, RAN4 is asked to study and define corresponding R17 RRM relaxation method” proposed in [2];**
3. **“For RRC\_CONNECTED, RAN4 is asked to study whether additional RRM relaxation method is needed. If yes, please specify it.” proposed in [2];**
4. **Other…**

|  |  |  |
| --- | --- | --- |
| **Company** | **Content(s)** | **Comments** |
| Fraunhofer | 1,2,4 | Regarding 3. the RRM relaxation method needs to match the criteria (for an harmonic overall solution). We think that we should discuss other criteria before asking RAN4 to specify the method. As pointed in our contribution (R2-2107145) we think that including a new criterion based on measurements of other cells (non-serving) is needed to prevent certain handover failures and network degradation. We suggest we discuss that before asking RAN 4 to specify the methods.4 – we should kindly request that RAN 4 whether certain methods should not be used in RRC\_CONNECTED. In particular, we have concerns regarding the existing Rel16 method of stopping measurements for 1 hour. In our view this should not be applicable to RRC\_CONNECTED because it will prevent the UE to know it should leave RRM relaxation timely.  |
| Ericsson | 1, 2 | Regarding 3, we have not yet decided how RRM relaxation in CONNECTED should be achieved. We describe in our paper [R2-2108275](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_115-e/Docs//R2-2108275.zip) that there can be done in two different ways:1. define a new RRC measurement mode that the UE can be put in to, e.g. the network would tell the UE "please enable RRM relaxation".
2. rely on network configuration, e.g. network can deconfigure/reconfigure RRM measurements

This discussion needs to be sorted out before we involve RAN4. |
| ZTE | 1,2,3 | For CONNECTED UEs, RAN2 already agreed the network implementation based approach. But we don’t think RAN2 is able to discuss other relaxation methods, and whether IDLE/INACTIVE methods can be reused for CONNECTED UEs. So it is better to inform RAN4 what has been agreed in RAN2, and let them to discuss and decide whether additional methods are needed.  |
| KDDI | 1,2,3 |  |
| Xiaomi | 1,2,3 | We are OK for these. |
| CATT | 1 | We can fine-tune the LS after we have concluded the agreements. |
| Huawei, HiSilicon | 1, 2, 3 | Information 2/3 may help RAN4 to correctly understand RAN2 status. |
| vivo | 1,2,3 | For connected UE, we think RAN4 should discuss and decide which additional methods are needed.  |
| Sharp | 1,2,3 | And we have sympathy with Fraunhofer’s comments on stopping measurement time in RRC\_CONNECTED. Maybe gNB could control the stopping measurement time. |
| CMCC | 1,2,3 |  |
| OPPO | 1,2,3 |  |
| Thales | 1,2, (3) | Whether to include 3 also depends on the progress/outcome of the current discussions around the RRM relaxation in RRC\_CONNECTED. |
| Nokia | 1,2,3 | See our comments for the previous question. |
| NTTDOCOMO | 1,2,3 | OK with these. |
| Futurewei | 1,2,3 |  |
| Qualcomm | 1,2,3 |  |
| Apple | 1,2,3 |  |
| Intel | 1 | RAN2 conclusion should be sufficient for RAN4 to start their discussion.  |
| Sequans | 1,2, (3, 4) | Agree with Thales. We are also OK to ask pre-emptive question for Connected, as suggested by Fraunhofer |
| Samsung | 1,2,3 | Agree with Thales |
| MediaTek | 1, 2 for now | The discussions on Connected mode operation in RAN2 are too premature at this point to involve RAN4. |
| Chinatelecom | 1,2,3 |  |
| BT | 1,2(,3) | Agree with Thales |
| Sony | 1,2,3 |  |
| DENSO | 1,2,3 |  |
| LG | 1,2,3 | For option 2, please refer our answer to Q4-1. |

Summary

26 companies provided views for Q4-1:

* All companies support to include “1. Agreed RAN2 conclusions”
* 24/26 companies (Fraunhofer, Ericsson, ZTE, KDDI, Xiaomi, Huawei, HiSilicon, vivo, Sharp, CMCC, OPPO, Thales, Nokia, NTTDOCOMO, Futurewei, Qualcomm, Apple, Sequans, Samsung, MediaTek, Chinatelecom, BT, Sony, DENSO, LG) support to include “2. For RRC\_IDLE/INACTIVE, RAN4 is asked to study and define corresponding R17 RRM relaxation method”
* 18/26 companies (ZTE, KDDI, Xiaomi, Huawei, HiSilicon, vivo, Sharp, CMCC, OPPO, Nokia, NTTDOCOMO, Futurewei, Qualcomm, Apple, Samsung, Chinatelecom, Sony, DENSO, LG) support to include “3. For RRC\_CONNECTED, RAN4 is asked to study whether additional RRM relaxation method is needed. If yes, please specify it”
* 1 company proposed to request RAN4 whether certain methods should not be used in RRC\_CONNECTED and 1 company agreed.

Based on the inputs, all companies support to include the agreed RAN2 conclusions in the LS, and the majority of companies support to include “For RRC\_IDLE/INACTIVE, RAN4 is asked to study and define corresponding R17 RRM relaxation method” so RAN4 can start the associated work for RRM relaxation in RRC\_IDLE/INACTIVE. As some companies think it is premature for RRC\_CONNECTED, RAN4 may need to wait for more conclusion in RAN2 for RRC\_CONNECTED then start the associated work for RRM relaxation in RRC\_CONNECTED, rapporteur understands at least the situation for RRC\_CONNECTED in RAN2 can be simply mentioned in the LS, the details can be discussed further during the LS draft phase.

Proposal 7 [For agreement]: The LS to RAN4 includes the agreed RAN2 conclusions (26/26) and “For RRC\_IDLE/INACTIVE, RAN4 is asked to study and define corresponding R17 RRM relaxation method” (24/26).

# Discussion for the second round

## R17 not-at-cell-edge threshold for IDLE/INACTIVE

For Rel-17 not-at-cell-edge criterion in RRC\_IDLE/INACTIVE, based on the first round discussion, the result was:

* 10 companies supported Option 1: Reuse Rel-16 not-at-cell-edge criterion with the same thresholds, when configured together with the R17 stationary criterion.
* 15 companies supported Option 2: Introduce separate Rel-17 not-at-cell-edge threshold, and the new threshold is only associated with Rel-17 stationary criterion (if configured).

The following is the summary based on the companies’ inputs during phase 1 discussion.

The motivations for Option 1 Reuse Rel-16 not-at-cell-edge criterion with the same thresholds

1. No benefit on adding a separate threshold
2. Fewer spec impacts, we don’t add anything new but rely on existing spec, easy for adoption in the field

The motivations for Option 2 Introduce separate Rel-17 not-at-cell-edge threshold

1. It is flexible that network can configure a different not-at-cell-edge threshold for stationary UEs
2. Clean separation of R16 and R17 triggers

In rapporteur’s understanding, a second round for selecting the supported option again won’t help much. The rapporteur would like to invite the companies to provide more views (e.g. pros and cons) for either or both solution(s).

**Q5 Companies are invited to provide more views (e.g. pros and cons) for either or both solution(s). If the view for supported option is changed compared with the first round reply, please companies indicate it in the Comments column.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | We don’t see benefits for adding new threshold for not-at-cell-edge for stationary UEs. The same not-at-cell-edge can be used for both low mobile and stationary UEs.  |
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## Report of fulfilling criterion for CONNECTED

For the message to be used to report whether the stationarity criterion is met or not by the UE in RRC\_CONNECTED, based on the first round discussion, the result was:

* 12 companies supported Option 1: Reuse UEAssistanceInformation message for the report.
* 16 companies supported Option 2: Reuse RRM measurement reporting mechanism.

The following is the summary based on the companies’ inputs during phase 1 discussion.

Option 1: Reuse UEAssistanceInformation message

1. UAI mechanism is more suitable since it is a report of assistance instead of providing RRM measurements
2. It is very easy to extend UAI with simple bits consumes less power, no need of reviewing full measurement procedure

Option 2: Reuse RRM measurement reporting mechanism

1. Simpler and straightforward to reuse RRM measurement reporting mechanism
2. A new measurement event can be introduced for the report of fulfilled criteria
3. Existing control parameters can be reused and more information could be carried if necessary

The rapporteur would like to invite the companies to provide more views (e.g. pros and cons) for either or both solution(s), and would suggest to understand how each option works, which can be considered further for determining the adopted mechanism.

**Q6-1 Companies are invited to provide more views (e.g. pros and cons) for either or both solution(s). If the view for supported option is changed compared with the first round reply, please companies indicate it in the Comments column.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | It would be beneficial for the NW to know when the UE is or is not relaxing the RRM measurements, because RRM relaxation can be taken into account in UE scheduling. NW can schedule the UE also during the measurement gap if the UE is not measuring frequencies requiring measurement gap. It would be straight forward to use measurement reporting enter and leave condition for this purpose. The UE should not start RRM measurement relaxation autonomously after the RRM measurement relaxation indication to the NW. NW should be able to allow/disallow RRM measurement relaxation using dedicated signaling.  |
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**Q6-2 For UAI mechanism, do companies agree that the same configuration (maybe with different thresholds) of stationarity criterion in RRC\_IDLE/INACTIVE can be reused in RRC\_CONNECTED, e.g. included in the *RRCReconfiguration* message?**

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| --- | --- | --- |
| **Company** | **Yes or No?** | **Comments** |
| Nokia | No |   |
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**Q6-3 For UAI mechanism, do companies agree that additional indication for reporting whether the stationarity criterion is met or not needs to be added in *UEAssistanceInformation* message?**

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| --- | --- | --- |
| **Company** | **Yes or No?** | **Comments** |
| Nokia | Yes | It would be beneficial for the network to know whether the UE is relaxing the measurements or not for scheduling purposes. NW can schedule the UE also during the measurement gap if the UE is not measuring frequencies requiring measurement gap. |
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**Q6-4 For RRM measurement reporting mechanism, do companies agree that new measurement event needs to be introduced for configuring stationarity criterion?**

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| --- | --- | --- |
| **Company** | **Yes or No?** | **Comments** |
| Nokia | Yes | It would be beneficial for the network to know whether the UE is relaxing the measurements or not for scheduling purposes. NW can schedule the UE also during the measurement gap if the UE is not measuring frequencies requiring measurement gap. Other measurement results can be provided at the same time. |
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**Q6-5 For RRM measurement reporting mechanism, do companies agree that more information needs to be added in *Measurementreport* message? If yes, what information needs to be added?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No?** | **Comments** |
| Nokia | Maybe | NW needs to know whether the UE is relaxing or not the RRM measurements. This can be possible determined from the measurement from event triggered the report.  |
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## Stationarity criterion configuration for CONNECTED

For the message to be used to provide the configuration of stationarity criterion to the UE in RRC\_CONNECTED, based on the first round discussion, 9 companies supported to combine the dedicated signalling with broadcast signalling. The comments for the broadcast signalling are summarised as below:

The reasons for no need of broadcast signalling:

1. The configuration of stationarity criterion configuration won’t cost a lot of overhead
2. It is flexible since the network is able to configure different parameters for different UEs

The reasons for need of broadcast signalling

1. It reduces the overhead if the configuration of stationarity criterion in RRC\_CONNECTED is the same as the stationarity criterion in RRC\_Idle/Inactive
2. It is flexible since the network can still override the broadcasted parameters for specific UEs via dedicated signaling. There is no need to have restriction on the flexibility for network configuration
3. Broadcast signaling can allow UE to evaluate the criteria before entering RRC\_CONNECTED state

As it was agreed that “the network can provide the configuration of stationarity criterion to the UE via dedicated signalling in RRC\_CONNECTED”, the issue we discuss here is whether the broadcast signalling can be used as an additional way for provide the configuration of stationarity criterion, e.g. the configuration of stationarity criterion in RRC\_CONNECTED is the same as the stationarity criterion in RRC\_Idle/Inactive. If the network prefers to configure the specific configuration of stationarity criterion for specific UEs in RRC\_CONNECTED, anyway the dedicated signalling can be used.

**Q7 Do companies support to use broadcast signalling to provide the configuration of stationarity criterion to the UE in RRC\_CONNECTED? To be noted, it is up to network implementation whether to use dedicated signalling (agreed) or broadcast signalling for stationarity criterion configuration in RRC\_CONNECTED.**

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| --- | --- | --- |
| **Company** | **Yes or No?** | **Comments** |
| Nokia |  | No strong view, dedicated signaling seems sufficient |
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# Conclusions

## Conclusions for the first round

**Proposals for potential agreement**

Proposal 1 [For agreement] (18/24): Do not introduce beam change based criterion in Rel-17.

Proposal 3 [For agreement] (25/26): The network provides the configuration of stationarity criterion to the UE via dedicated signalling (e.g. RRCReconfiguration message) in RRC\_CONNECTED.

Proposal 6 [For agreement] (26/26): To send LS to RAN4 to inform RAN2 conclusions for RRM relaxation.

Proposal 7 [For agreement]: The LS to RAN4 includes the agreed RAN2 conclusions (26/26) and “For RRC\_IDLE/INACTIVE, RAN4 is asked to study and define corresponding R17 RRM relaxation method” (24/26).

**Proposals for potential discussion online**

Proposal 2 [Online discussions]: RAN2 to discuss which option is to be supported for Rel-17 not-at-cell-edge criterion in RRC\_IDLE/INACTIVE:

1. Option 1 (10/25): Reuse Rel-16 not-at-cell-edge criterion with the same thresholds, when configured together with the R17 stationary criterion.
2. Option 2 (15/25): Introduce separate Rel-17 not-at-cell-edge threshold, and the new threshold is only associated with Rel-17 stationary criterion (if configured).

Proposal 5 [Online discussions]: RAN2 to discuss which option is to be supported for reporting whether the stationarity criterion is met or not by the UE in RRC\_CONNECTED:

* Option 1 (12/25): Reuse UEAssistanceInformation message for the report.
* Option 2 (16/25): Reuse RRM measurement reporting mechanism.

Proposal 4 [Online discussions] (9/26): RAN2 to discuss whether dedicated signalling can be combined with broadcast signalling.

## Conclusions for the second round

# References

1. R2-2107211, RRM measurement relaxation for RedCap UE, Huawei, HiSilicon.
2. R2-2107748, RRM relaxation for RedCap UEs, ZTE Corporation, Sanechips.
3. R2-2107218 RRM relaxations for RedCap UEs, Qualcomm Incorporated.
4. R2-2107754 RRM Relaxation for RedCap UE, NTT DOCOMO INC.