**3GPP TSG-RAN2 Meeting #115-e R2-210xxxx**

**Online, August 16 – 27, 2021**

**Agenda Item: 9.1.2**

**Source: Huawei**

**Title: Summary of AI 9.1.2 NB-IoT neighbour cell measurements (Huawei)**

**Document for: Discussion and decision**

# Introduction

This document summarises the contributions related to NB-IoT neighbour cell measurements and corresponding measurement triggering before RLF submitted to AI 9.1.2.

The document is organised according to the guidances provided for the AI.

# Discussion

## Details of the criteria and configuration for starting measurements

The following proposals are made in documents [1] - [7]:

|  |  |
| --- | --- |
| Tdoc | Proposals |
| R2-2107429 [2] | Proposal 1: Re-use the relaxed monitoring criteria defined for idle mode, i.e. even if the serving cell quality is below threshold for performing connected mode measurements for RLF, the UE may choose not to perform neighbour cell measurements if (SrxlevRef – Srxlev) < SSearchDeltaP for a period of TSearchDeltaP  Proposal 2: Introduce a new absolute RSRP threshold in system information which, if signalled, enables the requirement to perform connected mode measurements if relaxed monitoring criteria is not met.  Proposal 3: The parameters SSearchDeltaP and TSearchDeltaP may optionally be provided along with the RSRP threshold enabling the feature. If not present the UE should not enable relaxed monitoring for connected mode measurements.  Proposal 4: No need to define any explicit stop condition, i.e. the UE is required to perform measurements if the serving cell quality is below the absolute RSRP threshold, and relaxed monitoring criteria (if configured) is not met – otherwise no requirement. |
| R2-2107761 [3] | Proposal 2a: The network can configure separate criteria for NB-IoT UE to trigger intra-frequency measurements and/or inter-frequency measurements in connected mode.  Proposal 2b: The network can provide connected mode measurements criteria via dedicated RRC signaling. |
| R2-2107811 [5] | Proposal 2: In addition to configuring the triggering threshold for starting connected mode measurements network may also provide the list of target cells whose measurements should be prioritized. |
| R2-2108390 [7] | Proposal 1 The criteria to stop measurements should be specified to not require UE to continue performing the measurement.  Proposal 2 The criteria to start/stop measurements can be configured by broadcast signaling in SIB3-NB, serving cell quality threshold for intra and inter frequency measurement can be configurated separately. |

Rapporteur’ summary

Four companies propose to signal a serving cell NRSRP threshold for the configuration of the criteria to start the measurements ([2], [3], [5] and [7]). This is line with the agreement that the criteria is based on a combination of serving cell quality threshold and variance of the serving cell quality.

**Proposal 1:** [To agree] The configuration of the criteria for starting the measurements include a serving cell NRSRP threshold.

One company proposes to configure the criteria separately for intra- and inter-frequency measurements ([3]) and one company proposes to configure the criteria separately for intra- and inter-frequency cells ([7]).

**Proposal 2:** [To discuss] Whether to have separate criteria for intra- and inter-frequency neighbour cells or separate criteria for intra- and inter-frequency neighbour measurements.

One company proposes to reuse the existing relaxed monitoring criteria and optionally signal SSearchDeltaP and TSearchDeltaP parameters to enable it. This is line with the agreement that the criteria is based on a combination of serving cell quality threshold and variance of the serving cell quality.

**Proposal 3:** [To discuss] The configuration of the criteria for starting the measurements optionally includes SSearchDeltaP and TSearchDeltaP parameters to enable relaxed monitoring.

Two companies propose that the conditions where the UE is not required to perform measurements are specified, both assume that this can be a counterpart of the starting criteria and be implicit ([2] and [7]).

**Proposal 4:** [To discuss] The conditions where the UE is not required to perform measurements are specified. No additional configuration is needed.

Two companies propose that the configuration of the criteria is provided via broadcast signalling ([2] and [7]). One company proposes that the configuration of the criteria is provided via dedicated signalling ([3]). One company does not clarify ([5]).

**Proposal 5:** [To discuss] The configuration of the criteria for starting the measurements is provided via broadcast signalling.

## Whether any further information needs to be provided by the NW

The following proposals are made in documents [1] - [7]:

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| Tdoc | Proposals |
| R2-2107122 [1] | Proposal 1: In RRC connected state, measure one or more of the strongest neighbour cells measured in RRC idle state.  Proposal 2: In RRC connected state, measure one or more of the strongest neighbour cells measured in RRC idle state that do not require receiver re-tuning. |
| R2-2107429 [2] | Proposal 5: No additional new information needs to be configured by the NW (other than the parameters defining the measurement start conditions, and (FFS) RLF triggering timer). |
| R2-2107761 [3] | Proposal 3: Network can provide measurement configuration to the UE, e.g., the neighbor frequency, neighbor cells via dedicated RRC signaling. |
| R2-2107810 [4] | Observation 1: System Information acquisition time reduction during re-establishment can improve the overall Re-establishment time upto 40% compared to current performance.  Observation 2: If the connected mode measurement of the selected target cell is not available within configured time prior to RLF there will not be any improvement for re-establishment time reduction if other delay components are not optimised.  Observation 3: The impact of system information time reduction on re-establishment is higher than 40% if all the system information acquisition needed for RACH access is considered in the overall time estimation.  Observation 4: The reasons SI periodicity is set high is to limit the resource used/overhead for SI messages. SI messages are sent with multiple repetitions to enable different coverage enhancement scenarios.  Observation 5: For cell reselection cases for re-establishment the system information acquisition for SIB1-NB will further increase the delay of re-establishment.  Observation 6: For re-establishment scenarios UE may start random access with minimum system information acquisition and network may provision all the dedicated configurations explicitly as part of re-establishment procedure in this case.  Proposal 1: RAN2 to consider network assistance to UE related to minimum system information required for random access as part the signalling procedures defined for measurements and measurement triggering.  Proposal 2: Network assistance information containing the potential target cell identifiers is supported for connected mode measurements for RLF.  Proposal 3: RAN2 consider inclusion of target cell system information as a variation to the serving cell in the assistance information to minimise the system information acquisition for Re-establishment. |
| R2-2107811 [5] | Proposal 2: In addition to configuring the triggering threshold for starting connected mode measurements network may also provide the list of target cells whose measurements should be prioritized. |
| R2-2108390 [7] | Proposal 3 It is up to UE implementation to choose and prioritize carrier/cell list for measurement. |

Rapporteur’ summary

Three companies indicate that there is no need for the network to provide additional information regarding which cells/carriers to be considered, RRC\_IDLE mode configuration can be used ([1], [2], and [7]). Among these companies, one company proposes to define rules for prioritisation at the UE ([1]) and two companies think prioritisation can be left to the UE implementation ([2] and [7]). Two companies propose that the network provides the list of target cells whose measurements should be prioritized ([3], [4] and [5]).

**Proposal 6:** [To discuss] Provision of additional information regarding which cells/carriers to be considered is not supported. It is up to UE implementation to choose and prioritize carrier/cell list for measurement.

One company proposes to provide the UE with minimum system information for the target cell(s?) to minimise the delay for system information acquisition ([4]). No other contribution addresses the topic although it was already proposed in the last meeting.

**Proposal 7:** [To discuss] Provision of minimum system information for the target cell(s) to minimise the delay for system information acquisition is not supported.

## Whether any assistance information from UE is needed.

The following proposals are made in documents [1] - [7]:

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| --- | --- |
| Tdoc | Proposals |
| R2-2107122 [1] | Proposal 4: In RRC connected state, support UE indication requesting relaxed scheduling to perform neighbour cell measurements. |
| R2-2107429 [2] | Proposal 6: No assistance information from the UE needs to be specified. |
| R2-2107761 [3] | Proposal 4: The measured cell in idle mode can be sent from UE to the network to facilitate eNB to provide more suitable measurement configuration. |
| R2-2107811 [5] | Observation 1: Triggering of connected mode measurements at suitable time is key factor for optimised Re-establishment performance. Assistance information on the impact of measurement configuration on Re-establishment is essential to optimize the configuration.  Proposal 1: RRC Re-establishment complete message sent after RLF with connected mode measurement include additional information about connected mode measurements such as duration and time gap between measurements and Re-establishment starting point. FFS additional parameters. |
| R2-2108390 [7] | Proposal 4 Assistance information from UE is not needed.  Proposal 5 It is not needed for UE to report when it starts/stops measurements. |

One company proposes that the UE reports an indication when it starts/stops perform neighbour cell measurements to enable ‘relaxed’ scheduling [1]. Two companies think it is not needed ([2], [7]).

**Proposal 8:** [To discuss] Indication from the UE that it starts/ stops performing measurement is not supported.

One company proposes that the UE reports the measured cell(s) in RRC\_IDLE to assist measurement configuration by the network [3]. Two companies think it is not needed ([2], [7]).

**Proposal 9:** [To discuss] Report of the cells measured in RRC\_IDLE to assist measurement configuration is not supported.

One company proposes that the UE reports information of connected measurements during the RRC Connection re-establishment procedure for network optimisation [5]. One company thinks it is not needed ([2]).

**Proposal 10:** [To discuss] Report of information about connected measurements during the RRC Connection re-establishment procedure for network optimisation is not supported.

## If/how to support “early” RLF

The following proposals are made in documents [1] - [7]:

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| Tdoc | Proposals |
| R2-2107122 [1] | Observation 1: Not clear whether early RLF can in most cases lead to reduced time to complete data transfer.  Observation 2: Early RLF could lead to increased common radio resource usage and increased network signalling.  Proposal 3: For NB-IoT early RLF is not considered. |
| R2-2107761 [3] | Proposal 1: Early RLF is not introduced into NB-IoT. |
| R2-2107811 [5] | Observation 1: Comparative performance evaluation of early RLF against the RLF declaration of T310 expiry is not available for RAN2 decision on early RLF.  Observation 2: Work Item scope is limited to measurements and measurement triggering for RLF. Changes to RLM functionality is not in scope.  Proposal 3: Early RLF is considered only if benefits are established and WID scope should be updated for the impact to RLM. |
| R2-2107869 [6] | Observation 1: Reducing the time corresponding to cell selection will only bring marginal benefits for good coverage UEs, i.e. a couple of 100 ms.  Observation 2: The broadcast value of T310 is usually targeted to stationary UEs with short-lived connection and set to a large value.  Observation 3: For mobile UEs at the edge of the cell, a shorter T310 will reduce the interruption time and improve the user experience.  Observation 4: Using a shorter T310 always will reduce the chance of recovery for UEs not at the cell edge or not moving.  Proposal: Introduce an alternative shorter T310 timer that the UE uses to trigger RLF when at least the following condition is fulfilled:  ‐ The criteria for performing connected mode measurements is fulfilled (i.e. degrading serving cell quality)  ‐ FFS other conditions. e.g. RAI, target cell quality |
| R2-2108390 [7] | Observation 1 Fast RLF was introduced for HetNet scenario. Fast RLF needs a variety of adaptions for NB-IoT.  Proposal 6 Fast RLF should not be considered. |

Four companies propose that early RLF for NB-IoT is not supported ([1], [3], [5] and [7]) on the ground that the benefit is not clear, that it can lead to additional resource usage, that early RLF (T312) was introduced for Hetnet, cannot be reused directly and impacts the RLM procedure which is outside of the WID scope.

Nine companies propose to configure an alternative shorter T310 timer that the UE uses when certain conditions are fulfilled ([6]). A shorter T310 timer does not change the RLM procedure and the value is in under network control as it is today.

**Proposal 11:** [To agree] Configuration of an alternative shorter T310 timer that the UE uses when the criteria for performing connected mode measurements is fulfilled is supported. Need for other conditions is FFS.

## Other

The following proposals are made in documents [1] - [7]:

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| Tdoc | Proposals |
| R2-2107761 [3] | Observation 1a: In order to provide a single measurement occasion of length 400ms or 2000ms, the long DRX cycle would be required for supporting 400ms or 2000ms OFF period in a DRX cycle.  Observation 1b: If using DL gap, a single measurement occasion of length 2000ms cannot be provided in any configuration and 400ms measurement occasion can only be provided with few configuration. Such restriction on eNB configuration is almost unacceptable.  Observation 1c: If using NPDCCH gap, in order to provide a single measurement occasion of length 400ms or 2000ms, there is also much restriction on the scheduling parameters configuration.  Proposal 5: OFF period of DRX can be used for the neighbour cell measurement under scenario B, D and E. |
| R2-2108390 [7] | Proposal 7 UE capability for connected mode measurement is optional and without signaling to NW. |

One company proposes that the OFF period of DRX can be used for the neighbour cell measurement under scenario B, D and E.

**Proposal 12:** [To discuss] whether OFF period of DRX is used for the neighbour cell measurement under scenario B, D and E.

One company proposes that UE support for connected mode measurement is optional without capability signalling. Note that RAN2#113-e has already that the feature was optional.

**Proposal 13:** [To discuss] Support for connected mode measurement is optional without capability signalling.

# Conclusion

# References

1. R2-2107122 Consideration on neighbour cell measurement in RRC connected state Qualcomm Incorporated
2. R2-2107429 Open issues on connected mode measurements for RLF Huawei, HiSilicon
3. R2-2107761 Remaining issues on connected mode measurement ZTE Corporation, Sanechips
4. R2-2107810 Network assistance information for Re-establishment time reduction
5. R2-2107811 On the open aspects for connected mode measurements for RLF enhancements
6. R2-2107869 Triggering cell selection early Huawei, HiSilicon, MediaTek Inc., Spreadtrum Communications, Lenovo, Motorola Mobility, Fraunhofer, Novamint, CMCC, China Unicom, Reliance Jio
7. R2-2108390 Discussion on connected mode measurement in NB-IoT Ericsson discussion