**3GPP TSG-RAN WG2 Meeting #120 R2-221XXXX**

**Toulouse, France, 14th - 18th November 2022**

**Agenda Item:**  **8.13.5**

**Source: CATT (Summary rapporteur)**

**Title:** **Pre-meeting summary of 8.13.5 (CATT)**

**WI code(s): NR\_ENDC\_SON\_MDT\_enh2-Core**

**Document for: Discussion and Decision**

# Introduction

This document provides the summary of all the contributions submitted to 8.13.5 agenda item (SON for NR-U) of RAN2#120 meeting.

The summary is based on the following papers wherein the proposals are classified in section 2.

[1] R2-2211352 SON Enhancement for NR-U CATT

[2] R2-2211690 RAN2 progress on SON for NR-U Apple

[3] R2-2212034 Discussion on MRO for NR-U Lenovo

[4] R2-2212091 Enhancements of SON reports for NR-U Ericsson

[5] R2-2212221 Discussion on SON for NR-U Huawei, HiSilicon

[6] R2-2212284 Consideration on NR-U related SON ZTE Corporation, Sanechips

[7] R2-2212300 SON/MDT enhancements for NR-U Samsung R&D Institute India

[8] R2-2212452 LBT failures logging in SON\_MDT reports Nokia, Nokia Shanghai Bell Late

[9] R2-2212626 SONMDT enhancement for NR-U CMCC

[10] R2-2212667 Discussion on NR-U Related Enhancements Qualcomm Incorporated

[11] R2-2212808 Discussion on SON for NR-U Xiaomi

# Summary

## SON enhancements for NR-U in RA report

### How to log LBT failure information in RA report

#### Clarification on LBT failure number

In RAN2#119bis-e meeting, it was agreed that:

2 RAN2 agree to log kind of “the number of LBT failures” in the RA report.

 LBT failure is the failure to access the channel before transmission.

The definition of “the number of LBT failures” should be clarified.

FFS how to log the number of LBT failures in the RA report.

It can be seen that LBT failure which is the failure to access the channel before transmission is agreed to be logged in the RA report. But the definition of “the number of LBT failures” needs to be clarified. Inputs from companies are listed below.

|  |  |  |
| --- | --- | --- |
| Tdoc number | Company | Observations and Proposals |
| [R2-2211352](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2211352%20SON%20Enhancement%20for%20NR-U.docx) | CATT | Proposal 1: The definition of the number of LBT failures for RA report includes at least the LBT failure for failed RA preamble transmission which is counted into the PREAMBLE\_TRANSMISSION\_COUNTER (i.e., the case of that lbt-FailureRecoveryConfig is not configured).Proposal 2: For the case of lbt-FailureRecoveryConfig is not configured, two ways to log the number of LBT failure in RA report could be for down-selection:- Enhance the current PerRAInfoList to log the failed RA preamble transmission caused by LBT failure per RA attempt;- Include the number of LBT failures (i.e., failed RA preamble transmission) per RA procedure in RA report.Proposal 3: If RAN2 agree to define the number of LBT failures including the failed RA preamble transmission when lbt-FailureRecoveryConfig is configured (i.e., the failed RA preamble transmission will not counted in PREAMBLE\_ TRANSMISSION \_COUNTER ), it is suggested to define one new IE in RA-InformationCommon to log the failed RA preamble transmission caused by LBT failure. |
| [R2-2212221](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212221%20Discussion%20on%20SON%20for%20NR-U.docx) | Huawei, HiSilicon | Proposal 3: The number of LBT failure indication from lower layers should be regarded as the number of LBT failure per BWP. |

2 companies show their views on the definition of the number of LBT failure. 1 company (CATT) introduces one new counter for LBT failure and indicates the number of LBT failure can be the number of the failure RA preamble transmission due to LBT failure. 1 company (Huawei) thinks the number of LBT failure indication from lower layers can be regarded as the number of LBT failure per BWP. It can be seen that companies still have misunderstanding on the definition of the number of the LBT failures.

Based on the agreement made in RAN2#119bis-e meeting, it can be seen that LBT failure is the failure to access the channel before transmission. So, we focus on the failure which happens for the LBT procedure before each UL transmission.

In current MAC spec, it is specified that:

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| --- |
| 1> if LBT failure indication is received from lower layers for this Random Access Preamble transmission:2> if *lbt-FailureRecoveryConfig* is configured:3> perform the Random Access Resource selection procedure (see clause 5.1.2).2> else:3> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;3> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1: |

Based on the spec, it can be seen that when *lbt-FailureRecoveryConfig* is configured and LBT failure indication is indicated by lower layers, the *PREAMBLE\_TRANSMISSION\_COUNTER* will not be increased by 1. While *lbt-FailureRecoveryConfig* is not configured, *PREAMBLE\_TRANSMISSION\_COUNTER* will be increased by 1 when LBT failure is indicated by lower layers.

We can analyze this case by case. If *lbt-FailureRecoveryConfig* is configured, *LBT\_COUNTER* is used to record the LBT failure indications from lower layers including LBT failure indication of other procedures apart from preamble transmission. In rapporteur’s view, it is not suitable for RA report. This is because *LBT\_COUNTER* includes other LBT failures, e.g. LBT failure for PUSCH which may be not in RA procedure. If *lbt-FailureRecoveryConfig* is not configured, *PREAMBLE\_TRANSMISSION\_COUNTER* will be increased by 1 when LBT failure is indicated by lower layers. But this parameter may not be suitable to count the number of LBT failure for RA report. Since *PREAMBLE\_TRANSMISSION\_COUNTER* may be increased by 1 due to other RACH failures, e.g., the Random Access Response reception is not successful. Based on the analysis above, the rapporteur thinks the legacy counters may not be suitable in RA report for the number of the LBT failure.

Considering the above analysis and inputs from other companies, it is suggested:

Proposal 1: RAN2 to down-select one of the options for the definition of the number for LBT failure in RA report in the following options:

* **Option 1: Introduce one new counter, e.g., the number of failed preamble transmission due to LBT failure per RA procedure/beam/RA attempt regardless whether *lbt\_FailureRecoveryConfig* is configured or not;**
* **Option 2: Reuse the legacy counter, e.g., the number of LBT failure indication indicated by lower layers.**

#### Log LBT failure per RA procedure/beam/RA attempt

Regarding how to log LBT failure information, opinions from companies are listed in the following table.

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| --- | --- | --- |
| Tdoc number | Company | Observations and Proposals |
| [R2-2211352](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2211352%20SON%20Enhancement%20for%20NR-U.docx) | CATT | Proposal 2: For the case of *lbt-FailureRecoveryConfig* is not configured, two ways to log the number of LBT failure in RA report could be for down-selection:- Enhance the current *PerRAInfoList* to log the failed RA preamble transmission caused by LBT failure per RA attempt;- Include the number of LBT failures (i.e., failed RA preamble transmission) per RA procedure in RA report. |
| [R2-2212091](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212091%20-%20Enhancements%20of%20SON%20reports%20for%20NR-U.docx) | Ericsson | Proposal 2 UE logs number of LBT failures per selected beam in the RA report. |
| [R2-2212284](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212284%20Consideration%20on%20NR-U%20related%20SON.docx) | ZTE Corporation, Sanechips | Proposal 2: Include the the number of LBT failures received per consecutive attempts in the same beam in RA report.  |
| [R2-2212300](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212300_NRU.docx) | Samsung | Proposal 4: RAN2 can discuss following two options for logging information of multiple RA procedures related to consistent LBT failures in different BWP a. Log the LBT information in separate RA\_Reports.b. Log the LBT information with the RA\_Report of successful RA procedure.Proposal 5: UE logs the total number of LBT failures during RA procedure. |
| [R2-2212667](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212667%20-%20Discussions%20on%20NR-U%20Related%20Enhancements.docx) | Qualcomm Incorporated | Observation 1: There is no correlation between LBT failures and RACH resources, beams, or CSI-RS selected for performing the RACH procedure. Proposal 1: It is sufficient for UE to indicate that there was consistent LBT failure per RA procedure in RA Report. |
| [R2-2212808](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212808%20Discussion%20on%20SON%20for%20NR-U.docx) | Xiaomi | Proposal 1 If *lbt-FailureRecoveryConfig* is configured, for successive RA attempts on one SSB, if all the preamble transmissions failed due to LBT, UE still record the *PerRASSBInfo* for this SSB. And the *PerRAAttemptInfoList* in *PerRASSBInfo* records only one of RA attempt. Proposal 2 If *lbt-FailureRecoveryConfig* is configured, for successive RA attempts on one SSB, if at least one preamble transmission does not fail due to LBT, UE records the *PerRASSBInfo*, and its *PerRAAttemptInfoList* field only includes RA attempts with successful preamble transmission.Proposal 3 If *lbt-FailureRecoveryConfig* is not configured, UE records all the RA attempts, irrespective whether the preamble transmission is failed due to LBT or not. |

6 companies show their opinions on this issue and the opinions are summarized as the following options:

Option 1: Log the LBT failure information per RA procedure (CATT/Samsung/QCOM)

In option 1, the LBT failure information is logged per RA procedure. This is because some companies think there is no correlation between LBT failures and RACH resources, beams, or CSI-RS selected for performing the RACH procedure, so it is not necessary to log too detailed information.

Option 2: Log the LBT failure number per beam (Ericsson/ZTE)

One reason to support Option 2 is that this enables the network to identify problems at the beam level and the network can analyze the number of LBT failure per selected beam.

Option 3: Log the LBT failure information per RA attempt (Xiaomi)

In Option 3, if *lbt-FailureRecoveryConfig* is configured, for successive RA attempts on one SSB, if all the preamble transmissions failed due to LBT or if at least one preamble transmission does not fail due to LBT, UE still record the *PerRASSBInfo* for this SSB. If *lbt-FailureRecoveryConfig* is not configured, UE records all the RA attempts, irrespective whether the preamble transmission is failed due to LBT or not.

It can be seen there is no consensus on how to log the LBT failure information and the rapporteur propose that:

**Proposal 2: RAN2 to down-select one of the following options as candidate solution to log LBT failure information:**

* **Option 1: Per RA procedure;**
* **Option 2: Per Beam;**
* **Option 3: Per RA attempt.**

#### Log LBT failure with BWP information

Regarding whether BWP information is logged in RA report for NR-U, views from companies are shown below.

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| Tdoc number | Company | Observations and Proposals |
| R2-2212091 | Ericsson | Proposal 1: A List of RA-InformationCommon is used to capture information about the multiple RA procedures performed by the UE at different BWPs. |
| [R2-2212221](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212221%20Discussion%20on%20SON%20for%20NR-U.docx) | Huawei, HiSilicon | Proposal 3: The number of LBT failure indication from lower layers should be regarded as the number of LBT failure per BWP.Proposal 4: The UE should record the number of LBT failure in BWP level granularity in RA report. |
| R2-2212300 | Samsung | Proposal 1: UE doesn’t include RA\_InformationCommon when RA procedure is unsuccessful due to consistent UL LBT failure.Proposal 2: UE logs information to identify the frequency of RACH resources where consistent UL LBT failure occurred, e.g. in lbt-RAInformationCommon.Proposal 3: UE logs information of multiple RA procedures related to consistent LBT failures in different BWP in the RA\_ReportList, only when RA procedure is finally successful in a BWP.Proposal 4: RAN2 can discuss following two options for logging information of multiple RA procedures related to consistent LBT failures in different BWP a. Log the LBT information in separate RA\_Reports.b. Log the LBT information with the RA\_Report of successful RA procedure. |
| [R2-2212626](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212626_SONMDT%20enhancement%20for%20NR-U.docx) | CMCC | Proposal 1: For multiple RA procedures caused by consistence LBT failure, RA-Report is extended with a list of ra-InformationCommon for UE to record multiple RA procedures at different BWPs in an RA report. |
| [R2-2212808](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212808%20Discussion%20on%20SON%20for%20NR-U.docx) | Xiaomi | Proposal 7 RAN2 agrees to record at least the BWP information (e.g. pointA, location and bandwidth) of the RA procedures related to consistant LBT failures. |

5 companies show their views on this issue.

3 companies (Samsung, CMCC, Xiaomi) show preference to record BWP information in RA report for consistent LBT failures. This is because some companies think the consistent UL LBT failures in some BWPs may be lost based on the legacy the principle of legacy RA report considering only the successful RA procedures are logged in legacy RA report.

1 company (Huawei) indicates that the UE should record the number of LBT failure in BWP level granularity in RA report considering that *LBT\_COUNTER* will be reset to zero once the BWP switch is finished and in order to inform the NW side about the LBT situation in each BWP, the UE should record the number in BWP level granularity in RA report.

2 companies (Ericsson, CMCC) propose a list of *RA-InformationCommon* is used to capture information about the multiple RA procedures, considering the multiple RA procedures (performed as part of LBT recovery) may belong to multiple BWPs.

So, it is suggested by the rapporteur：

Proposal 3: Log BWP information in RA report for consistent LBT failure in NR-U.

Proposal 4: FFS on how to log the BWP information in RA report for NR-U, e.g. a list of RA-InformationCommon, and on what for BWP information, e.g. pointA, location and bandwidth and etc.

### What to log for NR-U for LBT failure

#### RSSI

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| Tdoc number | Company | Observations and Proposals |
| R2-2212091 | Ericsson | Proposal 3 UE includes the average RSSI values per selected beam for the following quantities- 1) average RSSI for the failed channel access attempts due to LBT failures 2) average RSSI for the successful channel access attempts. |
| [R2-2212221](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212221%20Discussion%20on%20SON%20for%20NR-U.docx) | Huawei, HiSilicon | Proposal 5: The logging granularity for RSSI measurement in NR-U should be to let UE record average RSSI per RA procedure. |
| [R2-2212667](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212667%20-%20Discussions%20on%20NR-U%20Related%20Enhancements.docx) | Qualcomm Incorporated | Observation 2: Actual LBT evaluation is performed based on sensed energy on the channel, i.e., the channel access procedure is not directly correlated to the RSSI value.Observation 3: In a practical implementation UE may use the max EDT configured at the UE, which is a cell-specific configuration and should be known to the network.Proposal 2: The RSSI and EDT are not reported in the RA report. |
| [R2-2212808](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212808%20Discussion%20on%20SON%20for%20NR-U.docx) | Xiaomi | Proposal 8 RAN2 agrees to not report the EDT set by UE, but only the RSSI. |

4 companies (Ericsson, Huawei, HiSilicon, Xiaomi) suggest record RSSI in the RA report considering RSSI is beneficial on pinpoint whether the random-access related issue was due to a bad uplink coverage, interference or the configuration used by the UE at the time of random-access procedure. 1 company (QCOM) thinks that RSSI is not reported in RA report.

This issue has been discussed in email [AT119bis-e][803] and majority companies agreed to include RSSI in *RA-InformationCommon* which is also included in RA report. Therefore, it is suggested that:

Proposal 5: RSSI is reported in RA report for NR-U, FFS on details for RSSI value, e.g. average RSSI per RA procedure, average RSSI for the failed channel access attempts and etc.

#### EDT

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| Tdoc number | Company | Observations and Proposals |
| R2-2212091 | Ericsson | Proposal 4 UE includes the average applied EDT value in UL applied by UE per selected beam for the following quantities- 1) average applied EDT value for the failed channel access attempts due to LBT failure. 2) average applied EDT value for the successful channel access attempt. |
| [R2-2212221](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212221%20Discussion%20on%20SON%20for%20NR-U.docx) | Huawei, HiSilicon | Proposal 6: The EDT applied in the UE should be reported to the NW side. |
| [R2-2212667](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212667%20-%20Discussions%20on%20NR-U%20Related%20Enhancements.docx) | Qualcomm Incorporated | Observation 2: Actual LBT evaluation is performed based on sensed energy on the channel, i.e., the channel access procedure is not directly correlated to the RSSI value.Observation 3: In a practical implementation UE may use the max EDT configured at the UE, which is a cell-specific configuration and should be known to the network.Proposal 2: The RSSI and EDT are not reported in the RA report. |
| [R2-2212808](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212808%20Discussion%20on%20SON%20for%20NR-U.docx) | Xiaomi | Proposal 8 RAN2 agrees to not report the EDT set by UE, but only the RSSI. |

4 companies show their views on this issue. 2 companies (Ericsson, Huawei) suggest record EDT in the RA report. 2 companies (QCOM, Xiaomi) thinks that EDT is not reported in RA report. So, it is still controversial for whether to report EDT in RA report.

The rapporteur finds in 37.213 that:

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| * 4.2.3 Energy detection threshold adaptation procedure

A UE accessing a channel on which UL transmission(s) are performed, shall set the energy detection threshold ($X\_{Thresh}$) to be less than or equal to the maximum energy detection threshold $X\_{Thresh\\_max}$.$X\_{Thresh\\_max}$ is determined as follows:- If the UE is configured with higher layer parameter *maxEnergyDetectionThreshold-r14* or *maxEnergyDetectionThreshold-r16*, - $X\_{Thresh\\_max}$ is set equal to the value signalled by the higher layer parameter;- otherwise- the UE shall determine $X'\_{Thresh\\_max}$ according to the procedure described in clause 4.2.3.1;- if the UE is configured with higher layer parameter *energyDetectionThresholdOffset-r14* or *energyDetectionThresholdOffset-r16*- $X\_{Thresh\\_max}$ is set by adjusting $X'\_{Thresh\\_max}$ according to the offset value signalled by the higher layer parameter;- otherwise- the UE shall set $X\_{Thresh\\_max}=X'\_{Thresh\\_max}$. |

Based on the specification, it can be seen that EDT is set be UE implementation. Thus, it is still unclear for the purpose to report EDT to the network. Hence, the rapporteur suggests:

Proposal 6: RAN2 to discuss the purpose for reporting EDT to the network in RA report for NR-U and then decide whether to report EDT to the network in RA report for NR-U.

### Others for SON enhancements for NR-U in RA report

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| Tdoc number | Company | Observations and Proposals |
| [R2-2211690](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2211690-SON-NR-U-v0.docx) | Apple | Title: RAN2 progress on SON for NR-UProposal 1: wait for RAN3 reply before making any further agreement on the SON for NR-U discussion.Proposal 2: to discuss whether we need to address the case where consistent LBT Failure Recovery has not been configured for the UE. |
| [R2-2212034](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212034%20Discussion%20on%20MRO%20for%20NR-U.docx) | Lenovo | Proposal 4: Number of LBT failures e.g. per RACH attempt or per RA procedure, and time duration for UL LBT before per RACH attempt can be included in the RACH report.  |
| [R2-2212221](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212221%20Discussion%20on%20SON%20for%20NR-U.docx) | Huawei, HiSilicon | Proposal 1: An RA attempt in NR-U is only counted when UE accesses the channel at the PHY layer, and transmits the preamble.Proposal 2: No need to introduce value 0 for the numberOfPreamblesSentOnSSB and numberOfPreamblesSentOnCSI-RS.Proposal 7: For RA-InformationCommon enhancements, the entire sensing, the ratio of idle contention windows, should be considered. |
| [R2-2212284](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212284%20Consideration%20on%20NR-U%20related%20SON.docx) | ZTE Corporation, Sanechips | Proposal 1: UE includes perRAAttemptInfoList only when preamble is actually transmitted in lower layer. |
| [R2-2212300](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212300_NRU.docx) | Samsung | Proposal 6: UE counts the RA attempt when it actually transmits the preamble. |
| [R2-2212626](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212626_SONMDT%20enhancement%20for%20NR-U.docx) | CMCC | Proposal 2: Add a new RA purpose for consistent LBT failure.Proposal 3: Suggest to study the LBT failure have impacts on the RA failure or RLF case.Proposal 4: The LBT information (e.g., the number of LBT failures) is added in the RACH report and RLF report.Proposal 5: The LBT information can be added in measurement reporting for immediate MDT. |
| [R2-2212808](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212808%20Discussion%20on%20SON%20for%20NR-U.docx) | Xiaomi | Proposal 4 RAN2 to consider to support value 0 for the numberOfPreamblesSentOnSSB-r16 and numberOfPreamblesSentOnCSI-RS-r16 explicitly or implicitly.Proposal 5 RAN2 agrees to record the RA procedures triggered by consistant LBT failure as well as the RA procedure during which the first not cancelled consistant LBT failure is detected.Proposal 6 RAN2 agrees to not record the whole RA-InformationCommon, but only the information related to LBT failure.Proposal 9 UE indicates whether MsgA payload transmission is failed due to LBT or not if fallback to 4-step RA occur. |

Some of the issues depend on the progress above and some can be studied in stage 3. Hence, the rapporteur suggests:

Proposal 7: Some FFS are left for further study for RA report for NR-U:

* other parameters to be reported in RA report, e.g., time duration for UL LBT;
* whether to introduce 0 for numberOfPreamblesSentOnSSB and numberOfPreamblesSentOnCSI-RS;
* the definition for RA attempt for NR-U;
* stage 3 design for how to add a new RA purpose for consistent LBT failure and how to add LBT information in RACH report.

## SON enhancements for NR-U for SHR

### SHR trigger

|  |  |  |
| --- | --- | --- |
| Tdoc number | Company | Observations and Proposals |
| [R2-2211352](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2211352%20SON%20Enhancement%20for%20NR-U.docx) | CATT | Proposal 4: Triggering condition for SHR reporting consistent LBT failure information can be:- Solution 1: the number of LBT failure in RA procedure is larger than a threshold during a duration when UE receives the HO command to the time of HO is successful;- Solution 2: the ratio between the LBT failure number and the total number of RA preamble transmission exceeds on threshold after the UE initiates handover in successful HO procedure. |
| [R2-2212034](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212034%20Discussion%20on%20MRO%20for%20NR-U.docx) | Lenovo | Proposal 5: Consistent LBT failures in at least one UL BWP on the source cell and/or target cell can be considered as a triggering condition for generating a SHR in NR-U. |
| [R2-2212091](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212091%20-%20Enhancements%20of%20SON%20reports%20for%20NR-U.docx) | Ericsson | Proposal 9 Introduce new SHR triggering conditions for NR-U, e.g. UL LBT failure prior to successfully completion of the HO. |
| R2-2212300 | Samsung | Proposal 9: Existing SHR configuration and threhsolds can be reused for NR-U. |

4 companies show their views on this issue.

3 companies (CATT, Lenovo, Ericsson) propose to introduce new SHR triggering condition for NR-U. 1 company (Samsung) proposes to reuse existing SHR configuration and threshold for NR-U. Since the SHR with LBT failure is to report the LBT failure information which is different from legacy SHR procedure, so it is proposed that:

**Proposal 8: RAN2 to discuss whether to introduce new trigger condition for SHR for NR-U. Details FFS.**

### SHR content

|  |  |  |
| --- | --- | --- |
| Tdoc number | Company | Observations and Proposals |
| [R2-2211352](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2211352%20SON%20Enhancement%20for%20NR-U.docx) | CATT | Proposal 5: The content in SHR for LBT failure can follow the content in RA-InformationCommon for LBT failure. |
| [R2-2212034](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212034%20Discussion%20on%20MRO%20for%20NR-U.docx) | Lenovo | Proposal 6: The identifier of the UL BWP where consistent LBT failure occurs can be included in the SHR.Proposal 7: Number of LBT failures e.g. per RACH attempt or per RA procedure, and time information during handover procedure e.g. time duration for UL LBT before per RACH attempt and the time elapsed since the last HO execution until successful LBT can be included in the SHR. |
| [R2-2212091](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212091%20-%20Enhancements%20of%20SON%20reports%20for%20NR-U.docx) | Ericsson | Proposal 10 SHR includes information associated to the random access procedures that were initiated due to such consistent UL LBT failures just before the successful HO completion. |
| [R2-2212221](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212221%20Discussion%20on%20SON%20for%20NR-U.docx) | Huawei, HiSilicon | 1. The average sensing time. This metric represents the average time from when the UE starts to sense the channel for transmission purpose, to the time the UE successfully occupies the channel or consistent LBT failures are triggered. A longer average sensing time indicates the heavier load of the specific transmission channel and the minor occupancy rate.
2. The ratio of idle contention windows. As specified in TS 37.321, when sensing the unlicensed channel during a contention window, if the detected power for at least 4μs within the sensing slot duration is less than EDT, the channel will be regarded as idle during the sensing slot duration. A high ratio of idle contention windows reveals the channel is able to be occupied with less latency.
3. Average measured RSSI and EDT. The EDT in the UE is either configured by gNB or calculated by the UE itself. A minor gap between measured RSSI and EDT means the unlicensed channel is potentially not able to be occupied via future LBT and the following transmission may suffer from high NACK rate.
4. The number of consistent LBT failures and BWP specific lbt-*FailureRecoveryConfig*. These parameters help the network side to evaluate the channel load and influence from LBT failures during data transmission.

Proposal 8: RAN2 to discuss the above enhancements for RLF and SHR reports. |
| R2-2212300 | Samsung | Proposal 10: UE logs LBT related information of the cell (source/target) which provided the configuration of the satisfied condition in SHR. |

Companies provide diverse contents to be included in SHR including:

* The content in RA-InformationCommon;
* The identifier of the UL BWP where consistent LBT failure occurs;
* Number of LBT failures;
* information associated to the random access procedures that were initiated due to such consistent UL LBT failures just before the successful HO completion;
* the average sensing time;
* the ratio of idle contention windows;
* average measured RSSI and EDT;
* the number of consistent LBT failures and BWP specific lbt-FailureRecoveryConfig;
* LBT related information of the cell (source/target) which provided the configuration.

So, it is proposed that:

**Proposal 9: RAN2 to further study the content in SHR for NR-U.**

## SON enhancements for NR-U for RLF report

### RLF content

|  |  |  |
| --- | --- | --- |
| Tdoc number | Company | Observations and Proposals |
| [R2-2211352](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2211352%20SON%20Enhancement%20for%20NR-U.docx) | CATT | Proposal 6: RAN2 to further study what to be included in RLF report to reflect the RLF which is caused by consistent LBT failure indirectly. |
| [R2-2212034](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212034%20Discussion%20on%20MRO%20for%20NR-U.docx) | Lenovo | Proposal 1: Include measured RSSI and an explicit indication concerning handover failure due to consistent LBT failure in the RLF report.Proposal 2: The number of LBT failures e.g. per RACH attempt or per RA procedure can be included in the RLF report.Proposal 3: Time information during handover procedure, e.g. time duration for UL LBT before per RACH attempt and the time elapsed since the last HO execution until successful LBT, can be included in the RLF report. |
| R2-2212091 | Ericsson | Proposal 5 According to RAN3 LS, UE logs in the RLF-Report information indications that consistent LBT failure indirectly caused RLF/HOF. FFS on the detailsProposal 6 If at the moment of RLF/HOF, the UE had consistent UL LBT failures triggered in one or more BWPs at MAC layer, the RLF-Report includes information associated to the random access procedures that were initiated due to consistent UL LBT failures just before the RLF/HOF.Proposal 7 UE includes the RSSI measurements in the RA-InformationCommon logged as part of RLF report. The average RSSI can be logged per selected beam level for the successful and failed channel access attempts.Proposal 8 If RA-InformationCommon is not present, UE includes the RSSI measurements and applied EDT value in the RLF report. |
| [R2-2212221](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212221%20Discussion%20on%20SON%20for%20NR-U.docx) | Huawei, HiSilicon | 1. The average sensing time. This metric represents the average time from when the UE starts to sense the channel for transmission purpose, to the time the UE successfully occupies the channel or consistent LBT failures are triggered. A longer average sensing time indicates the heavier load of the specific transmission channel and the minor occupancy rate.
2. The ratio of idle contention windows. As specified in TS 37.321, when sensing the unlicensed channel during a contention window, if the detected power for at least 4μs within the sensing slot duration is less than EDT, the channel will be regarded as idle during the sensing slot duration. A high ratio of idle contention windows reveals the channel is able to be occupied with less latency.
3. Average measured RSSI and EDT. The EDT in the UE is either configured by gNB or calculated by the UE itself. A minor gap between measured RSSI and EDT means the unlicensed channel is potentially not able to be occupied via future LBT and the following transmission may suffer from high NACK rate.
4. The number of consistent LBT failures and BWP specific lbt-*FailureRecoveryConfig*. These parameters help the network side to evaluate the channel load and influence from LBT failures during data transmission.

Proposal 8: RAN2 to discuss the above enhancements for RLF and SHR reports. |
| [R2-2212626](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212626_SONMDT%20enhancement%20for%20NR-U.docx) | CMCC | Proposal 4: The LBT information (e.g., the number of LBT failures) is added in the RACH report and RLF report. |
| [R2-2212284](file:///Z%3A%5C%E4%B8%B4%E6%97%B6%E4%B8%AD%E8%BD%AC%5C%E6%96%87%E7%A8%BF%E5%88%86%E6%9E%90%5CRAN2%5C120%5Cdoc%5C8.13.5/R2-2212284%20Consideration%20on%20NR-U%20related%20SON.docx) | ZTE Corporation, Sanechips | Proposal 3: Include in RLF-report the latest RSSI measurements if available when RLF happens and rlf-cause is set to lbt-failure or when HOF happens and at least one consistent lbt-failure is detected.Observation 10: Based on existing RAN2 procedure UE declares RLF when consistent LBT failure detected while HOF is triggered due to expiry of T304, thus the indication that handover failure occurred due to consistent LBT failures is incorrect.Observation 11: UE includes RA-informationCommon when RLF is due to RA problem/BFR and when HOF happens, which can be enhanced to include detailed information associated to consistent LBT failure occurs during the event which can served as implicit indication.Proposal 4: No need to introduce explicit indication in RLF-report that the indication that handover failure occurred due to consistent LBT failures. |
| R2-2212300 | Samsung | Proposal 7: RAN2 to discuss additional info in RLF report when the reported RLF cause is not consistent UL LBT failures, but UL LBT failures have an impact on RLF.Proposal 8: Introduce RSSI measurements and channel occupancy measurements in the RLF report. |

6 companies (Ericsson, Huawei, HiSilicon, ZTE Corporation, Sanechips, Samsung) propose to introduce RSSI in RLF report, and RAN3 LS R2-2209105 also support to add the RSSI in RLF report. And other contents are not agreed by majority companies, it is proposed that:

Proposal 10: Introduce RSSI in RLF report for NR-U, FFS for other information in RLF report for NR-U.

# Conclusion

This document has made the following proposals:

**Easy agreement:**

Proposal 3: Log BWP information in RA report for consistent LBT failure in NR-U.

Proposal 5: RSSI is reported in RA report for NR-U, FFS on details for RSSI value, e.g. average RSSI per RA procedure, average RSSI for the failed channel access attempts and etc.

Proposal 10: Introduce RSSI in RLF report for NR-U, FFS for other information in RLF report for NR-U.

**Proposal which needs discussion:**

Proposal 1: RAN2 to down-select one of the options for the definition of the number for LBT failure in RA report in the following options:

* **Option 1: Introduce one new counter, e.g., the number of failed preamble transmission due to LBT failure per RA procedure/beam/RA attempt regardless whether *lbt\_FailureRecoveryConfig* is configured or not;**
* **Option 2: Reuse the legacy counter, e.g., the number of LBT failure indication indicated by lower layers.**

**Proposal 2: RAN2 to down-select one of the following options as candidate solution to log LBT failure information:**

* **Option 1: Per RA procedure;**
* **Option 2: Per Beam;**
* **Option 3: Per RA attempt.**

**Proposal 6: RAN2 to discuss the purpose for reporting EDT to the network in RA report for NR-U and then decide whether to report EDT to the network in RA report for NR-U.**

Proposal 8: RAN2 to discuss whether to introduce new trigger condition for SHR for NR-U. Details FFS.

**Proposal 9: RAN2 to further study the content in SHR for NR-U.**

**Proposals can be left for further study:**

Proposal 4: FFS on how to log the BWP information in RA report for NR-U, e.g. a list of RA-InformationCommon, and on what for BWP information, e.g. pointA, location and bandwidth and etc.

Proposal 7: Some FFS are left for further study for RA report for NR-U:

* other parameters to be reported in RA report, e.g., time duration for UL LBT;
* whether to introduce 0 for numberOfPreamblesSentOnSSB and numberOfPreamblesSentOnCSI-RS;
* the definition for RA attempt for NR-U;
* stage 3 design for how to add a new RA purpose for consistent LBT failure and how to add LBT information in RACH report.