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Agenda Item: 7.13.5

Source: Ericsson

Title: Summary of AI 7.13.5 SON for NR-U (Ericsson)

Document for: Discussion, Decision

#  Introduction

This document provides the summary of all the contributions submitted to 7.13.5 agenda item (SON for NR-U) of RAN2#121-bis-e meeting:

* [R2-2302857](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2302857.zip), [Discussion on SON for NR-U](https://ericsson.sharepoint.com/R2-2302857.zip), Nokia, Nokia Shanghai Bell
* [R2-2302858](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2302858.zip), [Discussion on storing LBT-FailureRecoveryConfig (Reply LS to R2-2300031)](https://ericsson.sharepoint.com/R2-2302858.zip), Nokia, Nokia Shanghai Bell
* [R2-2303113](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303113.zip), [SON Enhancement for NR-U](https://ericsson.sharepoint.com/R2-2303113.zip), CATT
* [R2-2303144](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303144.zip), [Consideration on NR-U related SON](https://ericsson.sharepoint.com/R2-2303144.zip), ZTE Corporation, Sanechips
* [R2-2303245](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303245.zip), [Discussion on MRO for NR-U](https://ericsson.sharepoint.com/R2-2303245.zip), Lenovo
* [R2-2303673](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303673.zip), [SON/MDT enhancements for NR-U](https://ericsson.sharepoint.com/R2-2303673.zip), Samsung R&D Institute India
* [R2-2303695](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303695.zip), [Discussion on NR-U Related Enhancements](https://ericsson.sharepoint.com/R2-2303695.zip), Qualcomm Incorporated
* [R2-2303803](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303803.zip), [SONMDT enhancement for NR-U](https://ericsson.sharepoint.com/R2-2303803.zip), CMCC
* [R2-2304031](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2304031.zip), [Discussion on SON for NR-U](https://ericsson.sharepoint.com/R2-2304031.zip), Xiaomi
* [R2-2304111](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2304111.zip), [Enhancements of SON reports for NR-U](https://ericsson.sharepoint.com/R2-2304111.zip), Ericsson

For each identified open issue, related questions are raised to facilitate the offline discussion during RAN#121-bis-e meeting.

#  Discussion

## 2.1 RA-Report enhancements

Related to RA-Report, the following has been agreed so far:

**Agreements from RAN2#119-bis-e:**

1 The UE will log information of multiple RA procedures related to consistent LBT failures. FFS details.

Agreements:

1 Introduce a new raPurpose in the RA-Report to indicate that the RA was initiated following a “consistent LBT failures” in the SpCell.

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.

**Agreements from RAN2#121:**

1: Log the last successful RA procedure related information in the RA report. Only some information to be logged for multiple successive RA procedures failed due to LBT issue. FFS what information.

In R2-2302857, Nokia proposes the following:

* **A RA should be considered as attempted only if the PHY layer actually transmitted the preamble**
* **LBT failure information is not needed in the RA-report**
* **RAN2 should not focus RA optimization issues when the NR-U related objective of this work item is discussed.**

In [R2-2303113](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303113.zip), CATT proposes the following:

* **The number of LBT failure in RA report includes the number of failed RA preamble transmission due to LBT failure**
* **The threshold based method is applied to define the number of LBT failure in RA report, the details could be discussed in stage 3**
* **RAN2 to discuss whether to consider the number of LBT failure in RA report for PUSCH transmission in MSGA.**
* **Log the number of LBT failures per RA procedure.**
* **Report BWP information where consistent LBT failure happens in RA report.**

In [R2-2303144](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303144.zip), ZTE proposes the following:

* **For multiple successive RA procedures failed due to LBT issue, UE includes the attempted RA resource configuration together with corresponding BWP information in RA report (for successful LBT failure recovery) or in RLF report (when RLF triggered due to consistent LBT failure)**
* **RAN2 further studies how to save signalling overhead used to store the attempted RA resource configuration and corresponding BWP information of multiple successive RA procedures due to LBT issues**
* **UE includes perRAAttemptInfo only when preamble is actually transmitted in lower layer.**
* **Include the the number of LBT failures received per consecutive attempts in the same beam in RA report.**

In [R2-2303245](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303245.zip), Lenovo proposes the following:

* **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.**

In [R2-2303673](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303673.zip), Samsung proposes the following:

* **For the multiple successive RA procedures failed due to LBT issue UE logs the following information in RA report.**
	1. **Either BWP id or absoluteFrequencyPointA-r16/locationAndBandwidth.**
	2. **Whether the LBT failures are for PRACH resources or PUSCH resources of MSG-A for 2 step RACH.**
	3. **Whether the LBT failures are for MSG1 or MSG3 of 4 step RACH.**
* **UE includes LBT\_RAInformationCommon containing information of the multiple successive RA procedures failed due to LBT issue in the RA Report for the successful RA procedure in the BWP.**
* **UE logs the total number of LBT failures during RA procedure.**
* **UE counts the RA attempt when it actually transmits the preamble**

In [R2-2303695](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303695.zip), [Qualcomm](https://ericsson.sharepoint.com/R2-2303695.zip) proposes the following:

* **UE provides the BWP information (I.e., locationAndBandwidth and subcarrierSpacing information) for previously failed RA procedures (when multiple consistent LBT failures happen).**
* **A random-access attempt is considered as attempted only if the PHY layer actually transmitted the preamble, i.e., successful LBT**.
* **UE logs relevant information such as the contentionDetected flag, dlRSRPAboveThreshold flag, and fallbackToFourStepRA if the preamble is successfully transmitted**
* **If UE observed LBT failures before successful preamble transmission, then UE includes a flag if LBT was observed before the last successful preamble transmission**

In [R2-2303803](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303803.zip), CMCC proposes the following:

* **An RA attempt is only counted when the PHY layer actually transmitted the preamble.**
* **At least include locationAndBandwidth-r16 to log the BWP information for multiple RA procedures related to consistence LBT failure**
* **Introduce a new counter to log the number of LBT failure regardless whether *lbt\_FailureRecoveryConfig* is configured or not**
* **Log the total number of LBT failures per RA procedure.**

In [R2-2304031](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2304031.zip), Xiaomi proposes the following:

* **Only preamble transmission with LBT success is considered as a RA attempt**
* **numberOfPreamblesSentOnSSB and numberOfPreamblesSentOnCSI-RS includes all the preamble attempts regardless whether the LBT is successful or not.**
* **The number of LBT failures can be implicitly known by the size of the PerRAAttemptInfoList and number of preambles sent on SSB/CSI-RS.**
* **RAN2 agrees to record the RA procedure where the first consistant LBT failure occurs, as well as the follow up RA procedures triggered by consistant LBT failure.**
* **RAN2 agrees to record at least the BWP information (e.g. pointA, location and bandwidth) of the RA procedures related to consistant LBT failures.**
* UE indicates whether MsgA payload transmission is failed due to LBT or not if fallback to 4-step RA occur.

In [R2-2304111](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2304111.zip), Ericsson proposes the following:

* **In case the UE experiences consistent LBT failures in multiple BWPs of the PCell prior the RLF/HOF, the UE logs in the RLF the entire RA-InformationCommon associated to the random access attempts performed in the last BWP, and some limited information for the other BWPs in which the UE experienced consistent LBT failures prior the RLF/HOF.**
* **For each BWP (except the last one) in which the UE experienced the consistent LBT failure, the UE includes in the RA-InformationCommon at least the locationAndBandwidth, and the subcarrierSpacing of the BWP.**
* For the last BWP, the UE logs all the random access attempts, irrespective of whether the attempt was blocked by LBT or not, and irrespective of whether the *lbt-FailureRecoveryConfig* is configured or not.
* If Proposal 4 is not acceptable, the following is proposed:
	+ If *lbt-FailureRecoveryConfig* is not configured, the UE logs for the last BWP all the random access attempts, i.e. in the perRAAttemptInfoList, irrespective of whether the attempt was blocked by LBT or not,
	+ If *lbt-FailureRecoveryConfig* is configured, the UE logs for the last BWP only the random access attempts, i.e. in the perRAAttemptInfoList, for which the LBT was successful.
* For the logging of the number of LBT failures for the last BWP, RAN2 selects one of the two following options:
	+ If all the random access attempts (irrespective of whether LBT was successful or not for an RA attempt) are logged in the perRAAttemptInfoList, introduce a flag for each attempt, i.e. for each entry, indicating whether the LBT was successful or not
	+ If only the random access attempts for which LBT was successful are logged in the perRAAttemptInfoList, the UE indicates for each successful attempt, i.e. for each entry, the number of subsequent LBT failures that occurred before this successful attempt
* For each BWP of the PCell, except the last BWP, in which the UE experienced consistent LBT failures, the UE indicates the number of LBT failures experienced in the BWP during the RA procedure.

Given the above proposals, Rapporteur identifies the following issues that will be discussed in the next chapters.

### 2.1.1 Issue#1: Which preamble attempts are logged in the perRAAttemptInfoList

Some companies are proposing to log only the random access attempts for which the LBT was successful, some others all the random access attempts irrespective of whether the LBT was successful or not. One company (Ericsson) observes that the problem of signaling overhead might be relevant only in case the lbt-FailureRecoveryConfig is configured in which case the number of overall attempts may be higher than the maximum preamble counter (preambleTransMax) as the total number of preamble transmission per RA procedure is limited to 200 (same as legacy RA) when the lbt-FailureRecoveryConfig is not configured.

* **Q1: Which preamble transmission attempts are represented in the “per RA attempt info list” for a given beam?**
	1. **Only the preamble transmission attempts for which LBT was successful**
	2. **All the preamble transmissions attempts, irrespective of whether the LBT was successful or not**
	3. **If *lbt-FailureRecoveryConfig* is not configured, the UE logs all the preamble transmissions attempts, irrespective of whether the LBT was successful or not. If *lbt-FailureRecoveryConfig* is configured, the UE logs only the preamble transmission attempts for which the LBT was successful**

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### 2.1.2 Issue#2: How to represent the preamble transmission attempts blocked by LBT

The different options proposed in the above contributions are addressed in the following question.
Rapporteur notes however that it is important to preserve the chronological order of attempts in the entries of the perRAAttemptInfoList. That is an important legacy features that allows the network to further analyze the random access problems, e.g. the network can estimate when the UE has performed the power ramping and can estimate whether the UE would have reached the max transmission power or not (it is to be noted that the flag maxTxPowerReached from LTE was discontinued in NR because this can be estimated based on the power ramping related information indirectly encoded in the chronological attempt of accessing the SSBs).

For example, let´s consider the following TS 38.321 excerpt:

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| From TS 38.321:The MAC entity shall, for each Random Access Preamble:1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and1> if the notification of suspending power ramping counter has not been received from lower layers; and1> if LBT failure indication was not received from lower layers for the last Random Access Preamble transmission; and1> if SSB or CSI-RS selected is not changed from the selection in the last Random Access Preamble transmission:2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1. |

And the following example in which the UE performs RA in SSB1 and SSB2, in which some preamble transmissions passed the LBT (green) and some did not (red):



In SSB1, the UE ramped the power twice, i.e. once after the 1st attempt, i.e. for the 2nd attempt, and once after the 3rd attempt, i.e. for the 4th failed attempt. After another failed attempt, then the UE switches to SSB2 and it keeps the same power used for the 4th attempt. However, if the UE does not log any information on the failed RA attempt in chronological order and just indicate that there have been two successful attempts in SSB1 and one attempt in SSB2, then the network will believe that power used in the 1st attempt in SSB2, is the same power used for the 3rd attempt in SSB1, which is incorrect. This behavior breaks a legacy functionality to preserve the chronological order of RA attempts for the sake of power analysis, and RAN2 should take this into account when evaluating the below options.
For example, options c), d), e) below do not take into account the problem above. With this analysis, Rapporteur would like to ask the following questions.

* **Q2: How do we represent the preamble transmission attempts blocked by LBT?**
	1. **For each preamble transmission attempt included in the perRAAttemptInfoList, a flag indicates whether it was blocked by LBT.
	This assumes that all the preamble transmission attempts are included in the perRAAttemptInfoList (i.e. Option b/c in Q1 is selected)**
	2. **For each preamble transmission attempt included in the perRAAtttemptInfoList, include a field indicating the number of preamble transmission failures experienced before this successful preamble transmission attempt.
	This assumes that only the LBT successful preamble transmission attempts are included in the perRAAttemptInfoList (i.e. Option a/c in Q1 is selected)**
	3. **Introduce a field that counts the number of preamble transmissions blocked by LBT per RA procedure.
	This assumes that only the LBT successful preamble transmission attempts are included in the perRAAttemptInfoList (i.e. Option a/c in Q1 is selected)**
	4. **Introduce a field that counts the number of preamble transmissions blocked by LBT per selected beam.
	This assumes that only the LBT successful preamble transmission attempts are included in the perRAAttemptInfoList (i.e. Option a/c in Q1 is selected)**
	5. **The number of failures can be deduced by comparing the number of overall preamble transmission attempts (FFS if the numberOfPreamblesSentOnSSB and the numberOfPreamblesSentOnCSI-RS can be reused) and the number of entries in the perRAAttemptInfoList.
	This assumes that only the LBT successful preamble transmission attempts are included in the perRAAttemptInfoList (i.e. Option a/c in Q1 is selected)**
	6. **Others**

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### 2.1.3 Issue#3: What to log for the last RA procedure (i.e. last BWP) prior to RA success/RLF/HOF

From the above contributions, and previous agreement in RAN2#121, it seems that companies assume that the entire RA-InformationCommon and the enhanced perRAAttemptInfoList as per Q1 and Q2 should be included only for the last BWP in which the UE attempted the random access prior the random access success (for the RA-Report) or prior the failure (for RLF-Report). Just for further clarification, Rapporteur would like to ask the following question.

* **Q3: Do you agree that the enhanced per RA attempt information (as per Q1 and Q2) should be included only for the last RA procedure in the last BWP prior to the random access success (for the RA-Report)?**
	1. **If no, please provide your explanation**

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### 2.1.3 Issue#4: What to log for the other BWPs (except the last one) in which the UE experienced the consistent LBT failure

RAN2 agreed that “Only some information to be logged for multiple successive RA procedures failed due to LBT issue”. Whereas for the last BWP in which RA was executed, it seems that the entire RA-InformationCommon should be included, the question is what to include for the other BWPs in which the consistent LBT failures were experienced.

* **Q4: What to log for the other BWPs (not for the last one) in which the UE experienced the consistent LBT failure?**
	1. **The locationAndBandwidth information of the BWP**
	2. **The subcarrierSpacing information of the BWP**
	3. **The absoluteFrequencyPointA information of the BWP**
	4. **The number of LBT failures experienced in the BWP during the RA**
	5. **Others**

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Two companies (Xiaomi, Ericsson) are also mentioning that the UE should log the BWP information associated to the BWP in which the UE was operating at the moment of detecting the consistent UL LBT failure for the first time. This was the BWP that was used initially by the UE for the UL transmissions before getting the first consistent UL LBT failure. Without this information, it will not be possible for the network to know the first BWP in which the UE detected the first consistent UL LBT failure.

* **Q5: Shall the UE log in the RA-Report, the BWP information of the BWP in which the UE was operating when it detected the first consistent UL LBT failure?**

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### 2.1.4 Issue#5: Other information associated to random access

Other miscellaneous information associated to random access are proposed to be reported by the UE by different companies. Regarding the information related to the LBT for the msgA payload, it seems that this information will be meaningful only if for the preamble and the msgA payload, the UE needs to apply different LBT procedure, which might not be always the case.

* **Q6: Which of the following information associated to random access should be reported by the UE?**
	1. **The number of msg3 transmissions blocked by LBT per RA procedure**
	2. **A flag per RA attempt, indicating if msg3 transmission was blocked by LBT**
	3. **The number of msgA payload transmissions blocked by LBT per RA procedure (this is required only if separate LBT is applied for msgA payload)**
	4. **A flag per RA attempt, indicating if msgA payload transmission was blocked by LBT (this is required only if separate LBT is applied for msgA payload)**
	5. **Nothing more needed**
	6. **Others.**

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## 2.2 RLF-Report enhancements

### 2.2.1 RLF

In [R2-2303113](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303113.zip), CATT proposes the following:

* **RAN2 to further study what to be included in RLF report to reflect the RLF which is caused by consistent LBT failure indirectly.**

In [R2-2303144](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303144.zip), ZTE proposes the following:

* **For RLF triggered due to consistent LBT failure, UE includes in RLF-report the last failed RA procedure related information and selective information for multiple successive RA procedures failed due to LBT issues**

In [R2-2303245](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303245.zip), Lenovo proposes the following:

* **The number of LBT failures e.g. per RACH attempt or per RA procedure can be included in the RLF report.**

In [R2-2303673](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303673.zip), Samsung proposes the following:

* **RAN2 to discuss additional info in RLF report when the reported RLF cause is not consistent UL LBT failurs, but UL LBT failures have an impact on RLF.**

In [R2-2303803](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303803.zip), CMCC proposes the following:

* **Study the LBT failure have impacts on the RA failure or RLF case.**

In [R2-2304111](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2304111.zip), Ericsson proposes the following:

* **At the moment of RLF, if the UE had consistent UL LBT failures triggered in one or more BWPs at MAC layer, the RLF-Report includes the RA-InformationCommon in the RLF-Report for the random-access procedures that were initiated in one or more BWPs before the RLF.**
* The UE includes in the RLF-Report the *locationAndBandwidth*, and the *subcarrierSpacing* of the BWP, in which the UE experienced the first consistent UL LBT failure.
* The UE indicates in the RLF-Report whether the UE detected unavailable SMTC occasions while T304/T310/T312 was running.

### 2.2.2 HOF

In R2-2302857, Nokia proposes the following:

* **Extend RLF-report with waiting/deferral time due to LBT of signalling and access messages involved in the handover process.**

In [R2-2303144](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303144.zip), ZTE proposes the following:

* **No need to introduce explicit indication in RLF-report that the indication that handover failure occurred due to consistent LBT failures.**

In [R2-2303245](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303245.zip), Lenovo proposes the following:

* **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.**

In [R2-2304111](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2304111.zip), Ericsson proposes the following:

* **In case of HOF, the UE includes the RA-InformationCommon in the RLF-Report (as in legacy) which will include NR-U related information as proposed in previous proposals.**

#### 2.2.2.1 Issue#6: What to log in the RA-InformationCommon included in the RLF-Report

From the contributions, it seems that companies assume that how to handle the “per RA attempt info” and the enhancements to the RA-InformationCommon discussed for the RA-Report in previous section should be the same as for the RLF-Report, i.e. the detailed information on the RA attempts should be only reported for the last random access procedure, whereas for the RA procedures in other BWPs the UE should only report some limited information.

* **Q7: Do companies agree that the enhancements discussed for the RA-InformationCommon for the RA-Report are applicable also to the RLF-Report? And that the detailed “per RA attempt info” are only reported in the RLF-Report for the last RA procedure before RLF/HOF, whereas limited information are reported for the other BWPs in which consistent LBT failure is detected?**
	1. **If no, please motivate and provide your view**

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Similar to the RA-Report, it seems important to log the BWP information of the BWP in which the UE detected the first consistent LBT failure. For example, if the UE is not configured with multiple BWPs with PRACH, or if the UE is not configured with LBT failure recovery configuration, then the UE will declare RLF straight away without performing RA in other BWPs, hence it will not include the RA-InformationCommon in the RLF-Report. Since, the LBT is a per-BWP operation, it is important if the UE includes information that allows the network to identify the BWP in which the UE was operating at the moment of the first consistent LBT failure.

* **Q8: Shall the UE log in the RLF-Report, the BWP information (e.g. locationAndBandwidth, and the subcarrierSpacing) of the BWP in which the UE was operating when it detected the first consistent UL LBT failure?**

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#### 2.2.2.2 Issue#7: When to include the RA-InformationCommon in the RLF-Report

In legacy, the RA-InformationCommon are included in the RLF-Report in case of HOF, or the RLF cause is randomAccessProblem or beamFailureRecoveryFailure. In the submitted contributions, some companies are proposing to discuss if the RA-InformationCommon should be included in the RLF-Report under different conditions, besides the legacy ones.

* **Q9: When shall the UE log RA-InformationCommon including LBT info in the RLF-Report?**
	1. **As in legacy, i.e. in case of HOF and when the RLF cause is randomAccessProblem or beamFailureRecoveryFailure**
	2. **If at the moment of declaring RLF, the UE was performing random access in other BWPs due to triggered consistent UL LBT failures**
	3. **When the RLF cause is lbtFailure, and the UE was performing random access in other BWPs due to triggered consistent UL LBT failures**
	4. **When the RLF cause is t310, and the UE was performing random access in other BWPs due to triggered consistent UL LBT failures**
	5. **When the RLF cause is t312, and the UE was performing random access in other BWPs due to triggered consistent UL LBT failures**
	6. **Others**

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| Company | Options (a,b,c,d,e,f,..) | Comments |
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#### 2.2.2.3 Issue#8: Other information to be included in the RLF-Report

Various companies are proposing to include in the RLF-Report other information, besides the BWP-specific information, and the LBT failures-related information.

* **Q10: What other information should be included in the RLF-Report?**
	1. **Indication of whether the UE detected unavailable SMTC occasions while T304/T310/T312 was running before RLF/HOF.**
	2. **Waiting/deferral time due to LBT during the HO, before HOF**
	3. **Time duration for UL LBT before RLF per RACH attempt**
	4. **Time elapsed since the last HO execution until successful LBT**
	5. **Others**

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### 2.2.3 On the inclusion of the latest RSSI and ED threshold

In [R2-2303144](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303144.zip), ZTE proposes the following:

* **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.**

In [R2-2303245](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303245.zip), Lenovo proposes the following:

* **Include measured RSSI and an explicit indication concerning handover failure due to consistent LBT failure in the RLF report.**

In [R2-2303673](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303673.zip), Samsung proposes the following:

* **Introduce RSSI measurements in the RLF report**

In [R2-2303695](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303695.zip), [Qualcomm](https://ericsson.sharepoint.com/R2-2303695.zip) proposes the following:

* **The RSSI and EDT are not reported in the RA report.**

In [R2-2304031](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2304031.zip), Xiaomi proposes the following:

* RAN2 agrees to not report the EDT set by UE, but only the RSSI.

In [R2-2303113](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303113.zip), CATT proposes the following:

* **RAN2 study what/how to report for detected energy and EDT to reduce signalling overhead.**

In [R2-2304111](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2304111.zip), Ericsson proposes the following:

* RAN2 includes some information per RA procedure to aid the network to properly configure the energy detection configuration.
* RAN2 to discuss one of the following approaches to aid the network to properly configure the energy detection configuration.
	+ The UE includes per RA procedure the average detected power during the RA.
	+ The UE includes per RA procedure the average detected power during the RA for the failed channel access attempts and the average detected power for the successful channel access attempts
* RAN2 to discuss the inclusion of one of the following information per RA procedure:
	+ The UE includes the UE specific ED configuration at the moment of executing the RA
	+ The UE includes the average applied EDT value
* The UE includes in the RLF-Report, for the case of RLF, the latest measured RSSI as part of the measurement results of the NR-U channel of the last serving cell.
* The UE includes in the RLF-Report, for the case of HOF, the latest measured RSSI of the NR-U channel of the source cell, and if available, the latest measured RSSI of the NR-U channel of the target cell.

#### 2.2.3.1 Issue#9: When to log the RSSI

Companies highlight different scenarios in which the RSSI should be logged in the RLF-Report.

* **Q11: When shall the UE log the RSSI in the RLF-Report?**
	1. **For any RLF or HOF in a cell operating in shared spectrum**
	2. **For any RLF for which at least one consistent LBT failure was detected at the moment of RLF**
	3. **For any HOF for which at least one consistent LBT failure was detected at the moment of RLF**
	4. **For any RLF for which the RLF cause is set to lbt-failure**
	5. **Never**
	6. **Others**

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#### 2.2.3.2 Issue#10: Which RSSI should be logged

* **Q12: Which RSSI should the UE log in the RLF-Report?**
	1. **For RLF, the the latest measured RSSI of the NR-U channel of the last serving cell**
	2. **For HOF, the latest measured RSSI of the NR-U channel of the source cell, and if available, the latest measured RSSI of the NR-U channel of the target cell**
	3. **Others**

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#### 2.2.3.3 Issue#11: On the logging of the detected power

In [10], it is noted that according to RAN4 specification the UE uses the detected power (rather than the RSSI) to determine whether the channel is busy or not prior to an UL transmission. Hence, in [10] it is claimed that the knowledge of the UE detected power would allow the network to properly configure the ED configuration.

* **Q13: Should the UE log the average detected power?**
	1. **Yes, the average detected power during the RA should be logged**
	2. **Yes, the average detected power during the RA for the failed channel access attempts, and the average detected power for the successful channel access attempts should be logged**
	3. **No**
	4. **Others**

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#### 2.2.3.4 Issue#12: On the logging of the ED information

* **Q14: What should the UE log about the ED information?**
	1. **The ED configuration provided by the network**
	2. **The average applied EDT value during the RA procedure**
	3. **Nothing**
	4. **Others**

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### 2.2.4 On the inclusion of lbt-FailureRecoveryConfig (RAN3 LS R2-2300031)

In R2-2302857, Nokia proposes the following:

* **Introduce a new configuration index parameter that is provided by the network with the configuration. The UE stores the configuration index and provides it within the RLF reports.**
* **Add an optional, 32-bit configuration index in the RRCReconfiguration message and in the RLF Report. The UE shall store only the most recently received configuration index for the RLF Report.**

In [R2-2304111](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2304111.zip), Ericsson proposes the following:

* UE logs the *lbt-FailureRecoveryConfig* in the RLF-Report, only in case of re-establishment procedure failure (i.e., when UE performs transition to RRC\_IDLE state).

#### 2.2.4.1 Issue#13: On the inclusion of lbt-FailureRecoveryConfig

In the LS R2-2300031, RAN3 claims that NW-based solution to retrieve the lbt-FailureRecoveryConfig is possible in some cases when the UE context is still available at the network, but that is not possible always, especially when the report is fetched long time after the failure. In short, the LS points that:

* If the RLF report is fetched immediately, existing network-based mechanism can be reused.
* If the RLF is not fetched immediately, then "the likelihood that the source and the last serving node can retrieve the needed information depends on RAN implementation and is practically minimal”.

In this regard, to address the above and to reduce the overhead at the UE and the network, it is proposed in [10] to limit the logging of the lbt-FailureRecoveryConfig by the UE to the scenarios that the re-establishment procedure fails (i.e., when it is not possible to fetch the RLF report immediately). Based on that proposal the following question is formulated.

* **Q15: Do you agree that UE logs lbt-FailureRecoveryConfig in the RLF-Report only upon re-establishment procedure failure? If not, please elaborate your reasoning and provide alternative solutions.**

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In addition, related to Nokia proposal in [1], Rapporteur observes that the solution proposed goes beyond the scope of the issue highlighted in the RAN3 LS.
RAN3 claims that in some cases, the network cannot retrieve the UE context, i.e. when the report is fetched long time after the failure, and it leaves to RAN2 to come up with solution to address this issue. On the other hand the solution in [1], already puts a requirements on the network to always keep the UE configurations, to be retrieved via a new configuration indexing method. However, this does not seem to be a problem according to the RAN3 LS, since RAN3 claims that when the UE context or the configuration is still available in the network, then “there is an existing network-based mechanism that can be reused for the NR-U case, based on the information provided from the UE (last serving PCell ID and C-RNTI), that enables the RAN to retrieve the UE context or the configuration used for the UE….”.
Hence, it is not clear from Rapporteur´s point of view, which problem the solution in [1] tries to solve, given the inputs from RAN3 that for retrieving the UE contexts there are already existing network-based mechanism that can be reused, e.g. based on C-RNTI.

Given that the above issues/concerns are way beyond the scope of the problem of logging LBT failure recovery configuration in the RLF report, Rapporteur believes that the mechanism addressed in [1] is not in scope of this discussion.

## 2.3 SHR enhancements

In [R2-2303113](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303113.zip), CATT proposes the following:

* **Triggering condition for SHR reporting consistent LBT failure information can be: 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.**
* **The content in SHR for LBT failure can follow the content in *RA-InformationCommon* for LBT failure.**

In [R2-2303245](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303245.zip), Lenovo proposes the following:

* **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**
* **The identifier of the UL BWP where consistent LBT failure occurs can be included in the SHR**
* **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**

In [R2-2303673](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303673.zip), Samsung proposes the following:

* **Existing SHR configuration and threhsolds can be reused for NR-U.**
* **UE logs LBT related information of the cell (source/target) which provided the configuration of the satisfied condition in SHR.**

In [R2-2304111](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2304111.zip), Ericsson proposes the following:

* **Introduce new SHR triggering conditions for NR-U, e.g., the number of UL LBT failure prior to successfully completion of the HO.**
* **SHR includes information associated to the random access procedure performed at HO, including e.g. the number of LBT failures experienced during RA and the random access information performed in different BWPs in case of consistent UL LBT failures, prior the successful HO completion**
* UE includes in the SHR the number of unavailable SMTC occasions detected during the HO.

### 2.3.1 Issue#14: New SHR triggering conditions

* **Q16: Which new triggering conditions should be considered for the SHR generation?**
	1. **Number of UL LBT failures during HO higher than a certain threshold**
	2. **Consistent UL LBT failures triggered during HO in at least one UL BWP on the source cell**
	3. **Consistent UL LBT failures triggered during HO in at least one UL BWP on the target cell**
	4. **No need for new triggering conditions**
	5. **Others**

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### 2.3.2 Issue#15: Information to be included in the SHR

* **Q17: Which information should be included in the SHR?**
	1. **The random access information, same as for the RA- and RLF-Report, i.e. including the number of UL LBT failures during HO, and the information on the multiple BWPs in which consistent UL LBT failures was triggered**
	2. **Number of unavailable SMTC occasions detected during the HO**
	3. **Time duration for UL LBT before each RACH attempt at HO**
	4. **Time elapsed since the last HO execution until successful LBT**
	5. **Others**

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## 2.4 Others

In [R2-2303803](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121bis-e/Docs/R2-2303803.zip), CMCC proposes the following:

* **The LBT information can be added in measurement reporting for immediate MDT.**

### 2.3.2 Issue#16: On MDT impacts

* **Q18: Should RAN2 consider adding LBT-related information in the immediate MDT?**

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# Conclusion

To be updated

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