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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
* R2-2303958, Discussion on SON MDT enhancements for NPN and NR-U, Huawei, HiSilicon

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.

In R2-2303958, Huawei proposes the following:

* **A random-access attempt is considered as attempted only if the PHY layer actually transmitted the preamble, i.e., successful LBT**

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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| --- | --- | --- |
| Company | Preferred Option (a,b,c) | Comments |
| Qualcomm | A |  |
| Huawei, HiSilicon | A) | A) is simple, and b) & c) will lead to some signalling overhead and both are more complex than a). |
| Ericsson | C (preferred)A(acceptable) | C is a good comprimise between overhead and complexity. In our view, it is simpler for the UE to just log all the preamble attempts irrespective of LBT outcome. From PHY layer point of view, any RACH preamble scheduled by MAC is an attempt, irrespective of the LBT outcome. The overhead problem is only an issue in case the lbt-FailureRecoveryConfig is configured, because in that case the amount RA preamble attemps may overcome the preambleTransMax; when the lbt-FailureRecoveryConfig is not configured, the preamble counter is always stepped as in non-NR-U systems, hence there is no issue.A is acceptable, as long as the chronological order of failure can be somehow tracked in the “per RA attempt info list” (addressed in Q2). |
| ZTE | A |  |
| Xiaomi | A or c  | For C, If *lbt-FailureRecoveryConfig* is not configured, preamble transmission with LBT failure would be counted in PREAMBLE\_TRANSMISSION\_COUNTER, so the maximum number of recorded RA attempt still equals to preambleTransMax , there is no issue of recording too much RA attempts, then it would be ok to log RA attempt with LBT failure.  |
| Lenovo | A |  |
| CATT | a | For Option b:If the preamble transmission due LBT failure is counted as one RA attempt, one possible solution is to reuse the current PerRAAttemptInfo IE structure which will brings unnecessary information for the this preamble transmission considering the IE content which is shown below.PerRAAttemptInfo-r16 ::= SEQUENCE { contentionDetected-r16 BOOLEAN OPTIONAL, dlRSRPAboveThreshold-r16 BOOLEAN OPTIONAL, ..., [[ fallbackToFourStepRA-r17 ENUMERATED {true} OPTIONAL ]]}Or we define another filed for the preamble transmission due LBT failure but again we have to define the information which can be included in the new field. Anyway this brings extra complexities.Besides, if we takes 2-step RA into account in which may also fail due to LBT faiure, the *Ra attempt* can reflect the case that PUSCH in MSGA transmission failure due to LBT failure.For option c) which takes whether lbt-FailureRecoveryConfig is configured or not, brings too much complexitiy to the spec which is not preferrable either. |
| Nokia | A | Our view is that RA reports are to optimize RA configuration. LBT issues cannot be solved by RA configuration. |
| Samsung | A | We also note that none of the information in current PerRAAttemptInfo-r16 is useful unless the preamble is transmitted. |
| Sharp | a |  |
|  |  |  |

### 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. **For each preamble transmission attempt included in the perRAAtttemptInfoList, include a flag indicating whether transmission failures experienced before this successful preamble transmission attempt and a flag indicating transmission failures experienced right before beam switching.
	This assumes that only the LBT successful preamble transmission attempts are included in the perRAAttemptInfoList (i.e. Option a/c in Q1 is selected)**
	7. **other**

|  |  |  |
| --- | --- | --- |
| Company | Preferred Option (a,b,c,d,e,f…) | Comments |
| Qualcomm | Okay: C or FNo: A, B, D, E |  |
| Huawei, HiSilicon | C) | First of all, we need to emphasize that the perRAAttemptInfoList can be recorded only when preamble is successfully transferred.Secondly, if “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” happens, we think that the network will believe “that power used in the 1st attempt in SSB2, is not the same power used for the 3rd attempt in SSB1” because two successful attempts mean two power ramping.So we are not convinved by “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”.For option c, we think it strikes a balance between the available information recording and UE storage burden. |
| Ericsson | A (if option b/c in Q1 is chosen)B (if option a/c in Q1 is chosen)F (acceptable with changes above) | As shown in the figure above, it is essential that the chronological order of preamble attempts is kept even if RAN2 agrees to include in the “per RA attempt info list” only the successul attempts. That would allow the network to identify the presence of burst type of interference, but most important it allows the network to determine how many power rampings the UE performed, and hence optimize the RA parameters (e.g. the preamble target power, the power ramping steps). Otherwise, if options c),d),e) are selected, then when there are LBT failures followed by a beam change, the network will not know if the power was ramped or not before the beam change. Hence, those options would in practice break a legacy NW functionality, which may potentially affect NW RA configuration optimizations.To reply to HW: in option c) the UE only includes the number of failures per RA-procedure, but it does not include any info on whether the failures happened right before the beam switch. As per current MAC spec, the power is not ramped for the first attempt in the new SSB (see spec atteched above), hence the network will believe that the power between the 3rd attempt in SSB1 and the 1st attempt in SSB2 was not ramped, but this is incorrect because the UE ramped the power for the 4th attempt in SSB1 (and this information will not be logged in the RA-Report if we go for option c) d) e)). See figure below on how the NW would interpret the power ramping:F can be also acceptable, but we need to add the changes highlighted to solve the problem depicted in the figure above. If we add a flag just for the failures before successful attempts, we cannot completely solve the problem. Let´s consider the example below, where the UE performs RA in SSB1 and then in SSB2 and where the 1s are the LBT successes and the 0s are the LBT failures:.SSB1 = [1 0 0 1 0 0] SSB2 = [0 0 1]Even if for the 3rd attempt in SSB2, we add a flag indicating the failures before, the network will still not be aware of the last two failures in SSB1, and hence it will believe that there was no power ramping between the last successful attempt in SSB1, i.e. 4th attempt in SSB1, and the first successful attempt in SSB2, i.e. 3rd attempt in SSB2 Thus, we need also a flag indicating any possible failure just before the beam switching, as proposed above. |
| ZTE | Prefer D | In our understanding if only successful LBT is counted in perRAAttemptList, then existing numberOfPreamblesSentOnSSB or numberOfPreamblesSentOnCSI-RS will be used to count the successful transmitted preambles(i.e., not block by LBT), in this case only the ones that block by LBT needs to be counted, together NW can know all the RA attempted per beam to evaluate the load on each beam.This approach can balance the signalling overhead with the level of information can be provided to NW. As for per RA attempt information, it can also provide similar accuracy, but noticed, since we have up-to 200 entries, it means even with 1 bit there are additional 200 bit requirement in UE memory.  |
| Xiaomi | e | With option a in Q1, the numberOfPreamblesSentOnSSB and numberOfPreamblesSentOnCSI-RS includes all the preamble attempts regardless whether the LBT is successful or not. Then the number of LBT failures can be implicitly known by the size of the PerRAAttemptInfoList and , i.e. equals to number of preambles sent on SSB/CSI-RS - the size of the PerRAAttemptInfoList.No additional field is needed. |
| Lenovo | C |  |
| CATT | c)  | Based on above comment, in our view, the power rampings in UE side is more related to the UL channel quality between UE and network side, if the channel quality is good, less power ramping steps will be applied, if the channel quality is poor, the UE needs more power ramping steps. The channel quality from UE and network maybe very dynamic, the benefits to optimize the preamble target power and the power ramping steps seems limited based on the LBT failure on each RA attempt.If majority view believe this is beneficial, we are fine to support b). |
| Nokia | F with comments | A single new flag that indicates of having an unsuccessful transmission attempt just before the switching is enough to solve the issue. The number of LBT failures does not help, as it does not tell the NW if LBT failure happened just before switching or not. |
| Samsung | C |  |
|  |  |  |

### 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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| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | Yes | In the RAN2#121 meeting, RAN2 agreed that only some information can be included about the previous procedure. We have huge memory concerns about including per RA attempt information for the previous procedure.  |
| Huawei, HiSilicon | Yes | For the rest RA procedure except for the last RA procedure, the UE should record the pointA, loacation and bandwidth information, subcarrirer spacing, as well as the LBT failure numbers per RA procedure. |
| Ericsson | Yes | It was already agreed that “ Log the last successful RA procedure related information in the RA report.” So, it seems natural to assume that the “per RA attempt info” are only logged for the last RA (last BWP) before RA success or RLF/HOF |
| ZTE | Partially | Our understanding is that previous agreements is on perRAAttemptInfoList , but for the RA-InformationCommon, UE can at least include all attempted BWP-relevant information, so that NW can know the BWPs that experienced LBT failures. |
| Xiaomi | Yes |  |
| Lenovo |  | Why just logging the last BWP? Maybe the UE can log all the attempted BWPs in the last RA procedure, thus NW can know in which BWPs LBT failure happens. |
| CATT | Yes |  |
| Nokia | Yes |  |
| Samsung | Yes |  |
|  |  |  |

### 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**

|  |  |  |
| --- | --- | --- |
| Company | Options (a,b,c,d,e) | Comments |
| Qualcomm | A, B | A BW part is identified by locationAndBandwidth information and subcarrier spacing. This should be sufficient. No need for other information.  |
| Huawei, HiSilicon | A, B, C, D | We think a, b, c, d are enough, while a, b, c are used to precisely locate the BWP area and d is used to describe the load in the BWP. |
| Ericsson | A),b),d) c) (same value for all the BWPs) | a) b) are essential to identify the BWP. C) is also important but that shold be common to all the BWPs of the PCell, so we do not need to repeat it for all the BWPsd) is important. If it is agreed that the “per RA attempt info” are logged only for the last RA procedure (last BWP), then we should have at least some information on how many failures occurred in the other BWPs. One may claim that this value would be the same as the consistent LBT failure counter (lbt-FailureInstanceMaxCount), however we note that the lbt-FailureInstanceMaxCount may be reset during the RA, e.g. upon lbt-FailureDetectionTimer expiry, hence the failures may be more than the configured lbt-FailureInstanceMaxCount. |
| ZTE | At least a,b,c, d is also helpful | The locationAndBandwidth information is with respect to absolute point A, therefore c is also needed to identify BWP. And we can further discuss if UE can omitted part of information if there are the same.  |
| Xiaomi | A, B |  |
| Lenovo | A, B, D |  |
| CATT | a, b, c,d | We think it can use the same informat as the current RA-InformationCommon including absoluteFrequencyPointA, locationAndBandwidth and subcarrierSpacing.The details on c could be left to stage.3. |
| Nokia | A, B | It is enough to identify the BWP |
| Samsung | See comments | We can either log A) and B) or BWP-Id as in Q5. |
|  |  |  |

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?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | Okay |  |
| Huawei, HiSilicon | No | The sub-clause is for RA report enhancement, we don’t think that the consistent UL LBT failure for other data transmission except for preamble transmission, should also be considered into RA report. |
| Ericsson | Yes | Otherwise, the NW will not know which was the first BWP in which the UE was operating when it experienced the first consistent LBT failure, because in that BWP the UE may have not performed any RA. Hence it is important to log in the RA-Report some info associated to this first BWP (the locationAndBandwidth and the subcarrierSpacing would be sufficient we believe). No need to log non-PRACH information. |
| ZTE |  | Wonder if it can already be implicitly derived based on the order of included the BWP information as discussed in previous question. |
| Xiaomi | Yes |  |
| Lenovo |  | Why just logging the first BWP? Maybe the UE can log all the attempted BWPs in the last RA procedure, thus NW can know in which BWPs LBT failure happens. |
| CATT | Comments | We have sympathy on this intention. But it seems brings complexities to the whole procedure, repect to majority view. |
| Nokia | No | This has no relation to RA (It does not help optimizing RA configuration) |
| Samsung | See comments | We can either log A) and B) in Q4 or BWP-Id as in this question. |
|  |  |  |

### 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.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | E |  |
| Huawei, HiSilicon | E | We think whether MSG3 and MSGA is transmitted in the different time-frequency domain compairing to MSG1, so we do not see much values to record the LBT failure information related to MSG3 and MSGA in RA report. Besides, a ~ d will bring extra storage burden to the UE. |
| Ericsson | B (preferred)A (acceptable) | Adding some information about blocked LBT would be beneficial. It should be clarified in general what happens with the legacy flag contentionDetected. In this case, the flag will be set to false, since the contention resolution was not obviously successful. But it will not be clear if that is due missing RAR (preamble problem), or missing reception of msg3 (e.g. due to msg3 link adaptation issues). Hence logging information on whether the msg3 was blocked or not would help the network to better figure out the issue, and conclude for example that the unsuccessful contention resolution was due to LBT in msg3For the msgA payload, we should first check/discuss if it is really possible that in some cases the transmission of the msgA payload undergoes a different LBT procedure than the preamble. In our view, in most typical scenarios the msgA preamble transmission and the msgA payload exploit the same LBT procedure.  |
| ZTE |  | UE use the same beam to transmit preamble and Msg3/MsgA, so the LBT condition may be similar? More justification may be needed for this information. |
| Xiaomi | d | For each RA attempt, UE will indicate whether fallbackToFourStepRA is occur. The reason for UE to fallback to 4 step RA may be:- *PREAMBLE\_TRANSMISSION\_COUNTER* = *msgA-TransMax* + 1;- fallbackRAR is received;- preamble is successfully transmitted, but MsgA payload transmission fails.For the last reason, MsgA payload transmission failure can be either due to LBT failure or poor channel quality. It would be beneficial that if network can understand the reason why fallback occur. Network can know whether fallback is due to poor RSRP based on the reported dlRSRPAboveThreshold. Network can also know whether *PREAMBLE\_TRANSMISSION\_COUNTER* reaches maximum value based on the reported number of preamble sent and msgA-TransMax. Network will not be able to tell whether the fallback is due to LBT failure for MsgA payload transmission or due to fallbackRAR is received. Thus, it would be beneficial if UE can indicate whether MsgA payload transmission is failed due to LBT or not. |
| Lenovo | B, D |  |
| CATT | e) | For a) and b) we think Msg3 is scheduled by RAR (new transmission) or DCI (retransmission), this resource may be allocated dynamically, the benefit to perform SON optimization is limited, so it is not necessary to record Msg3 related information in RA report like legacy.For c)/d) we want to know the benefits for reporting this information. |
| Nokia | E |  |
| Samsung | A ,C | Especially since NR-U can have a very wide bandwidth,it would be useful to know if the failure is in msg1/msg3 or PRACH/PUSCH part of MSG-A. However we think procedure level granularity is sufficient,considering the overheads.  |
|  |  |  |

## 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**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | Wait  | We would like to wait for the outcome of issue#3 before making any agreement on this for the RLF report.  |
| Huawei, HiSilicon | Yes |  |
| Ericsson | Yes | It seems simpler to assume, as baseline, that whatever enhancement is agreed for RA-Report that applies also to RLF-Report. |
| ZTE | Agree | For the RA information included in RLF-report, we reuse the same IEs defined in RA report, therefore it is straightforward that the same principle can applies here.  |
| Xiaomi | Yes |  |
| Lenovo | Yes |  |
| CATT | Comments | **Do companies agree that the enhancements discussed for the RA-InformationCommon for the RA-Report are applicable also to the RLF-Report?**[CATT] Yes.**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?**[CATT] We think whether “per RA attempt info” are report in RLF-report depends on the discussion in section 2.1. We can wait for the outcome. |
| Nokia | Yes |  |
| Samsung | Yes |  |
|  |  |  |

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?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm |  | Isn’t this is duplicate with Q5.  |
| Huawei, HiSilicon | Yes | Q5 is for RA report enhancements, while Q8 is for RLF report enhancement.Being different to the discussion in Q5, for RLF report, the BWP information of which the first consistent UL LBT failure is dected, should be included. |
| Ericsson | Yes | For the same reasoning as in Q5 for the RA-Report.Currently in the RLF-Report we do not log any BWP-specific information, because the RLF failures are not very tighly related to BWP operations. Instead, the LBT procedure is clearly BWP-related, hence some information related to the first BWP in which the UE was operating at the moment of RLF should be included, so that the NW can figure out for example that some BWPs are more affected by LBT problems than others. |
| ZTE |  | We can wait for the outcome of Q4. Also, not sure why only the first BWP is logged. |
| Xiaomi | Yes |  |
| Lenovo |  | Similar question as ZTE, why just logging the first BWP? Maybe the UE can log all the attempted BWPs in the last RA procedure, thus NW can know in which BWPs LBT failure happens. |
| CATT | Yes | The BWP information can follow the Q4. |
| Nokia | No | We do not understand why this is useful in RLF reports |
| Samsung | No |  |
|  |  |  |

#### 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**

|  |  |  |
| --- | --- | --- |
| Company | Options (a,b,c,d,e,f,..) | Comments |
| Qualcomm | A | RAN2 agreed to include information about only the last RA procedure. Therefore, B-E does not apply.  |
| Huawei, HiSilicon | A, B, C, D, E |  |
| Ericsson | b) (preferred)a) and c) (at least) | The presence of consistent LBT failures may directly (as for the case of RLF-cause lbtFailure), or inderectly (e.g., as for the case of HOF) affect any type of RLF. Hence, we believe that irrespecitve of the specific RLF-cause, the UE can log the RA-InformationCommon if the UE had performed RA due to consistent LBT failures.If b) is not acceptable, we believe that at least A (as in legacy) and c) should be agreed. C) is needed in case the UE performed RA in different BWPs before declaring RLF with RLF-cause=lbtFailure.  |
| ZTE | At least C and A | Before UE declares RLF due to consistent LBT failure, UE will try to recovery from LBT by initiating RACH on BWP configured with RA resource |
| Xiaomi | A |  |
| Lenovo | A |  |
| CATT | A  |  |
| Nokia | A |  |
| Samsung | A |  |
|  |  |  |

#### 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**

|  |  |  |
| --- | --- | --- |
| Company | Options (a,b,c,d,e,f,..) | Comments |
| Qualcomm | None  |  |
| Huawei, HiSilicon | B,D | For a, the target node can deduce the unavailable SMTC occasions.For c, the signaling costs would be significant. |
| Ericsson | a) | The UE knows if unavailable SMTC occasions were detected just before the RLF/HOF, due to missing SSBs, and that may obviously play an important role in the expiry of the T304 (HOF) or T310. So, if the UE logs this information, then the NW can for example get to know that the expiry of T304 may be due to large interruption time in the acquiring of the target SSBs, rather than UL LBT issues.The other information related to time waiting/duration time may be not necessary, as the UE already knows from the RA-InformationCommon the failed RA attempts. |
| ZTE | Too early to discuss | We shall first identify conditions/scenarios for UE to store LBT relevant information in RLF-report before discussing required information |
| Xiaomi | None |  |
| Lenovo | C, D | For C and D, time information during handover procedure is useful to decide how RLF report is used for MRO analysis, for example, if too long time which is close to timer period of T304 is spent for UL LBT, it may mean that the failure is mainly caused by channel occupancy rather than coverage issue even though LBT during handover procedure is successful, network may not perform a coverage optimization after receiving the RLF report. |
| CATT | Postphone | Agree with ZTE. |
| Nokia | B | We think that to enable trigger condition optimization the network should know if the failure happened due to long LBT delays or not |
| Samsung | Postpone |  |
|  |  |  |

### 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**

|  |  |  |
| --- | --- | --- |
| Company | Options (a,b,c,d,e,f,..) | Comments |
| Qualcomm | D | Only when RLF cause is set as LBT-failure. Similar to other RRM measurements, UE should log only the latest RSSI measurements when RLF happens due to LBT failure, i.e., the RLF cause is set to lbt-failure.  |
| Huawei, HiSilicon | B or D | The RSSI before consistent LBT failure should be recorded to help analyze the load in NR-U channels. |
| Ericsson | a) | If the UE has measurements RSSI available for the PCell, then the UE should report it, since RSSI is an important measurement in the NR-U spectrum. If that is not available, e.g. if the UE is not capable of RSSI measurement, then of course it will not report it. |
| ZTE | D and c | As for c, it can be helpful to know if the HO failure has anything to do with the load |
| Xiaomi | A | RSSI can be used to analyze whether the RLF or HOF is due to heavy load.   |
| Lenovo | A | Agree with E///. |
| CATT | d) | Other issues may also contribute to RLF. So, it is difficult to estimate how much LBT failure contributes to the RLF. And d) clearly identifes the RLF is triggered by lbt-failure. |
| Nokia | D |  |
| Samsung | A |  |
|  |  |  |

#### 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**

|  |  |  |
| --- | --- | --- |
| Company | Options (a,b,c,d,e,f,..) | Comments |
| Qualcomm | A  | During the handover, UE is not required to obtain RSSI measurement. Therefore, irrespective of RLF/HoF, UE should include the latest RSSI measurement of the source cell. |
| Huawei, HiSilicon | A, B | The UE should log RSSI in the RLF report according to the failure type, and thus both a and b should be logged. |
| Ericsson | A for RLF,B for HOF | For RLF, the RSSI should be included, if available, only for the PCell in which the RLF occurred.For the HOF, both target and source meausurements should be included in available. |
| ZTE | A, B | This information is include if available anyway |
| Xiaomi | A, b,C | Some clarification is needed about the understanding of latest measured RSSI, i.e. whether it means the latest RSSI-result (linear average of sample value(s) provided by lower layers in the *reportInterval*), or the latest RSSI measurement provided from lower layer. A single RSSI measurement from lower layer may not be able to reflect the load. So, our understanding is the latest rssi-result.Besides, RSSI alone can not accurately reflect the load, channel occupancy should be provided together with RSSI to tell the load situation.Thirdly, the rssi and channel occupancy of neighbor cells may also be useful for analyzing why the target cell is chosen by gNB for HO. |
| Lenovo | A, B |  |
| CATT | a)/b) | We think RSSI can be used to reflect the channel interference status. |
| Nokia | A |  |
| Samsung |  | A) for RLF and the target cell RSSI (if available) for HOF. |
|  |  |  |

#### 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**

|  |  |  |
| --- | --- | --- |
| Company | Options (a,b,c,d,…) | Comments |
| Qualcomm | C | The basic principle for SON/MDT has been that UE can include the measurements that are already available at the UE (at RRC or MAC layer). We would like companies to respect the basic principle for SON/MDT. UE should not obtain any new measurements and requested measurements should be available (at RRC or MAC) for reporting.  |
| Huawei, HiSilicon | A | We think a comprehensive average detected power during the RA procedure, including the failed and successful channel caccess attempts should be logged, to help evaluate which channels are in heavy load.For the detected power, we think it has been available in current specs. For example, in TS 38.331, the energyDetectionConfig can be used to indicate whether to use some thresholds for energy detection, and then UE behaviours (regarding the detected power and threshold) are defined in TS 37.213. So we do not think the detected power is a new measurement, and RAN2 can discuss how to get the average values. |
| Ericsson | A | If the objective is to optimize the ED configuration, e.g. the ED threshold *maxEnergyDetectionThreshold*, then the UE should provide info on the detected power because according to RAN4 procedures the UE uses the detected power on the NR-U channel, rather than the RSSI, to determine if the channel is busy or not.We note that the if the ED threshold is set to a too low value, then there it might be more difficult for a 3GPP UE to access the unlicensed spectrum in this cell, i.e. more LBT failures will be experienced, whereas if that is set to a too high value, the interference in the unlicensed spectrum may increase potentially impacting a fair coexistence with other devices. Hence, a proper setting of the ED threshold is important to ensure good performances in the NR-U spectrum. |
| Xiaomi | C | Agree with QC that this is a new measurement, SON/MDT should avoid requiring new measurement from UE.Besides, according to TS37.213, the maximum energy detection threshold (*maxEnergyDetectionThreshold*) can be configured by network. If network doesn’t configure it, UE will calculate the maximum energy detection threshold based on the formula in 4.2.3.1 in 37.213, and network can use the same formula to know the maximum energy detection threshold used by UE.After determine the maximum energy detection threshold, UE will by implementation set energy detection threshold to be less than or equal to the maximum energy detection threshold. So, it would be hard for network to use the detected power for energy detection threshold configuration, since it is UE implementation to control the threshold.  |
| Lenovo | C | Similar view as QC. |
| CATT | Commnets | We agree that the detected energy can be reported to the network to reflect the interference status on the share spectrum. But we are wondering whether report amout is huge, what is the meaning of “average detected power”. |
| Nokia | C |  |
| Samsung | C |  |
|  |  |  |
|  |  |  |

#### 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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| --- | --- | --- |
| Company | Options (a,b,c,d,…) | Comments |
| Qualcomm | C | Same comment as above. The basic principle for SON/MDT has been that UE can include the measurements that are already available at the UE (at RRC or MAC layer). We would like companies to respect the basic principle for SON/MDT. UE should not obtain any new measurements and requested measurements should be available (at RRC or MAC) for reporting. |
| Huawei, HiSilicon | B) | According to TS 37.213, the UE may use different values comparing to the EDT configured by the NW. Therefore, the exact applied EDT value should be reported by the UE. To decline UE burden, the average value during the RA procedure should be adopted. |
| Ericsson | B (preferred)A (acceptable) | According to TS 37.213, the UE shall set the energy detection threshold to be less than or equal to the maximum energy detection threshold $X\_{Thresh\\_max}$ which can get the value of maxEnergyDetectionThreshold configured in RRC or it can be calculated according to procedures in TS 37.213 and the energyDetectionThresholdOffset. Hence, since the EDT can vary, it would be good for the network to know the value applied by the UE so that the network, together with the information on the detected power (Q13), can come up with a proper ED configuration that ensures good channel accessibility and fair coexistence.In case B is not agreed, A can at least allow the NW to know which was the configured ED, and it can possibly optimize it. |
| Xiaomi | C | Same comment as Q13 |
| Lenovo | C |  |
| CATT | Comments | For a)Since EDT can be decided by UE implementation when $X\_{Thresh\\_max}$ is not configured by the network. So a) is not accurate.For b)Same comments as in Q13. |
| Nokia | C |  |
| Samsung | C |  |
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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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| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | No | We would like Nokia’s proposal to be considered (for every aspect including this one, where the companies are proposing UE to report back different configurations). For example, in agenda item 7.13.6, different companies are proposing to report back even the common configurations (e.g., feature priority, feature combination preambles, etc.). This framework also simplifies may other configuration-related reporting issues for other reports.We are strictly against the trend in SON/MDT WI, where companies are proposing UE to report back configuration. The SON/MDT feature was not designed to handle network-side optimization by the UE. If the network is interested in the optimization it should store the configuration, UE should only be required to provide some assistance (not storing everything on behalf of the network). Therefore, we would like Nokia’s proposal to be considered as a common framework for all such scenarios, where UE context/configuration retrieval is required. We cannot keep discussing the retrival of configuration from UE.  |
| Huawei, HiSilicon | Yes | In the other use cases, the source node shall store the lbt-FailureRecoveryConfig configuraiton. |
| Ericsson | Yes | This approach would meet the RAN3 requirements, i.e. no need to have any UE-based mechanism if the UE reestablishes after the RLF (the UE context will still be in the NW). There is need for UE-based mechanism only when the RLF-Report is fetched later (as it could be in the case of reestablishment failure). |
| ZTE | Yes | Our understanding is that for configuration that is cell specific, it is possible for NW to memorized this information but for UE-specific configuration it would be difficult for NW to do so especially when the relevant report may be retrieved afterwords (e.g., after several hours and so on) it may be even more difficult for NW to do the correlation which is exactly what’s reflected in RAN3’s reply LS. But to limit the overhead we can specify conditions to limit the report.To introduce configuration index in every feature that is considered in SON-MDT only for reporting purpose is not a common method and will has an impact on other features which we consider is not decision can made sorely in MDT session. |
| Xiaomi | No | We don’t see lbt-FailureRecoveryConfig consumes a lot of signalling, since it only has two parameters:LBT-FailureRecoveryConfig-r16 ::= SEQUENCE { lbt-FailureInstanceMaxCount-r16 ENUMERATED {n4, n8, n16, n32, n64, n128}, lbt-FailureDetectionTimer-r16 ENUMERATED {ms10, ms20, ms40, ms80, ms160, ms320}, ...}We are ok either to report or not to report it, but there is no need to optimize when to report it if RAN2 agrees to report it. |
| Lenovo | Yes | LBT configuration is beneficial if UE context is released at NW side. |
| CATT | Yes | Network maybe does not store this UE-specific information.  |
| Nokia | NO | We have alternative proposal in R2-2302857: 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 |
|  |  |  |
|  |  |  |

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**

|  |  |  |
| --- | --- | --- |
| Company | Options (a,b,c,d,…) | Comments |
| Qualcomm | D | No need for new triggers. Existing triggers are sufficient and address all the proposed triggers in one way or another.  |
| Huawei, HiSilicon | A, B, C | LBT failure related parameters should be included in NR-U specific SHR trigger conditions. |
| Ericsson | a) | It would be good to generate an SHR if the number of LBT failures are higher than a certain threshold. If A is agreed, no need to have triggering conditions on the consistent LBT failures. |
| ZTE | D | It has been agreed that for NR-U RAN2 focus on RLF-report and RA report |
| Xiaomi | D |  |
| Lenovo | B, C |  |
| CATT | a) | We think a) is simple and sufficient. |
| Nokia | D |  |
| Samsung | d | It can be easily detected that LBT failures causes a “near failure” with the existing triggers. |
| Sharp | a | Option a) seems reasonable. In our understanding, LBT failure is not a rare case in NR-U, thus for b) or c), it may lead to too many SHR triggered, which is not necessary. Besides, we think may be current T304 threshod in SHR-config can be an option to trigger the LBT failure related information in SHR. |

### 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**

|  |  |  |
| --- | --- | --- |
| Company | Options (a,b,c,d,…) | Comments |
| Qualcomm | Wait for ANo for others |  |
| Huawei, HiSilicon | A,C with comments | We prefer ot modify c to be the average time duration for UL LBT before each RACH attempt at HO. |
| Ericsson | A, B | The random access information seems necessary to get information on the LBT problems during RA.Also the number of missing DL SMTC occasions is good input, because that maybe affect the interruption time. A large interruption time may be due to UL LBT issues, but also to DL LBT issues at the gNB, since the UE would not be able to quicly acquire timing information of the target cell. |
| Xiaomi | A |  |
| Lenovo | A, C, D | For C and D, time information during handover procedure can be useful to decide how SHR is used for MRO analysis, for example, if too long time which is close to timer period of T304 is spent for UL LBT, it may mean that the near-failure is mainly caused by channel occupancy rather than coverage issue even though LBT during handover procedure is successful. |
| CATT | A |  |
| Nokia | A |  |
| Samsung | A | LBT related information of the cell which provided the satisfied trigger can be logged. |
| Sharp | a |  |
|  |  |  |

## 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?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | No. | From UE perspective, we already report RSSI as part of immediate MDT. We are not sure what enhacements are needes. |
| Huawei, HiSilicon | Yes | OK to consider it |
| Ericsson | No strong view | Impact on MDT can be considered later in the WI, if time allows. |
| ZTE | No | It has been agreed that for NR-U RAN2 focus on RLF-report and RA report |
| Xiaomi | No |  |
| Lenovo | No |  |
| CATT | No strong view | May be we can discuss it if time allows. |
| Nokia | No |  |
| Samsung | No |  |
|  |  |  |

# Conclusion

To be updated

# 4. References

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