**3GPP TSG-RAN WG2 Meeting #119-bis electronic R2-22nnnnn**

**Online, 10th – 19th August, 2022**

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

**Source: Ericsson (Summary rapporteur)**

**Title:** **Pre-meeting summary of 8.13.5 SON for NR-U (Ericsson)**

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

**Document for: Discussion and Decision**

# Introduction

This summary paper addresses the proposals proposed as part of 8.13.5 dedicated to SON for NR-U.

The summary is divided into three sub-sections for RA report, RLF report and SHR, based on the following contributions.

# Summary

## Proposals extracted for RA report enhancement for NR-U

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| --- | --- |
| Company | Proposal |
| CATT [1] | **Proposal 1:** Add a new RA purpose of LBT on SpCell. |
| Samsung [3] | **Proposal 1:** Introduce a new value for RA-purpose for consistent UL LBT failures in the RA-report.**Proposal 2:** Introduce an indicator for consistent UL LBT failures for each RA attempt. |
| Huawei [4] | **Proposal 2:** Change the record area of RA-InformationCommon from the last BWP to a list of BWPs those UE ever performed RACH procedures.**Proposal 3:** For RA-InformationCommon enhancements, the entire sensing, the ratio of idle contention windows, the average measured RSSI and EDT, the number of consistent LBT failures and BWP specific lbt-FailureRecoveryConfig could be considered. |
| Lenovo [5] | **Proposal 5:** Include an indication of consistent LBT failures per RA procedure in the RA report.**Proposal 6:** UL LBT duration time can be included in the RA report. |
| Xiaomi [6] | **Proposal 1:** RAN2 to consider to introduce value 0 for the numberOfPreamblesSentOnSSB-r16 and numberOfPreamblesSentOnCSI-RS-r16.**Proposal 2:** RAN2 to clarify whether only the preamble transmissions that lead to PREAMBLE\_TRANSMISSION\_COUNTER increase are counted as RA attempts.**Proposal 3:** RAN2 to agree to introduce indication on whether lbt-FailureRecoveryConfig is configured or not in RA related information in ConnEstFailReport, RA-Report, RLF-Report, SuccessHO-Report.**Proposal 4:** UE indicates whether MsgA payload transmission is failed due to LBT or not if fallback to 4-step RA occur. |
| CMCC [7] | **Proposal 1:** When LBT-FailureRecoveryConfig is not configured, the random access problem caused by LBT failure needs to be indicated.**Proposal 2:** The number of LBT failures on each BWP need to be reported when LBT-FailureRecoveryConfig is not configured.**Proposal 3:** The LBT information (e.g., the number of LBT failures) can be added in the RACH report and RLF report. |
| Ericsson [8] | 1. Proposal 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. Proposal 2: If at the moment of successfully completing the random-access procedure, the UE had consistent LBT failures triggered in one or more BWPs, the RA-Report includes information associated to those random-access procedures performed due to the consistent LBT failures.
3. Proposal 3: For each RA attempt, it is indicated whether the corresponding RA attempt (i.e. preamble transmission) was blocked by LBT.
4. Proposal4: UE includes the measured RSSI for each RA attempt in RA report.
5. Proposal 5: For each RA procedure, UE includes the EDT value used for LBT recovery.
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| ZTE [10] | **Proposal 1:** Enhance RA report (e.g., raPurpose) to allow indication to indicate whether the RA procedure is initiated for consistent LBT failure recovery.**Proposal 2:** UE stores RA information of multiple RA procedure at different BWP associated with continuous consist LBT failure event. |

**Compact summary of the proposals and enhancements of the RA report:**

* New value for RA-purpose for consistent UL LBT failures [1][3][5][7][10]
* Change the record area of RA-InformationCommon from the last BWP to a list of BWPs [4] [8][10]
* LBT issue per RA attempt [3][8]
* RSSI and EDT in RA report [4][8]
* Number of consistent LBT failure [4][7]
* LBT recovery configuration (per BWP) [4][6]
* The entire sensing, the ratio of idle contention windows [4]
* LBT time duration in RA report [5]

Since the RA-InformationCommon is a common IE in the RA report, SHR and the in some cases in the RLF report (e.g., HOF), rapporteur suggest RAN2 first discuss the required enhancement of the RA-InformationCommon for NR-U and then build the direct enhancements for the SHR and RLF report when the agreements for the RA-InformationCommon are set.

**Summary Proposal 1: RAN2 first enhance the RA-InformationCommon for NR-U purpose, and then address direct enhancements of the RLF report and SHR when the agreements on RA-InformationCommon are set.**

Basing the summary on the above assumption, Huawei, Ericsson and ZTE proposed that the RA information needed to be extended to capture multiple RA procedures information performed in multiple BWPs in NR-U. Based on the provided proposals, rapporteur proposes the following:

1. Summary Proposal 2: Upon execution of last random-access procedure, the UE stores a list of RA-InformationCommon for multiple RA procedures triggered due to consistent LBT failure successively at different BWPs in an RA report.

Moreover, some companies (including Huawei, Ericsson [4, 8]) proposed to include the RSSI and used EDT, number of LBT failures and BWP specific lbt-FailureRecoveryConfig in the RA report and in particular in the RA-InformationCommon. Therefor rapporteur of the summary proposes the following:

**Summary Proposal 3: Include RSSI measurements in the RA-InformationCommon. FFS: values should be per RA procedure or per RA attempt.**

**Summary Proposal 4:** **Include the applied EDT in the RA-InformationCommon per RA procedure**

**Summary Proposal 5: RAN2 discuss whether to**

* **include lbt-FailureRecoveryConfig in the RLF report, or**
* **consult RAN3 to evaluate whether it is possible for the network to know the lbt-FailureInstanceMaxCount.**

In addition, Samsung and Ericsson in [3 and 8] proposed to include the LBT indication per RA attempt, while Huawei in [4] and CMCC in [7] proposed to include the number of LBT failures and Lenovo [5] proposed to include the time duration of the LBT issue in the RA report. Therefore, given that some of the information be redundant (e.g., total number of LBT issues can be deduced from an LBT issue flag per RA attempt) the rapporteur propose the following:

**Summary Proposal 6: RAN2 discuss which of the following measurement and information to be added to the RA-informationCommon**

* **Whether each RA attempt (i.e. preamble transmission) was blocked by LBT,**
* **Time duration of the LBT failures during the RA procedure,**
* **Total number of LBT failure during a RACH procedure.**

based on the provided proposals 6 companies including Lenovo, ZTE, Samsung, CATT, Ericsson and CMCC in [1, 3, 5, 7, 10] proposed to introduce an indication of consistent LBT failure in the RA report. 4 companies proposed to have the consistent LBT failure indication as a new *raPurpose*. Provided that the rapporteur proposes the following:

1. Summary Proposal 7: Introduce a new *raPurpose* in the *RA-Report* to indicate that the RA was initiated following a “consistent LBT failures” in the SpCell.

In addition, Xiaomi proposed that the value 0 should be introduced for the number of preambles sent over selected SSB and CSI-RS. Although this is provided by a single company, rapporteur thinks this is a valid and easily agreeable proposal, hence proposing the following.

**Summary Proposal 8: RAN2 to introduce value 0 for the numberOfPreamblesSentOnSSB-r16 and numberOfPreamblesSentOnCSI-RS-r16.**

The rapporteur of summary suggests to have either offline discussion(s) for the remaining proposals (mainly proposed by single companies) or postpone them to the next meetings.

**Summary Proposal 9: RAN2 discuss the following proposals via offline discussions or postpone them to the next meeting.**

* **UE indicates whether MsgA payload transmission is failed due to LBT or not if fallback to 4-step RA occur.**
* **For RA-InformationCommon enhancements, the entire sensing, the ratio of idle contention windows could be considered**

## Proposals extracted for RLF report enhancement for NR-U

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| Company | Proposal |
| CATT [1] | **Proposal 2:** RAN2 to further study what to be included in RLF report to reflect the RLF which is caused by consistent LBT failure indirectly. |
| Apple [2] | **Proposal 1:** to request RAN3 to evaluate whether it is possible for the network to know the lbt-FailureInstanceMaxCount which has been configured to the UE that sent the RLF-Report. |
| Samsung [3] | **Proposal 3:** RAN2 to discuss additional info in RLF report when the reported RLF cause is not consistent UL LBT failures, but UL LBT failures have an impact on RLF.**Proposal 4:** Introduce RSSI measurements and channel occupancy measurements in the RLF report.**Proposal 5:** UE may store the time of failure when the RLF occurred due to consistent UL LBT failures. |
| Huawei [4] | **Proposal 1:** RAN2 to consider reuse measResultForRSSI to enhance RLF report.**Proposal 4:** RAN2 to discuss the need of collecting measurements for RLF and SHR reports, e.g. the entire sensing, the ratio of idle contention windows, the average measured RSSI and EDT, the number of consistent LBT failures and BWP specific lbt-FailureRecoveryConfig. |
| Lenovo [5] | **Proposal 1:** Include measured RSSI and an explicit indication concerning handover failure due to consistent LBT failure in the RLF report.**Proposal 2:** Configuration related with LBT failure detection and recovery (e.g. lbt-FailureRecoveryConfig) can be included in the RLF report.**Proposal 3:** The measured channel occupancy in the unlicensed spectrum of target PCell can be included in the RLF report.**Proposal 4:** The time duration for UL LBT during handover procedure can be included in the RLF report. |
| Xiaomi [6] | **Proposal 3:** RAN2 to agree to introduce indication on whether lbt-FailureRecoveryConfig is configured or not in RA related information in ConnEstFailReport, RA-Report, RLF-Report, SuccessHO-Report. |
| CMCC [7] | **Proposal 3:** The LBT information (e.g. the number of LBT failures) can be added in the RACH report and RLF report. |
| Ericsson [8] | 1. Proposal 1: According to RAN3 LS, UE logs in the RLF-Report information on whether consistent LBT failure was triggered in the SpCell at the moment of RLF/HOF.
2. Proposal 2: If at the moment of RLF/HOF, the UE had consistent UL LBT failures triggered in one or more BWPs at MAC layer, the RLF-Report includes information associated to the random access procedures that were initiated due to such consistent UL LBT failures just before the RLF/HOF.
3. Proposal 3: UE includes the RSSI measurements in the RA-InformationCommon logged as part of RLF report.
4. Proposal 4: The UE includes in the RLF report the LBT configuration, e.g., the configured “*lbt-FailureInstanceMaxCount”.*
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| Nokia [9] | **Proposal 1:** For application of MRO in NR-U, it is proposed to introduce information in the RLF report which allows to distinguish between RLFs caused by wrongly configured handover parameters (useful for MRO) and those spoiled by LBT caused channel access delays (not useful for MRO).**Proposal 2:** Introduce logging of channel access delay information experienced during the handover process (e.g., in RLF Report) to enable a correct treatment of the reported RLFs with respect to MRO and other SON methods. |
| ZTE [10] | **Proposal 3:** Include in RLF-report the latest RSSI measurements if available when RLF happens and rlf-cause is set to lbtfailure or when HOF happens and at least one consistent lbt failure is detected.**Proposal 4:** No need to introduce explicit indication in RLF-report that the indication that handover failure occurred due to consistent LBT failures. |

**Compact summary of the enhancements to the RLF report:**

* RSSI measurement in the RLF report. [3][4][5][8][10]
* Indication of LBT issue when consistent LBT issue is indirectly causing the failure. proponents: [1][3][5][8] opponent: [10]
* LBT recovery configuration in RLF report. proponent: [5][6][8], [2] requesting LS to RAN3
* Channel occupancy measurements [3][5]
* Channel access delay (time duration of LBT issue) in case of HOF [9][5]

Concerning MRO, rapporteur summarizes the proposals for the discussion based on the relevance and popularity of the proposals among the companies.

5 companies including [3][4][5][8][10] proposed to include the measured RSSI in the RLF report. This is in accordance with the RAN3 LS (R3-225241) to RAN2 requesting to include the measured RSSI in the RLF report. However, if it is agreeable to include the RSSI measurements in the RA-InformationCommon as discussed in the section 2.1, it may not be needed to include the RSSI measurements in the RLF report when RA-InformationCommon is included. Hence rapporteur of the summary proposes the following.

**Summary Proposal 10: The UE includes the RSSI measurements in the RLF report. If it is agreed that the UE includes RSSI value in the RA-InformationCommon in the RLF report (Proposal 3), the UE does not need to log the RSSI measurement directly in the RLF report for HOF cases.**

In addition, 3 companies including [5][6][8] proposed to include the lbt-FailureRecoveryConfig in the RLF report while one company [2] proposed to consult RAN3 to evaluate whether it is possible for the network to know the lbt-FailureInstanceMaxCount. Hence rapporteur proposes the following:

**Summary Proposal 11: RAN2 discuss whether to**

* **include lbt-FailureRecoveryConfig in the RLF report, or**
* **consult RAN3 to evaluate whether it is possible for the network to know the lbt-FailureInstanceMaxCount.**

5 companies including [1,3, 5, 8] discussed to include an indication in the RLF report that the failure occurred due to consistent LBT failure while one company [10] discussed that no explicit indication is needed. Indication of the consistent LBT failure in the RLF report is in accordance with RAN3 LS sent to RAN2 requesting to include an indication of consistent LBT failure in the RLF report. Having implicit indication can be an option as UE in some scenarios includes RA-informationCommon when RLF is due to RA problem/BFR and when HOF happens, which can be enhanced to include detailed information associated to consistent LBT failure occurs during the event which can served as implicit indication. In addition, by including some NR-U specific measurements such as RSSI value (discussed in proposal 10), it might be plausible to implicitly derive the LBT issues. Hence, rapporteur proposes the following.

**Summary Proposal 12: According to RAN3 LS, RAN2 agree to indicate the consistent LBT failure in the RLF report when the consistent LBT failure is causing the failure indirectly. FFS on explicit or implicit indication.**

## Proposals extracted for SHR enhancement for NR-U

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| Company | Proposal |
| CATT [1] | **Proposal 3:** Triggering condition for SHR reporting consistent LBT failure information can be further studied for SHR.**Proposal 4:** SHR cause can be extended to include consistent LBT failure information. |
| Apple [2] | **Proposal 2**: to consider enhancing Successful HO Report to include LBT\_COUNT. |
| Samsung [3] | **Proposal 6:** SHR may include information about the time of handover, consistent UL LBT failure indication, number of UL LBT failures, RSSI measurements and channel occupancy measurements.**Proposal 7:** Existing SHR configuration can be reused for NR-U. |
| Huawei [4] | **Proposal 4:** RAN2 to discuss the need of collecting measurements for RLF and SHR reports, e.g. the entire sensing, the ratio of idle contention windows, the average measured RSSI and EDT, the number of consistent LBT failures and BWP specific lbt-FailureRecoveryConfig. |
| Lenovo [5] | **Proposal 7:** 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.**Proposal 8:** The identifier of the UL BWP where consistent LBT failure occurs can be included in the SHR. |
| Xiaomi [6] | **Proposal 3**: RAN2 to agree to introduce indication on whether lbt-FailureRecoveryConfig is configured or not in RA related information in ConnEstFailReport, RA-Report, RLF-Report, SuccessHO-Report. |
| CMCC [7] |  |
| Ericsson [8] | 1. Proposal 10: Introduce new SHR triggering conditions for NR-U, e.g., UL LBT failure prior to successfully completion of the HO.
2. Proposal 11: SHR includes information associated to the random-access procedures that were initiated due to such consistent UL LBT failures just before the successful HO completion.
3. Proposal 12: The UE includes in the SHR report the LBT configuration, e.g., the configured “*lbt-FailureInstanceMaxCount”.*
 |
| Nokia [9] |  |
| ZTE [10] |  |

**Compact summary of the enhancements to the SHR:**

* NR-U based triggering conditions for SHR [1][5][8]
* consistent UL LBT failure indication, number of UL LBT failures, RSSI measurements and channel occupancy measurements [3]
* number of LBT failures [2][3]
* RSSI measurements [3][4]
* the entire sensing, the ratio of idle contention windows, the average measured RSSI and EDT, the number of consistent LBT failures and BWP specific lbt-FailureRecoveryConfig. [4]

Based on the summary of the enhancement, rapporteur suggest discussing the common enhancement between SHR and the RA-InformationCommon in the section 2.1 and here discuss the enhancements that are non-overlapping with the RA-InformationCommon enhanecements. 3 companies discusses a new NR-U specific SHR triggering conditions. Hence the rapporteur proposes the following.

**Summary Proposal 13: Introduce new SHR triggering conditions for NR-U e.g., UL LBT failure prior to successfully completion of the HO.**

**Summary Proposal 14: RAN2 discuss the enhancement of the successful handover report content for NR-U, after progress in enhancing RA-InformationCommon IE in RA report.**

## Miscellaneous

CMCC in [7] proposed the following for the immediate MDT measurement

**Proposal 4:** The LBT information can be added in measurement reporting for immediate MDT.

**Proposal 3:** Extend MDT reports to provide a solution for recording of a cancellation of an LBT failure.
However since it is agreed to first focus on the RA report, RLF-report and SHR, rapporteur does not provide any proposal for these topics, and enhancements for MDT in NR-U can be postponed to the next meetings.

# Conclusion

## RACH report enhancements

**Summary Proposal 1: RAN2 first enhance the RA-InformationCommon for NR-U purpose, and then address direct enhancements of the RLF report and SHR when the agreements on RA-InformationCommon are set.**

1. Summary Proposal 2: Upon execution of last random-access procedure, the UE stores a list of RA-InformationCommon for multiple RA procedures triggered due to consistent LBT failure successively at different BWPs in an RA report.

**Summary Proposal 3: Include RSSI measurements in the RA-InformationCommon. FFS: values should be per RA procedure or per RA attempt.**

**Summary Proposal 4:** **Include the applied EDT in the RA-InformationCommon per RA procedure**

**Summary Proposal 5: RAN2 discuss whether to**

* **include lbt-FailureRecoveryConfig in the RLF report, or**
* **consult RAN3 to evaluate whether it is possible for the network to know the lbt-FailureInstanceMaxCount.**

**Summary Proposal 6: RAN2 discuss which of the following measurement and information to be added to the RA-informationCommon**

* **Whether each RA attempt (i.e. preamble transmission) was blocked by LBT,**
* **Time duration of the LBT failures during the RA procedure,**
* **Total number of LBT failure during a RACH procedure.**
1. Summary Proposal 7: Introduce a new *raPurpose* in the *RA-Report* to indicate that the RA was initiated following a “consistent LBT failures” in the SpCell.

**Summary Proposal 8: RAN2 to introduce value 0 for the numberOfPreamblesSentOnSSB-r16 and numberOfPreamblesSentOnCSI-RS-r16.**

**Summary Proposal 9: RAN2 discuss the following proposals via offline discussions or postpone them to the next meeting.**

* **UE indicates whether MsgA payload transmission is failed due to LBT or not if fallback to 4-step RA occur.**
* **For RA-InformationCommon enhancements, the entire sensing, the ratio of idle contention windows could be considered**

## RLF report enhancement for NR-U

**Summary Proposal 10: The UE includes the RSSI measurements in the RLF report. If it is agreed that the UE includes RSSI value in the RA-InformationCommon in the RLF report (Proposal 3), the UE does not need to log the RSSI measurement directly in the RLF report for HOF cases.**

**Summary Proposal 11: RAN2 discuss whether to**

* **include lbt-FailureRecoveryConfig in the RLF report, or**
* **consult RAN3 to evaluate whether it is possible for the network to know the lbt-FailureInstanceMaxCount.**

**Summary Proposal 12: According to RAN3 LS, RAN2 agree to indicate the consistent LBT failure in the RLF report when the consistent LBT failure is causing the failure indirectly. FFS on explicit or implicit indication.**

## SHR enhancement for NR-U

**Summary Proposal 13: Introduce new SHR triggering conditions for NR-U e.g., UL LBT failure prior to successfully completion of the HO.**

**Summary Proposal 14: RAN2 discuss the enhancement of the successful handover report content for NR-U, after progress in enhancing RA-InformationCommon IE in RA report.**

# References

1. [R2-2209573](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119bis-e/Docs/R2-2209573.zip)[M](http://mannerheim.nomadiclab.com/Mannerheim/tdoc/R2-2209573)[NR-U enhancements for SON](%5CR2-2209573.zip) **CATT**
2. [R2-2209765](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119bis-e/Docs/R2-2209765.zip)[M](http://mannerheim.nomadiclab.com/Mannerheim/tdoc/R2-2209765)[SON enhancements for NR-U](%5CR2-2209765.zip) **Apple**
3. [R2-2209824](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119bis-e/Docs/R2-2209824.zip)[M](http://mannerheim.nomadiclab.com/Mannerheim/tdoc/R2-2209824)[SON/MDT enhancements for NR-U](%5CR2-2209824.zip) **Samsung R&D Institute India**
4. [R2-2209897](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119bis-e/Docs/R2-2209897.zip)[M](http://mannerheim.nomadiclab.com/Mannerheim/tdoc/R2-2209897)[Discussion on SON for NR-U](%5CR2-2209897.zip) **Huawei, HiSilicon**
5. [R2-2209958](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119bis-e/Docs/R2-2209958.zip)[M](http://mannerheim.nomadiclab.com/Mannerheim/tdoc/R2-2209958)[Discussion on MRO for NR-U](%5CR2-2209958.zip) **Lenovo**
6. [R2-2210039](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119bis-e/Docs/R2-2210039.zip)[M](http://mannerheim.nomadiclab.com/Mannerheim/tdoc/R2-2210039)[Discussion on SON for NR-U](%5CR2-2210039.zip) **Xiaomi**
7. [R2-2210148](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119bis-e/Docs/R2-2210148.zip)[M](http://mannerheim.nomadiclab.com/Mannerheim/tdoc/R2-2210148)[SONMDT enhancement for NR-U](%5CR2-2210148.zip) **CMCC**
8. [R2-2210180](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119bis-e/Docs/R2-2210180.zip)[M](http://mannerheim.nomadiclab.com/Mannerheim/tdoc/R2-2210180)[Enhancements of SON reports for NR-U](%5CR2-2210180.zip) **Ericsson**
9. [R2-2210270](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119bis-e/Docs/R2-2210270.zip)[M](http://mannerheim.nomadiclab.com/Mannerheim/tdoc/R2-2210270)[MRO and MDT enhancements for NR-U](%5CR2-2210270.zip) **Nokia, Nokia Shanghai Bell**
10. [R2-2210290](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119bis-e/Docs/R2-2210290.zip)[M](http://mannerheim.nomadiclab.com/Mannerheim/tdoc/R2-2210290)[Consideration on NR-U related SON](%5CR2-2210290.zip) **ZTE Corporation, Sanechips**