**3GPP TSG-RAN WG2 Meeting #119bis electronic *Draft\_*R2-2210935**

**Online, October, 2022**

**Source: vivo (Rapporteur)**

**Title:** **Summary of [AT119bis-e][504][V2X/SL] Consistent SL LBT failure (vivo)**

**Agenda Item:** **8.15.2**

**Document for:** **Discussion and Decision**

# Introduction

This contribution summarizes the discussion of the following offline discussion:

* [AT119bis-e][504][V2X/SL] Consistent SL LBT failure (vivo)

**Scope:** Discuss SL LBT Failure:

Q1: Need of SL LBT Failure indication from PHY?

Q2: Need of consistent SL LBT failure declaration in MAC?

Q3: How to declare consistent SL LBT failure?

Q4: UE behaviour when MAC declares consistent LBT failure?

Q5: Consistent SL LBT Failure detection granularity?

**Intended outcome:** Discussion summary in R2-2210935.

**Deadline:** 10/13 10:00 (UTC), will be handled in R18 SL session.

The discussion is organized based on companies’ contributions focusing on this topic as listed in the Reference Section.

# Need of SL LBT Failure indication from PHY

In NR-U, the consistent LBT failure detection and recovery procedure is based on the LBT indication from PHY. So, whether in SL-U we still need/have an SL-specific LBT failure indication from PHY is the basis for further discussion on the SL-specific consistent LBT failure detection and recovery procedure.

**Question 1-1:**  Do companies agree that as in NR-U, the SL-specific LBT failure indication from PHY is needed for the consistent LBT detection procedure in the MAC in SL-U?

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| **Company** | **Yes/No** | **Comments if any** |
| CATT | Yes | It had better follow the same principle as NR-U. |
| OPPO | Yes |  |
| Apple | Yes, but... | We prefer to reuse NR-U mechanism. However, we think the information included in "SL-specific LBT failure indication from PHY" needs further discussion or RAN1 input. For example, whether the indication from PHY also includes the corresponding resource pool ID or RB set ID. |
| vivo | Yes |  |
| Xiaomi | Yes with comments | Just to clarify the LBT failure indication is not only used for consistent LBT failure detection procedure. In NR-U, some counters will not be incremented and some timers will not be started/restarted if LBT failure indication is received from PHY. So for SL-U, we should not limit the usage of LBT failure indication to consistent LBT failure detection only. |
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# Need of consistent SL LBT failure declaration in MAC?

Nearly all companies in their contributions proposed to support the SL-specific LBT failure detection and recovery procedure for SL-U. So below is to confirm the support of SL-specific LBT failure detection and recovery procedure. Note, details on the SL-specific LBT failure detection and recovery procedure are to be discussed in later Sections.

**Question 2-1:**  Do companies agree that the SL-specific consistent LBT failure detection and recovery procedure needs to be supported in the MAC in SL-U?

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| **Company** | **Yes/No** | **Comments if any** |
| CATT | Yes |  |
| OPPO | Yes |  |
| Apple | Yes | Same issue of consistent LBT in NR-U may happen in SL-U. |
| vivo | Yes |  |
| Xiaomi | Yes |  |
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# Consistent SL LBT failure detection granularity

In NR-U, the consistent LBT failure is detected per UL BWP at the UE side, as specified in TS 38.321, subclause 5.21.1. Basically, the consistent LBT detection is tightly related the resource configuration granularity.

In SL-U, the PHY channel structure design is still under the discussion in RAN1. The related RAN1 agreements on resource configuration granularity can be found in RAN1 #109e minutes, as follows. So, such agreements from RAN1 need be fully considered when we determine the granularity for SL-specific consistent LBT failure detection in SL-U. Considering such RAN1 agreements, plenty of contributions were also proposing the SL-specific consistent LBT failure detection in various operational granularity [2][3][4][8][10][14][18].

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| Agreement  SL BWP, SL resource pool in R16/R17 NR SL and RB set in R16 NR-U are reused for SL-U as baseline   * Only one SL BWP is (pre-)configured within a carrier * The SL BWP is (pre-)configured to include one or multiple SL resource pools |

**Question 3-1:**  In which operational granularity should SL-specific consistent LBT failure detection be performed (from *resource configuration* perspective)?

1. Per SL BWP
2. Per SL-U carrier
3. Per resource pool
4. Per RB set
5. Per LBT subband
6. Ask RAN1 for clarification.
7. Others. If this option is selected, please elaborate the solution you propose.

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| **Company** | **Option selection** | **Comments if any** |
| CATT | F | Since LBT is performed in PHY layer, it had check with RAN1. |
| OPPO | F | This issue essentially depends on for which granularity, the LBT failure are relevant / irrelevant, so that some check to R1 would be necessary. |
| Apple | F first (need to understand granularity of SL LBT failure indication from PHY) | We think RAN2 need to first ask RAN1 on the granularity of SL LBT failure indication from PHY because the granularity of consistent SL LBT in MAC can only be larger than granularity of SL LBT failure indication from PHY. For example:   * If granularity of SL LBT indication from PHY is per BWP, then consistent SL LBT failure in MAC can only be per BWP. * If granularity in PHY is per resource pool, RAN2 can further discuss whether it is per BWP or per resource pool. |
| vivo | F (preferred) or C | According to the current RAN1 progress, it seems that RAN1 guys intend to make Resource pool in SL-U play a similar role as UL BWP in NR-U, so we think perhaps C is the most promising operational granularity for the SL-specific consistent LBT detection. However, since this is anyway related to the channel/resource structure design for SL-U, which is right under the discussion in RAN1, we also think the safest way is to directly seek for the answer from RAN1.  Also, we think it is quite straightforward that operational granularity of the SL-specific consistent LBT failure detection should just be the same as the granularity of the SL-specific LBT failure indication from the PHY. Otherwise, it is unclear how the consistent LBT failure is detected based on an LBT failure discussion with a different granularity… |
| Xiaomi | C or F | Regarding Apple’s comments, if we understand correctly, they propose to check with RAN1 on the granularity of LBT procedure itself? i.e., whether a LBT procedure is performed per BWP or per RP? Actually based on our understanding LBT is performed per 20MHz, which is the same size as a RB set.  However the granularity of SL LBT failure indication itself should be per SL transmission, including PSSCH/PSCCH/PSFCH, any SL transmission on SL unlicensed spectrum. For each SL transmission, if LBT fails, PHY should deliver LBT failure indication to MAC. This is also aligned with NR-U, in NR-U, the granularity of LBT failure indication is per UL transmission.  For the granularity of consistent LBT failure detection, as listed by Rapp, it can be per RP per BWP, etc. This means when UE counts the LBT failure, all the LBT failure indications corresponding to the SL transmissions carried on this RP/BWP are counted and UE detects consistent LBT failure based on this counting.  In NR-U, consistent LBT failure is detected per BWP since multiple BWPs are supported on a single carrier. But for SL-U, since RAN1 already agreed only one BWP is allowed to be (pre)configured, it is not reasonable to detect consistent LBT failure per BWP. So we think resource pool is a more suitable granularity since multiple RPs are supported on this single BWP.  We are also fine to check with RAN1 if this is majority view but we think we need to make the question clear. |
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In addition, some companies proposed to consider the SL-specific natures and thus are considering also the SL-specific consistent LBT failure detection in a per DST, per unicast connection or a per cast type manner (e.g. in [4][10][18]). Since the DST/unicast connection/cast type are typically regarded as RAN2-level factors, whether such operational granularity needs to be supported should be looked into by RAN2. However, the motivation/rationale of supporting such per DST/per unicast link/per cast type consistent LBT failure detection in SL need be fully clarified before introducing it as a brand new feature.

**Question 3-2:**  Do companies agree to support SL-specific consistent LBT failure detection at a per DST/per unicast link/per cast type level?

1. Yes, SL-specific consistent LBT failure can be detected per DST.
2. Yes, SL-specific consistent LBT failure can be detected per unicast link.
3. Yes, SL-specific consistent LBT failure can be detected per cast type.
4. No, do not support any form of per DST/per unicast link/per cast type consistent LBT failure detection in SL-U.

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| **Company** | **Option selection** | **Please specify the rationale/motivation, if an option with “Yes” is selected.** |
| CATT | D | LBT is only corresponding Tx UE behavior, it is not related to DST/unicast link/cast type. |
| OPPO |  | Do not get the point / difference between Q3-1 and Q3-2, is Q3-2 also for granularity issue? |
| Apple | D | LBT is performed per radio resource (either BWP/Resource Pool/RB set) rather than per logical link (either DST/link/cast-type). |
| vivo | D | Per our reading of companies’ contribution, this seems to be another granularity/dimension, in addition to the resource granularity discussed in Q3-1, so the question is listed here just to collecting companies’ thinking.  From our perspective, note that in NR SL the resource configuration is common to all cast types/DSTs/unicast links since Rel-16 (where this issue was intentionally discussed) which is a principle highly likely to be inherited to SL-U. From this perspective, there is no clear motivation/logic to take consistent LBT failure detection as a cast-type/DST/unicast link specific operation, while still keeping the resource configuration common to all of them. On the other hand, such per cast-type/per DST/per unicast may also requires the PHY to submit the LBT failure indication in the corresponding granularity, which may lead to further complication to L1 and further burden to RAN1 discussion on its feasibility. |
| Xiaomi | A | We think A is also feasible considering SL is for the transmission between UEs. For this option, UE counts LBT failure for all SL transmissions targeted at a certain destination no matter in which resource pool/RB set the SL transmission is performed, and upon the counter reaching the maximum configured value, consistent LBT failure is triggered for this destination. This applies to unicast, groupcast and broadcast. With this operation, the impact caused by consistent LBT failure detection is minimized compared with per RP/BWP solution since if consistent LBT failure is detected on a RP/BPW then all the SL transmissions carried on this RP/BWP will be impacted. But with this option, only the destination is impacted. |
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# How to declare consistent SL LBT failure

In NR-U, the consistent LBT failure is detected and declared by the MAC entity, and the related procedure is specified in TS 38.321. Specifically, the general idea is to rely on an LBT failure detection counter to record the accumulated LBT failure instances indicated by the PHY and judge whether a maximum count threshold is reached, and rely on an LBT failure detection timer to judge whether the LBT failure is autonomously recovered in the PHY.

There is a majority of contributions proposing to reuse this NR-U design also to SL-specific consistent LBT failure detection procedure, at least as the baseline [1][2][3][5][6][7][8][9][15][18]. So below questions are to check to which extent the NR-U consistent LBT detection mechanism in the MAC can be reused for SL-specific consistent LBT failure detection/declaration operation.

**Question 4-1:**  Do companies agree to introduce the following parameters/variables for the SL-specific consistent LBT failure detection procedure, as in NR-U? [[1]](#footnote-1)

1. An SL-specific LBT failure indication counter (e.g. SL\_LBT\_COUNTER)
2. An SL-specific maximum LBT failure instance count threshold (e.g. *sl-LBT-FailureInstanceMaxCount*)
3. An SL-specific LBT failure detection timer (e.g. *sl-LBT-FailureDetectionTimer*)

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| **Company** | **Option selection** | **Please specify the reason, if you think any of option A/B/C is not needed.** |
| CATT | A, B, C | Similar solution as NR-U. |
| OPPO | A,B,C | We understand the 3 are all to mimic NR-U behavior. |
| Apple | ABC, but... | We prefer to reuse same mechanism of NR-U. So. all these 3 parameters are required.  However, if RAN2 agree the granularity of consistent LBT failure is per resource pool or RB set, we may need multiple sets of parameters. This can be FFS. |
| vivo | A, B, C | Yes, if needed, we may further discuss the need of any other SL specific enhancement, following later RAN1/2 progress. |
| Xiaomi | A, B, C | Reuse NR-U solution. |
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Below questions further discuss which of the NR-U operations on the COUNTER and TIMER handling for consistent LBT failure detection can be reused in SL-U.

**Question 4-2:** Do companies agree that the COUNTER and TIMER handling for consistent LBT failure detection in NR-U can be reused as the baseline for SL-specific consistent LBT failure detection in SL-U?

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| **Company** | **Yes/No** | **Please specify the reason, if “No” is selected.** |
| CATT | Yes |  |
| OPPO | Yes |  |
| Apple | Yes, but.. | We prefer to reuse same mechanism of NR-U.  However, if RAN2 agree the granularity of consistent LBT failure is per resource pool or RB set, maybe RAN2 need to specify some new rules on whether counter is reset or continued after switching resource pool. Or multiple sets of timers/counter are run in parallel. This can be FFS. |
| vivo | Yes | This question aims to derive a high-level principle, whereas the next question further strives for which functional operation in NR-U can be actually reused in SL-U on the basis of this principle |
| Xiaomi | Yes |  |
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**Question 4-2a:** If “Yes” is selected to Q4-2, which of the following operations for consistent LBT failure detection in NR-U can be reused for SL-specific consistent LBT failure detection procedure in SL-U? Please select ALL the operations you agree to support.

1. As in NR-U, if an SL-specific LBT failure indication is received from the lower layer, the SL-specific LBT failure indication counter (e.g. SL\_LBT\_COUNTER) is incremented by one.
2. As in NR-U, if an SL-specific LBT failure indication is received from the lower layer, start or restart the SL-specific LBT failure detection timer (e.g. *sl-LBT-FailureDetectionTimer*)
3. As in NR-U, if the SL-specific LBT failure indication counter value is equal to or larger than the SL-specific maximum LBT failure instance count threshold (e.g. *sl-LBT-FailureInstanceMaxCount*), consistent LBT failure is triggered/declared by the MAC entity[[2]](#footnote-2).
4. As in NR-U, if the SL-specific LBT failure detection timer (e.g. *sl-LBT-FailureDetectionTimer*) expires, the SL-specific LBT failure indication counter (e.g. SL\_LBT\_COUNTER) is reset to 0.
5. As in NR-U, if the maximum LBT failure instance count threshold (e.g. *sl-LBT-FailureInstanceMaxCount*) or SL-specific LBT failure detection timer (e.g. *sl-LBT-FailureDetectionTimer*) is reconfigured, SL-specific LBT failure indication counter (e.g. SL\_LBT\_COUNTER) is reset to 0.
6. Others. If this option is selected, please elaborate the solution you propose.

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| **Company** | **Option selection** | **Comments if any** |
| CATT | A, B, C ,D , E |  |
| OPPO | A-E | We understand the behavior here are all to mimic NR-U behavior. |
| Apple | ABCDE, but.. | We prefer to reuse same mechanism of NR-U.  However, if RAN2 agree the granularity of consistent LBT failure is per resource pool or RB set, maybe RAN2 need to specify some new rules on whether counter is reset or continued after switching resource pool. Or multiple sets of timers/counter are run in parallel. This can be FFS. |
| vivo | A, B, C, D, E | Of course, more Stg.3 details can be further discussed in future meetings, if the options listed have not exhausted all necessary detailed behaviors in SL-U. |
| Xiaomi | ABCDE | Reuse NR-U solution. |
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# UE behaviour when MAC declares consistent LBT failure

Regarding the SL-specific consistent LBT failure recovery procedure, several companies in their contributions explore the differentiated handling for Mode-1 and Mode-2.

For a Mode-1 UE, several contributions mentioned to report the occurrence of SL-specific consistent LBT failure to the gNB and rely on gNB’s configuration for the recovery [1][2][3][4][6][7][8][9][14][15][18], which is following the same design logic of NR-U. Some companies also proposed even further details on the signaling type for the reporting (e.g. MAC CE or RRC message).

For a Mode-2 UE, companies are proposing some ways for UE autonomous recovery from SL-specific LBT failure, e.g. switching SL BWP/resource pool/SL carrier, etc. [1][2][3][18], instead of making it reported to the gNB. This is somewhat like the autonomous UL BWP switching for the Spcell consistent LBT failure recovery in NR-U.

**Question 5-1:**  Do companies agree that as in NR U, a **Mode-1** UE can indicate the SL-specific consistent LBT failure (if triggered and not cancelled) to the gNB?

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| **Company** | **Yes/No** | **Comment if any** |
| CATT | Yes |  |
| OPPO | Yes | While we understand this Q5-1 is not to exclude the reporting for RRC\_CONNECTED mode-2 UE reporting, but just to conclude on mode-1 first? Or? |
| Apple | Yes | It follows general principle of recovery in NR. Upon reception of the failure indication, t is up to gNB implementation how to perform recovery (e.g. reconfiguration of resource pool, handover the UE to another cell, *etc*.). |
| vivo | Yes |  |
| Xiaomi | See comments | We have similar concern as OPPO, we think mode 2 UE operating in RRC CONNECTED mode may also be allowed to report to the network. We should not limit the reporting to mode 1 at this early stage. |
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**Question 5-1a:**  If “Yes” is selected to Q5-1, which signaling should be used for such SL-specific consistent LBT failure indication to the gNB?

1. MAC CE
2. RRC message
3. Others. If this option is selected, please elaborate the solution you propose.

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| **Company** | **Option selection** | **Comments if any** |
| CATT | A |  |
| OPPO |  | In NR-U, the MAC-CE is used to report LBT issue in a per-cell manner, so we understand now the decision between MAC-CE/RRC is coupled with the conclusion of granularity (Q3-1, Q3-2), i.e., we can evaluate the feasibility of MAC-CE design depending on the dimension(s) to take care. |
| Apple | Prefer A,  B is acceptable | Note that NR-U used MAC-CE while Rel-16 NR V2X has supported to use SUI to convey failure information in case of SL RLF. We think both solution can work.  Among them, we slightly prefer A (i.e. MAC-CE) because consistent LBT failure should be expected to be faster than SL RLF. |
| vivo | At least A | We want to reuse MAC CE based way as in NR-U as much as possible. Regarding RRC signaling, we might further justify the use case of using it, before agreeing to support it. We also share OPPO’s comment, as how the signaling should be designed is tightly depend on the granularity of consistent LBT detection in SL. |
| Xiaomi | See comments | We think both can work and the detailed design of this report may depend on the conclusion of the granularity of consistent LBT failure detection. So seems too early to conclude on this issue. |
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**Question 5-2:**  Do companies agree that for a Mode-2 UE, when the consistent LBT failure is triggered on a “set of resources”, the UE can autonomously switch to another “set of resources” where consistent LBT failure is not triggered for further transmission?

* *Note that the granularity of such “set of resources” depends on the granularity for SL-specific consistent LBT failure detection in Q3-1/3-2.*

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| **Company** | **Yes/No** | **Comment if any** |
| CATT | See comment | It is too early to discuss this since the set of resources is unclear now. |
| OPPO | Yes |  |
| Apple | Wait conclusion of granularity | This solution can only work when both below conditions are met:   * If granularity of consistent SL LBT failure is agreed to be per resource pool or RB sets. * If more than 1 resource pools are configured for a Mode-2 UE. So, if per-BWP granularity is agreed, this solution can't work (i.e. total number of "set of resources" is 1).   Meanwhile, how to reselect resource pool is within RAN1 expertise. So, we suggest RAN2 to wait for conclusion of granularity first. |
| vivo | Yes | Regarding this “set of resources”, just as an example, if RAN1/RAN2 decides that the SL-specific consistent LBT failure detection is per resource pool, then the mode-2 UE needs to perform resource pool switching/reselection once the consistent LBT failure detection is triggered on one of the resource pools.  We are also fine to put this discussion on-hold, until the granularity of the SL specific consistent LBT failure is determined. |
| Xiaomi | See comments | We agree with CATT and Apple. Too early to discuss this issue. |
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In NR-U, there is an exceptional case where all the UL BWPs configured with PRACH occasions are experiencing the consistent LBT failure for the SpCell. In this case, MCG/SCG RLF will be declared in RRC. Some companies also mentioned this case for SL-specific consistent LBT failure, and mentioned PC5 RLF for unicast as an analogy. Whether such an operation is needed can also be confirmed among companies.

**Question 5-3:**  Do companies agree that when SL-specific consistent LBT failure has been triggered for ALL the “set of resources” configured for transmission, PC5 RLF can be triggered for unicast?

* *Note that the granularity of such “set of resources” depends on the granularity for SL-specific consistent LBT failure detection in Q3-1/3-2.*

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| **Company** | **Yes/No** | **Comment if any** |
| CATT | Yes |  |
| OPPO |  | Even though we are open to this direction, we feel it is too early to discuss this, we may need to see the output of granularity first to progress on this aspect. |
| Apple | No | This proposal doesn't make sense at least for Mode-1 UE case (in Q5-1). If this proposal is agreed and Model-1 UE is agreed to report LBT failure info to gNB, then it will mean consistent SL LBT failure == SL RLF. We believe the intention of Mode-1 UE reporting LBT failure info is to allow gNB to recover its failure in AS layer (e.g. handover to another cell) instead of declaring PC5 RLF directly.  For Mode-2 UE, we have similar view of Q5-2 that we should wait for conclusion of granularity. |
| vivo | Yes |  |
| Xiaomi | See comments | Agree with OPPO. We should wait until we have conclusion on the granularity of the consistent LBT failure detection. |
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# Conclusions

# References

1. R2-2209386 Discussion on LBT impact in SL-U OPPO discussion Rel-18 NR\_SL\_enh2
2. R2-2209464 Discussion on RAN2 aspects for SL-U vivo discussion
3. R2-2209535 Discussion on LBT for SL-U Huawei, HiSilicon discussion Rel-18 NR\_SL\_enh2
4. R2-2209612 Discussion on RAN2 aspects in SL-U LG Electronics France discussion Rel-18 NR\_SL\_enh2
5. R2-2209678 Discussion on RAN2 scope of SL-U ZTE Corporation, Sanechips discussion Rel-18 NR\_SL\_enh2
6. R2-2209679 Discussion on CAPC definition and consistent sidelink LBT failure handling ZTE Corporation, Sanechips discussion Rel-18 NR\_SL\_enh2
7. R2-2209738 MAC related aspects for SL-U Intel Corporation discussion Rel-18 NR\_SL\_enh2
8. R2-2209743 Discussion on the SL-U Scenarios and LBT CATT discussion Rel-18 NR\_SL\_enh2
9. R2-2209762 User plane aspects of sidelink on unlicensed spectrum (SL-U) Apple discussion Rel-18 NR\_SL\_enh2
10. R2-2209936 Discussion on LBT impact to MAC for NR SL-U Lenovo discussion Rel-18
11. R2-2209973 Consideration on channel access priority in SL-U Spreadtrum Communications discussion Rel-18
12. R2-2209996 LBT failure handling for SL-U Spreadtrum Communications discussion Rel-18
13. R2-2210002 Discussion on consistent LBT failure for SL-U NEC discussion Rel-18 NR\_SL\_enh2
14. R2-2210249 Aspects of channel access mechanisms Ericsson discussion Rel-18 NR\_SL\_enh2
15. R2-2210257 LBT Impacts to the MAC Layer InterDigital discussion Rel-18 NR\_SL\_enh2
16. R2-2210281 Discussion on sidelink LBT impact Qualcomm India Pvt Ltd discussion
17. R2-2210366 Discussion on RAN2 Aspects in SL-U Fraunhofer IIS, Fraunhofer HHI discussion Rel-18 NR\_SL\_enh2
18. R2-2210380 Discussion on LBT for sidelink operation on unlicensed spectrum Xiaomi discussion NR\_SL\_enh2
19. R2-2210588 Discussion on sidelink un-licensed ITL discussion Rel-18

1. The question has no intention to determine the specific variable/parameter names. Those names in “e.g.” are just examples for readers’ better understanding on the counterparts in NR-U each of these SL-specific ones intends to imitate. [↑](#footnote-ref-1)
2. Note that whether SL-specific consistent LBT failure is triggered **per [X]** is pending the conclusion of Question 3-1/3-2. So a high-level description is formulated here w/o including the granularity detail. [↑](#footnote-ref-2)