

Agenda Item: 6.2.2.2

Source: OPPO

Title: Uplink LBT failure recovery for NR-U

Document for: Discussion, Decision

1 Introduction

In RAN2#105bis meeting, RAN2 agreed to introduce a mechanism to handle UL LBT failure:

- ⇒ **Adopt a mechanism in MAC spec to handle the UL LBT failure, where “consistent” UL LBT failures (at least for UL transmissions of SR, RACH, PUSCH) are used for problem detection**

In RAN2#107 meeting, further agreements on the UL LBT failures have been agreed:

- ⇒ **L2 LBT failure mechanism take into account any LBT failure regardless UL transmission type.**
- ⇒ **The UL LBT failure mechanism will have the same recovery mechanism for all failures regardless UL transmission type**

Baseline Mechanism, further enhancements not precluded:

- ⇒ **A “threshold” for the maximum number of LBT failures which triggers the “consistent” LBT failure event will be used.**
- ⇒ **Both a timer and a counter are introduced, the counter is reset when timer expires and incremented when UL LBT failure happens**
- ⇒ **The timer is started/restarted when UL LBT failure occur.**

Chair summary on the baseline mechanism: The BFD inspired mechanism seems to be supported by many, but there is also some concerns. Agree it as a baseline mechanism to allow further review later, to understand whether further enhancements are needed.

- ⇒ **UL LBT failures are detected per BWP**
- ⇒ **The UE will report the occurrence of consistent UL LBT failures on PSCell and SCells. The assumption is to reuse SCell failure reporting for BF**

In this contribution, we discuss the left issues on the uplink LBT failure, mainly about the recovery behaviours.

2 Discussion

2.1 UL LBT failures on PSCell and SCell(s)

According to the agreements in last meeting, RAN2 concludes that the UL LBT failure are detected per BWP. The UL LBT failure mechanism will have the same recovery mechanism for all failures regardless of UL transmission type.

Furthermore, it's agreed that the UE will report the occurrence of consistent UL LBT failures on PSCell and SCells. The assumption is to reuse SCell failure reporting for beam failure.

For SCell failure reporting for beam failure, in eMIMO, it was agreed that UE can trigger a MAC CE to indicate SCell beam failure. The details contents of the triggered MAC CE is still under discussion in RAN2, however according to the LS from RAN1 R2-1908613, the MAC CE would need to convey new beam information and failed SCell(s) information.

Here, for uplink LBT failure reporting for PSCell and SCells, it seems the MAC CE used for SCell beam failure can not be reused due to the following reasons:

- Network may not differentiate whether the UE has uplink LBT failure or SCell beam failure if the MAC CE for SCell beam failure is received.
- UE does not need to report the new beam information for uplink LBT failure reporting for PSCell and SCell(s);
- The SCell beam failure MAC CE format is still on-going discussion, NR-U can not wait until the eMIMO has a concrete conclusion on the SCell beam failure MAC CE.

Observation 1 SCell beam failure MAC CE can not be re-used for reporting UL LBT failure for PSCell and SCell(s) in NR-U.

In NR-U, instead, we would need to discuss the mechanisms on how to report UL LBT failure for PSCell and SCell independent of what's being discussed in SCell beam failure reporting in eMIMO.

Basically, there are two options:

Option1: UE triggers a new MAC CE containing the serving cell index with UL LBT failure.

The MAC CE will not reuse the MAC CE for SCell beam failure recovery. Then, similar as the discussion in SCell beam failure, RAN2 need to discuss the following issues:

- Whether the triggered MAC CE can be transmitted on any available uplink grants including the one which triggers the UL LBT failure?
- Whether there is a dedicated SR configured for requesting uplink grant if there is no available uplink grants for the MAC CE?
- Whether the MAC CE can contain multiple serving cells if they have UL LBT failure?

It should be noted that those questions are also sent to RAN1 during the eMIMO discussion and RAN2 still waits for the response from RAN1. Here for NR-U discussion, RAN1 may not be involved since UP LBT failure mechanisms are mainly designed in RAN2.

Observation 2 Several issues similar as SCell beam failure reporting need to be solved if UE triggers MAC CE for PSCell and SCell UL LBT failure reporting.

Option2: Re-use SCG failure information procedure and failure information procedure for PSCell and SCell UL LBT failure reporting.

If RAN2 does not want to handle all those open issues for the option 1, there is another alternative which is to reuse the SCG failure information procedure for PSCell UL LBT failure reporting and failure information procedure for SCell UL LBT failure reporting.

To us, the remaining issues may be limited and we don't need to define new procedure nor new MAC CE format.

For reusing failure information procedure to report SCell UL LBT failure, RAN2 may need to discuss to add a new failure type in the failure information message, and then the serving cell index which has the UL LBT failure should also be included.

For reusing the SCG failure information procedure, similar as that for failure information procedure, the new failure type may need to be added.

Observation 3 By re-using SCG failure information procedure and failure information procedure for PSCell and SCell UL LBT failure reporting, it will have less issues than re-using SCell beam failure reporting.

Proposal 1 RAN2 considers to reuse SCG failure information procedure and failure information procedure for PSCell and SCell UL LBT failure reporting.

2.2 UL LBT failures on PCell

The left issue from last meeting was how to handle the UL LBT failure on PCell.

For PCell, considering large bandwidth supported in NR and multiple BWPs configuration supported by the UE, it may not be a good option to trigger RLF immediately once UL LBT failure detected on a UL BWP of the PCell, which might be just a portion of the supported wide bandwidth.

Observation 4 It's not preferable to trigger RLF immediately upon UL LBT failure is declared.

There should be several cases to be discussed upon UL LBT failure on PCell:

If there is only one UL BWP configured for the UE, i.e., the initial UL BWP, the UE would not have any choice but just trigger RLF when UL LBT failure is detected.

Proposal 2 If the UE is configured with only one UL BWP, i.e., the initial UL BWP, UE triggers RLF upon UL LBT failure declared on the UL BWP.

However, if the UE is configured with multiple UL BWPs, and each with different overlapped LBT subband. Then, the UE may have other choices than triggering RLF immediately. For example, it can try at least other UL BWP which configures with RACH resources.

From simplicity point of view, it would be good to allow the UE try another UL BWP, at least the UL initial BWP, if the UL LBT failure is declared on a non-initial UL BWP.

Proposal 3 If UL LBT failure is triggered on a non-initial UL BWP, UE triggers BWP switching and initiates RACH procedure on the initial UL BWP.

3 Conclusion

Based on the discussion in section 2 we propose the following:

Observation 1 SCell beam failure MAC CE can not be re-used for reporting UL LBT failure for PSCell and SCell(s) in NR-U.

Observation 2 Several issues similar as SCell beam failure reporting need to be solved if UE triggers MAC CE for PSCell and SCell UL LBT failure reporting.

Observation 3 By re-using SCG failure information procedure and failure information procedure for PSCell and SCell UL LBT failure reporting, it will have less issues than re-using SCell beam failure reporting.

Observation 4 It's not preferable to trigger RLF immediately upon UL LBT failure is declared.

Proposal 1 RAN2 considers to reuse SCG failure information procedure and failure information procedure for PSCell and SCell UL LBT failure reporting.

Proposal 2 If the UE is configured with only one UL BWP, i.e., the initial UL BWP, UE triggers RLF upon UL LBT failure declared on the UL BWP.

Proposal 3 If UL LBT failure is triggered on a non-initial UL BWP, UE triggers BWP switching and initiates RACH procedure on the initial UL BWP.