

Agenda Item: 8.8.2 - LTE Rel-14: WI: L2 latency reduction techniques

Source: ASUSTeK

Title: Discussion on skipping UL grants

Document for: Discussion

1. Introduction

The following are two objectives of work item of latency reduction.

- Introduction of short SPS period to allow UL prescheduling
- Reduction of padding in case of dynamic and SPS based UL pre-scheduling to reduce interference and UE power consumption

In TR 36.881, it has been studied that

In current specifications, the UE sends a MAC PDU containing a MAC CE for padding BSR and optionally padding bits in response to an allocated UL dynamic or configured grant even if no data is available for transmission in the UE buffer and no other regular MAC CE is needed to be sent. It is beneficial to [allow UEs to skip \(most\) dynamic and configured uplink grants](#) if no data is available for transmission. With frequent UL grants, allowing skipping UL grants may decrease UL interference and improve UE battery efficiency. The UE will continue to send one or more regular MAC CE(s), if any. The eNB may enable skipping UL grants by RRC dedicated signalling.

In this document, we will discuss some factors UE need to consider whether to skip the uplink grant if no UL data available for transmission.

2. Discussion

2.1 MAC Control Elements (CE)

There are several types of MAC CE, BSR, Sidelink (SL) BSR, and PHR in the current MAC spec. The following table provides some simple analyses for all of them.

	Does a UE skip an UL grant if no UL data available for transmission but a MAC CE is triggered ?	
	Skip	Not Skip
Regular BSR		V Since there is new data coming or some unexpected errors happened (i.e. <i>retx-BSR-Timer</i> expired).
Periodic BSR	V Since it might be frequent.	
Padding BSR	V Since it is frequent.	

Regular SL BSR		V Similar to Regular BSR.
Periodic SL BSR	V If there is <u>no</u> SL data available for transmission	V If there is SL data available for transmission
Padding SL BSR	V Similar to Padding BSR.	
PathlossChange PHR		V It is better to let eNB know that something is changed. Besides, it seems not frequent.
Periodic PHR	V Similar to Periodic BSR.	
Other PHR (e.g. SCell activation, PSCell addition, etc.)		V These events are not frequent so it should be fine not to skip.

Table 1

Proposal 1: Discuss whether a UE needs to skip an UL grant if no UL data available for transmission but a **MAC CE in Table 1 is triggered.**

2.2 Uplink Control Information (UCI)

In the current MAC spec, a UE would always send a Transport Block (TB) on PUSCH upon reception of an UL grant (i.e. dynamic or pre-configure SPS). If there is some Uplink Control Information (UCI) (e.g. CQI or HARQ ACK) occurring in the same TTI, UE could multiplex the UCI into PUSCH together with a TB. Therefore, it needs to be discussed if a UE should skip a UL grant if there is UCI occurring in the same TTI.

Proposal 2: Discuss whether a UE needs to skip a UL grant if no UL data available for transmission but there is **UCI needed to be sent in the same TTI.**

2.3 Collision between Non-Adaptive HARQ Retx and the configured SPS grant

If short SPS period is configured (e.g. 2 ms), a non-adaptive HARQ retransmission would always collide with a pre-configured SPS UL grant, which means there is no HARQ retransmission opportunities.

One example as shown in Table 2, SPS period of 2 ms is configured and Data 1 is coming at TTI 2. If Data 1 was not decoded successfully, it should be non-adaptive retransmitted at TTI 10. However, Data 2 may be available at TTI 9 and will be transmitted at TTI 10, which collides with the retransmission of Data 1. According to the current MAC spec, Data 2 will be sent at TTI 10 and it is not possible to retransmit Data 1, which means Data 1 is missing in this case.

eNB																			
			↑		↑		↑		↑		↑		↑		↑		↑		↑
UE			Data 1						Data 2	?									
TTI	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
↑ : Pre-configured SPS UL grant (i.e. New transmission) ↑ : Non-Adaptive HARQ Retransmission																			

Table 2

Several options can solve this issue.

1. Non-adaptive HARQ Retx is prioritized over pre-configured SPS grant. (i.e. Skipping UL grant)
2. Using asynchronous UL HARQ operation.
3. Releasing UL SPS if any data uses the pre-configured SPS grant.

Proposal 3: Discuss whether a UE needs to skip a pre-configured UL grant if it was collided with a non-adaptive HARQ retransmission.

3. Conclusion

In this document, we further discuss yyy

Proposal 1: Discuss whether a UE needs to skip an UL grant if no UL data available for transmission but a MAC CE in Table 1 is triggered.

Proposal 2: Discuss whether a UE needs to skip a UL grant if no UL data available for transmission but there is UCI needed to be sent in the same TTI.

Proposal 3: Discuss whether a UE needs to skip a pre-configured UL grant if it was collided with a non-adaptive HARQ retransmission.

Reference