

Agenda Item: 7.11
Source: Samsung
Title: Skipping uplink transmission with no data to transmit
Document for: Discussion

1 Introduction

Pre-scheduling is considered as one of the promising solutions for latency reduction. This contribution discusses the problem of the pre-scheduling in terms of battery consumption, and proposes to enhance the UE behaviour to mitigate the problem.

2 Discussion

2.1 The problem of pre-scheduling in the current specification

In pre-scheduling solution, ENB schedules uplink resource for a UE without knowing the buffer status of the UE, which leads to allocating uplink resource to a UE without data to transmit. Current specification mandates UE to produce and transmit a padding MAC PDU even in such case.

In terms of latency reduction, for pre-scheduling scheme to be effective, uplink resource should be granted with very short interval. On the other hands, if UE runs TCP applications or web applications, uplink data will occur infrequently. All these just suggest that there will be continuous padding MAC PDUs which would drain UE battery quickly. Straightforward solution would be to allow UE to skip uplink transmission if no data is available for transmission.

Proposal 1: To allow UE to skip uplink transmission if no data is available for transmission

2.2 Solution to mitigate the problem of pre-scheduling

Legacy behaviour of transmitting padding PDU was specified due to following reasons.

1. Transmitting padding PDU is beneficial to uplink power control point of view. Padding PDU is just a normal PDU in HARQ operation. If UL transmission is skipped without ENB knowing it, ACK/NACK statistics should be adjusted accordingly
2. Implicit SPS release mechanism is designed based on padding PDU transmission.

It would be necessary for ENB to know whether UE having no data to transmit will skip uplink transmission or sending padding PDU. At least legacy ENB would expect uplink transmission always taken place if uplink resource is granted. In that sense, UE should behave according to legacy rule (i.e. sending padding PDU) in the legacy network.

Proposal 2: To introduce a singling mean to indicate whether UE is allowed to skip uplink transmission if no data is available for transmission

In the implicit SPS release mechanism, UE autonomously release UL SPS after transmitting *implicitReleaseAfter* padding PDUs. If UE skips uplink transmission instead of transmitting padding PDU, the implicit SPS release mechanism does not work.

One way to keep implicit release mechanism working would be to apply 'skipping uplink transmission' only for dynamic scheduling and to apply 'transmitting padding PDU' for SPS scheduling. Implicit SPS release is to ensure that UE having missed SPS release command does not misuse SPS resource continuously. If 'skipping uplink transmission' is configured, such UE would anyway not use SPS resource; hence no real need for implicit release mechanism exists if 'skipping uplink transmission' is configured.

Proposal 3: *To not enhance implicit release mechanism for pre-scheduling scenario (i.e. if 'skipping uplink transmission' is configured, UE without data to transmit skips uplink transmission regardless of whether it is by the dynamic grant or by the configured grant).*

If Proposal 3 is agreed, the consequence would be that implicit SPS release is simply disabled when 'skipping uplink transmission' is configured, because padding MAC PDU will not be produced anymore. There is no impact toward any specification w.r.t this aspect.

2.3 Impact to the specification

Table 1 summarize the possible specification impact to introduce 'skipping uplink transmission when no data to send'.

<Table 1>

Specification	Description on the change/impact
36.331	New IE <i>SkipUplinkTransmission</i> to indicate that UE shall skip uplink transmission if there is no data to transmission except padding BSR
36.321	Section 5.4 should be updated so that UE does not transmit UL-SCH if <i>SkipUplinkTransmission</i> is configured and there is no data to transmit.

Draft CRs are in [1] and [2].

3 Suggestion

Followings are proposed;

Proposal 1: *To allow UE to skip uplink transmission if no data is available for transmission*

Proposal 2: *To introduce a singling mean to indicate whether UE is allowed to skip uplink transmission if no data is available for transmission*

Proposal 3: *To not enhance implicit release mechanism for pre-scheduling scenario (i.e. if 'skipping uplink transmission' is configured, UE without data to transmit skips uplink transmission regardless of whether it is by the dynamic grant or by the configured grant).*

Draft CRs for 36.321 and 36/331 are in [1] and [2].

Reference

- [1] R2-153333 Skipping uplink transmission with no data to transmit (321 CR)Samsung
- [2] R2-153334 Skipping uplink transmission with no data to transmit (331 CR)Samsung