

Agenda Item : 8.8.2
Source : Huawei, HiSilicon
Title : PUSCH resource waste in case of short SPS period
Document for : Discussion and Decision

1. Introduction

In RAN#71, a new work item on L2 latency reduction techniques for LTE was approved [1], and one of the objectives was as follow:

- *Introduction of short SPS period to allow UL prescheduling*

In RAN2#93bis, the following agreement on short SPS period was made [2]:

- *FFS what SPS periodicity values other than 1ms should be introduced*

In respect of the objective of introducing short SPS period, there are still quite some open issues to discuss. In this contribution, we will discuss the issue of PUSCH resource waste after the introduction of short SPS period for pre-scheduling.

2. Discussion

Once the short SPS period of 1ms is introduced, it means UE has uplink PUSCH resources in every subframe. This will certainly reduce latency of the first UL transmission. However, for most traffics, data arrival interval is longer than 1ms, e.g. for gaming, the average data arrival interval is around 40ms. Then, UE will have no data available for transmission on many subframes with pre-allocated SPS resources. In other words, many pre-allocated PUSCH resources will be wasted. Generally, we can calculate the total amount of wasted PUSCH resources with different SPS periods using the following Formula:

$$N_{PUSCH \text{ wasted}} = \frac{P_{DATA}}{P_{SPS}} - 1, \quad (1)$$

Wherein, $N_{PUSCH \text{ wasted}}$ is the number of wasted PUSCH resources between two consecutive packet transmissions, P_{DATA} is the average packets inter-arrival time and P_{SPS} is the SPS period.

And accordingly, the PUSCH resource efficiency E_{PUSCH} , which represents the ratio of PUSCH resources with packet transmission to total allocated PUSCH resources between two consecutive packet transmissions, can be calculated as follows:

$$E_{PUSCH} = \frac{P_{SPS}}{P_{DATA}}, \quad (2)$$

Assuming P_{DATA} is 40ms, Figure 1 shows the wasted PUSCH resources N_{PUSCH} with different SPS periods, and Figure 2 shows the PUSCH resource efficiency E_{PUSCH} with different SPS periods.

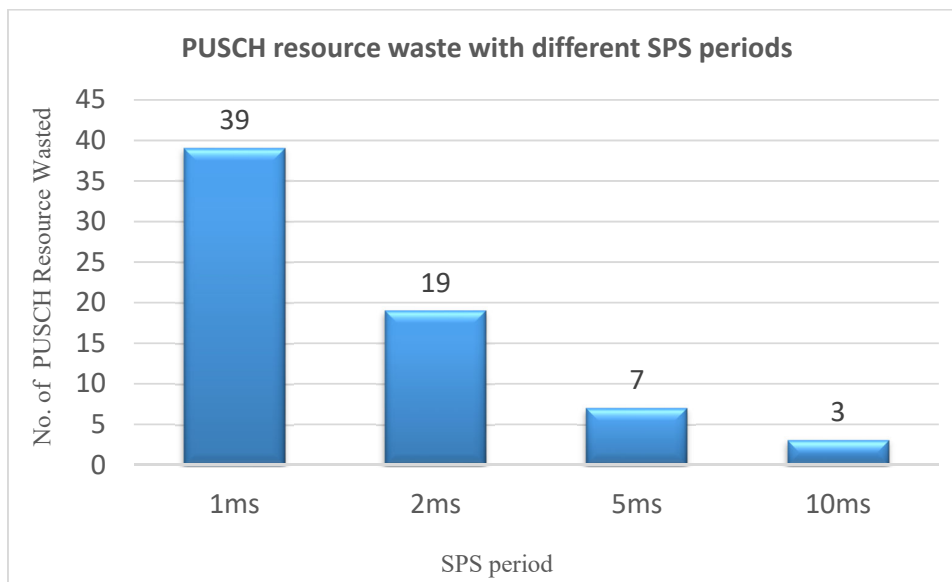


Figure 1: PUSCH resource waste with different SPS periods

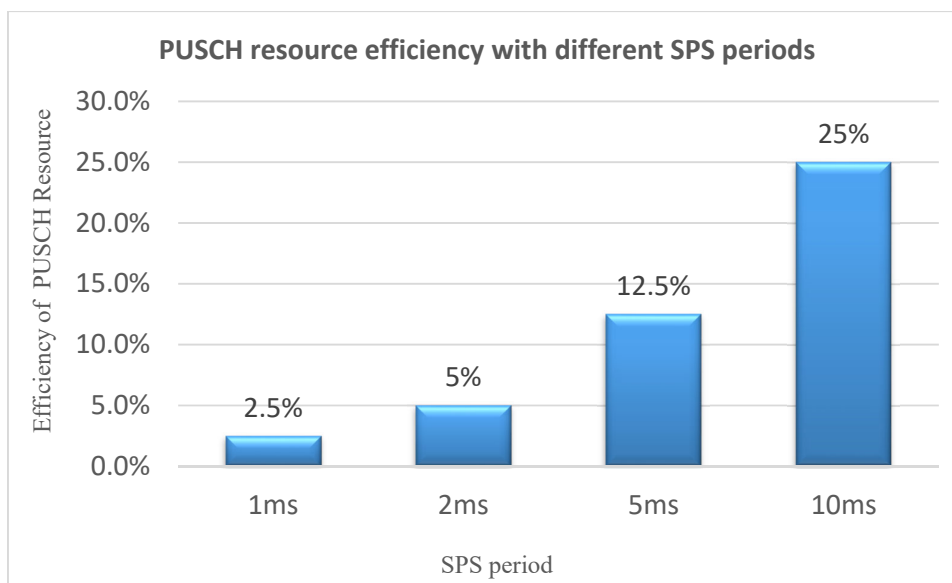


Figure 2: PUSCH resource efficiency with different SPS periods

Observation: Shorter SPS period may lead to PUSCH resource waste and the PUSCH efficiency is very low.

As short SPS period for pre-schedule is necessary to be introduced to reduce the latency, we should try to solve the PUSCH resource waste problem caused by it. The contention-based PUSCH transmission mechanism as captured in [3] is one promising solution. We are also open to other solutions.

Proposal: The PUSCH resource waste problem needs to be solved.

3. Conclusion

In this contribution, we discussed the PUSCH resource waste problem caused by shorter SPS period. Based on the discussion, we propose:

Proposal: The PUSCH resource waste problem needs to be solved.

4. Reference

[1] R2-160667, WI for L2 latency reduction techniques for LTE; Ericsson

[2] R2-163056, V2V_V2X_D2D_LATRED_RAN2#93bis_notes_(draft R2-163056) _15_04_09-50

[3] TR36.881, Study on latency reduction techniques for LTE