TSG-RAN Working Group 2 (Radio layer 2 and Radio layer 3)
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Title: **Traffic Volume Measurements**

Document for: Decision

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1 Introduction

This document describes how the traffic should be measured in the UE in order to support transport channel switching and network optimisation. Since we have both a common and a dedicated type of transport channels it is essential for the system capacity that the network has full control of when and why a UE should use one or the other of these types of channels.

This paper also describes how the measurements will be done and what quantity to use for payload in buffers.

2 Discussion

For Traffic Volume measurements there are two important factors. First the network has to be able to react fast when the UE has uplink data to transmit. Second, there must be means for the network to limit the amount of measurement reports sent from the UE.

Currently there are two ways to send a traffic volume measurement report, periodical and event triggered. Immediate reporting or one-shot measurements are considered to be periodical reports with only one report. In both cases the UE sends a measurement report to the network containing the RLC buffer payload as a measure for the expected UL traffic. The network evaluates this payload and has several methods to meet the demands for capacity. For UEs on common channels a switch to a dedicated channel could increase the throughput. Another way is to allow a transport format with higher bitrate. The latter is mostly used on a dedicated channel but is also applicable on a common channel where several different bitrates could be allowed.

In order for the MAC layer to choose the appropriate Transport format combination for each frame there must be a close interaction between MAC and RLC. The current load situation, i.e. payload in each RLC buffer must be known at all times in MAC.
Further, since a traffic volume measurement report should be possible to be triggered on transport channel level it is necessary for this measurement to be performed in MAC. Otherwise the knowledge of MAC multiplexing must be transferred up to RLC.
It is in 25.301 [1] stated that the Traffic volume monitoring is one of the MAC functions. Traffic volume is then evaluated in RRC, which sends a measurement report to the network if the measurement reporting criteria is fulfilled. RRC in the network uses this report as a basis for e.g. transport channel type switching or for re-evaluating the used transport formats.

3 Measurements of RLC buffer payload

Several different measures could be used for traffic volume or RLC buffer payload. One way could be to count the number of payload units in the RLC buffers. This could have some benefits since it is a common measurement for all UEs regardless of what bitrates (i.e. different sizes on their RLC payload units) they use.
For a UE that uses a common channel it is also most likely that all transport channels uses the same sizes on the RLC payload units. So for UEs that switches between common transport channel and dedicated transport channel this measure will not cause any problem. However, for a UE that only uses a dedicated transport channel it is not required that the payload units from different RLC entities uses the same sizes on the payload units. This will then cause a problem if a UEs total RLC buffer payload is to be measured.
Therefor, and to have a general measure for all UEs it is here proposed that the traffic volume payload quantity should be number of bytes. This is also the intuitive most natural way to describe RLC buffer payload.

3.1 Traffic Volume Measurement quantity

For traffic volume measurements in the UE only one quantity is measured. This quantity is RLC buffer payload in number of bytes. In order to support a large variation of bitrates and RLC buffer size capabilities, a non-linear scale should be used *[Note: Details are FFS]*. Since, the expected traffic includes both new and retransmitted RLC payload units all these should be included in the payload measure. It should also be noted that traffic volume measurements are only applicable for acknowledged and unacknowledged mode.
According to what is stated in the Measurement Control message, the UE should support measuring buffer payload for a specific RAB, RABs multiplexed onto the same Transport channel and the total UE buffer payload (the same as one transport channel for a UE that uses RACH).

3.2 Traffic Volume reporting events

Traffic volume can be reported in two different ways, periodical and event triggered. For periodical reporting the UE simply measures the number of bytes for the transport channel (i.e. the RLC buffers of the RABs multiplexed onto that transport channel) stated in the measurement control message and reports the traffic volume at the given time instants. For event triggered reporting, exceeding a threshold triggers the report.
What reporting quantities that should be included in the report is stated in the measurement control message. This could e.g. be which RABs or RLC buffers to include when sending the payload to the network.

3.2.1 Reporting event 4 A: RLC buffer payload exceeds an absolute threshold

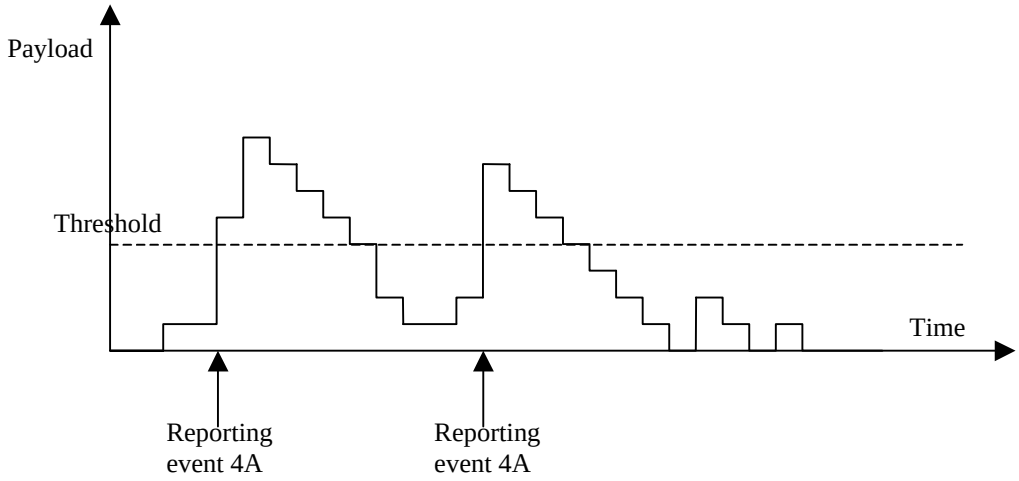

Figure 1: Event triggered report when RLC buffer payload exceeds a certain threshold.

If the monitored payload exceeds an absolute threshold, this is an event that could trigger a report. The corresponding report contains at least what transport channel that triggered the report.

4 Means to limit amount of reporting

When using periodical measurement reporting the network sets the reporting periodicity. The periodicity value is a trade-off between how fast the network gets a rapid change of RLC buffer payload and the amount of sent measurement reports. Anyhow the network has full control of the amount of signalling overhead that is created by these reports.
When using event triggered measurement reports, the UE sends a measurement report when there is a large amount of UL data to be sent (RLC buffer payload threshold exceeded). Since it is the exceeding of the threshold that is reported, an increase of the buffer payload is reported only once. However, the buffer payload can fluctuate around this threshold and by that cause the triggering several times. There is also a possibility that different transport channels during a short time period trigger a measurement report to be sent.
Hysteresis and time to trigger are two ways to solve this. However, hysteresis is not that effective since it is common that traffic increases fast and decreases slowly, and it is most important to know when the traffic increases. It is therefor better to increase the threshold instead of using hysteresis. Time to trigger could also be useful for traffic that fluctuates. However, this will give the same trade-off as pure periodical reporting. The fast changes can not be detected fast enough or the measurement reports can appear too frequently.
It is here proposed to use time-to-trigger and a pending time after trigger. The latter is only to limit consecutive reports and does not delay the first report. This is because if the network take actions (e.g. transport channel type switching or assigning new transport formats) regarding the increased demand of uplink capacity for a UE, it is unnecessary for the UE to send more reports that further will limit the user data throughput on the uplink channel.

4.1 Traffic volume reporting mechanisms

Traffic volume measurement triggering could be associated with both a *time-to-trigger* and a *pending time after trigger*. The time-to-trigger is used to get time domain hysteresis, i.e. the condition must be fulfilled during the time-to-trigger time before a report is sent. Pending time after trigger is used to limit consecutive reports when one traffic volume measurement report already has been sent. This is described in detail below.

4.1.1 Pending time after trigger

This timer is started in the UE when a measurement report has been triggered. The UE is then during this time period forbidden to send any new measurement reports with the same measurement ID although the triggering condition is fulfilled again. Instead the UE waits until the timer has suspended. If the payload still is above the threshold when the timer has been suspended, the UE sends a new measurement report. Otherwise it waits for a new triggering.

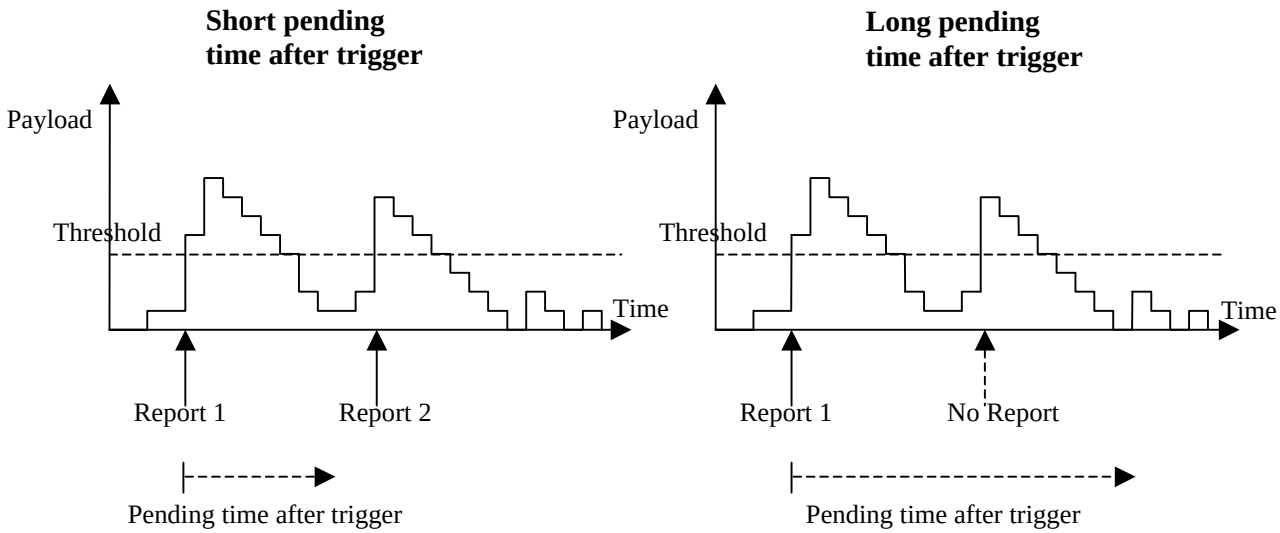

Figure 2. Pending time after trigger limits the amount of consecutive measurement reports.

In Figure 2 it is shown that by increasing the pending time after trigger a triggered second event does not result in a measurement report.

5 Proposal

It is proposed to include section 3.1, 3.2 and 4.1 into chapter 15 of 25.331 [2]. It is also proposed that a new parameter *pending time after trigger* is included in the traffic volume measurement control message.

6 References

[1] 3GPP TS 25.301, v 2.0.0 : Radio Interface Protocol Architecture
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[2] 3GPP TS 25.331, v 1.0.0 : RRC Protocol Specification
Source: Editor