

Source: Ericsson  
Title: Filtering for UE Power Headroom Measurement  
Agenda Item: 9.2  
Document for: Discussion and Decision

## 1. Introduction

At the RAN1#42 meeting in London, UK, 29 Aug – 02 Sept 2005, RAN1 discussed the UE power headroom measurement.

The result of this discussion is that the UE power headroom measurement is defined as:

UE transmission power headroom (UPH) is the ratio of the maximum UE transmission power and the corresponding DPCCCH code power, and shall be calculated as following:

$$UPH = P_{\max,tx} / P_{DPCCCH}$$

where:

$P_{\max,tx} = \min \{ \text{Maximum allowed UL TX Power, } P_{\max} \}$  is the UE maximum transmission power;

Maximum allowed UL TX Power is set by UTRAN and defined in TS 25.331;

$P_{\max}$  is the UE nominal maximum output power according to the UE power class and specified in TS 25.133 table 6.1;

$P_{DPCCCH}$  is the transmitted code power on DPCCCH.

The exact definition is specified in RAN1 Specification [4].

This contribution discusses Layer 3 filtering for the UE Power Headroom measurement and includes proposals for text in applicable specifications.

## 2. Discussion

The UE physical layer measures the UE Power Headroom on a slot basis; after filtering over a measurement period, e.g. 2ms, the measurement is delivered to higher layers. After some processing by the UE, the UPH information is further sent to the node B together with other control information (Figure 1).

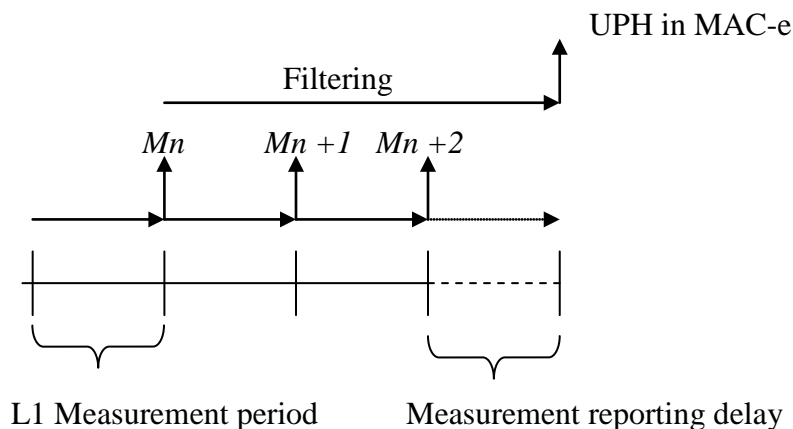


Figure 1 UPH Measurement and reporting - illustration

The UPH information bits are sent in the Scheduling Information, SI, appended at the end of the MAC-e PDU. The periodicity of the Scheduling Information sent to node B is defined in the order of TTI, with 1 TTI as the shortest report period and is configurable through RRC signaling. Note that apart from the configurable periodicity, the inclusion of SI can be made arbitrarily, if for instance padding allows it or if triggered by higher priority data entering the UE buffer.

The UE should include the latest measurement to the network. It is in e.g. [2] proposed to specify the minimum requirements for a UPH measurement reporting delay, which is defined as the maximum time between the end of the UPH measurement and the start of the UPH measurement reporting.

From a RAN2 point of view the question is what kind of filtering that would be required in order to accommodate the requirements from RAN4 specifications using the current definition of UPH.

In RAN4 the topic has been discussed [1], [2], and it is expected that requirements will be defined with regards to:

- Layer-1 filtering (e.g. measurement period)
- Accuracy requirements (e.g. Value range -> Number of bits)
- Impact of compressed mode
- Measurement Reporting Delay

While it still remains to be decided on many of these points, the basis for defining the Layer 3 filtering in RAN2 can still be made:

- Layer-1 filtering: Processing/filtering is executed at the end of a L1 measurement period as defined in [5]. The proposed layer 3 filtering can be defined independently of this.
- Accuracy: The value range (i.e. number of bits) and accuracy for UPH is defined in RAN4[5]. A proposal [2] having 5 bits is discussed. A separate CR for User Control Data should be discussed in RAN2 [6].
- Impact of compressed mode: No measurement will be reported from the physical layer [2]. The proposed filtering can be defined independently of this.
- Measurement Reporting Delay: Requirements in [5]. The proposed filtering can be defined independently of this.

This means that in order to specify the filtering, parameters in 25.321 and filtering coefficient in 25.331, it has been identified the following considerations remain:

- Assuming that the Physical layer delivers a measurement  $M_n$  at the end of each measurement period and filtering is according to section 8.6.7.2 in 25.331 (see Annex A), the options to consider for the filtering coefficient(s) are:
  - The filtering coefficient is a fixed value
  - Is signaled by RRC
  - Is defined by the periodicity (RRC signaled) of the Scheduling Information

Now, considering the options above. If a fixed value is used this does not take into account the dependability on a static vs. dynamic environment, the number of measurements from L1 (periodicity of SI) and so on. For this case one would need to simulate and evaluate what typically the coefficients would be.

From this point of view it would be an advantage of allowing for “tuned” coefficients depending on the operation of the NW and the actual use of user control information. Having a UE internal scheme with a coefficient depending on the periodicity of the SI could be one option, but then it would require the UE, apart from other issues like testing, store a table with corresponding values and adds to the complexity of the filtering.

**Proposal:** It is proposed that the layer 3 filtering coefficient(s) is signaled in RRC and is based on the existing requirements in 3GPP TS 25.331 as outlined in this document and accompanied CR [6].

### 3. Conclusion

It is proposed that RAN2 discusses the issue and decides on the inclusion of the Layer 3 filtering coefficients in 25.331. The outcome could be reported back to RAN4 for feedback.

## 4. References

- [1] R4-050936 UE power headroom, MAC filtering and way forward, Panasonic
- [2] R4-051125, Requirements for UE Power Headroom, Ericsson
- [3] R2-052462 LS on UE power headroom measurement
- [4] 3GPP TS 25.215, 'Physical Layer - Measurements'.
- [5] 3GPP TS 25.133: "Requirements for Support of Radio Resource Management (FDD)".
- [6] Proposed CR to 25.331 [Rel-6] on UE power headroom, Ericsson

## Annex A - Text reproduced from 3GPP 25.331

--- Omitted text ---

### 8.6.7.2 Filter coefficient

If the IE "Filter coefficient" is received the UE shall, depending on the measurement quantity (see Table 8.6.7.2), apply filtering of the measurements for that measurement quantity according to the formula below. This filtering shall be performed by the UE before UE event evaluation. The UE shall depending on the reporting quantity (see Table 8.6.7.2), also filter the measurements reported in the IE "Measured results". The filtering shall not be performed for the measurements reported in the IE "Measured results on RACH" and for cell-reselection in connected or idle mode.

The filtering shall be performed according to the following formula.

$$F_n = (1 - a) \cdot F_{n-1} + a \cdot M_n$$

The variables in the formula are defined as follows:

$F_n$  is the updated filtered measurement result

$F_{n-1}$  is the old filtered measurement result

$M_n$  is the latest received measurement result from physical layer measurements, the unit used for  $M_n$  is the same unit as the reported unit in the MEASUREMENT REPORT message or the unit used in the event evaluation.

$a = 1/2^{(k/2)}$ , where  $k$  is the parameter received in the IE "Filter coefficient".

NOTE: if  $k$  is set to 0 that will mean no layer 3 filtering.

In order to initialise the averaging filter,  $F_0$  is set to  $M_1$  when the first measurement result from the physical layer measurement is received.

The physical layer measurement results are sampled once every measurement period. The measurement period and the accuracy for a certain measurement is defined in [19] and [20].

Table 8.6.7.2 lists for all measurement quantities and reporting quantities if L3-filtering is applicable or not and used L3-filtering type for each measurement quantity.

**Table 8.6.7.2: L3 filtering applicable for each measurement quantity and reporting quantity**

Measurement- / Reporting quantity	L3-filtering applicable	Linear or logarithmic filtering	Comment
Pathloss	Yes	Log	
Cell synchronisation information	No	-	
Cell Identity	No	-	
Frequency quality estimate	No	-	Although the frequency

			quality estimate itself is not filtered, the inputs to the frequency quality estimate calculation (CPICH Ec/N0 or CPICH RSCP or P-CCPCH RSCP) are filtered
UTRA carrier RSSI	Yes	Log	
GSM carrier RSSI	Yes	Log	
UE transmitted power	Yes	Log	
FDD			
> UE Rx-Tx time difference	No	-	
> CPICH Ec/N0	Yes	Log	
> CPICH RSCP	Yes	Log	
TDD			
> Primary CCPCH RSCP	Yes	Log	
> Proposed TGSN	No	-	
> Timeslot ISCP	Yes	Log	
> TADV (1.28 Mcps TDD)	No	-	
> Applied TA (3.84 Mcps TDD)	No	-	

The UE shall support 2 different layer 3 filters per measurement type defined in subclause 8.4.0 (i.e. the UE shall be capable to apply at least 2 different L3 filters to intra-frequency measurement results, at least 2 different L3 filters to inter-frequency measurement results, etc.). If a MEASUREMENT CONTROL message is received that would require the UE to configure more than 2 different layer 3 filters, the UE may:

- 1> set the variable CONFIGURATION\_INCOMPLETE to TRUE.

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