TSG-RAN Meeting #24 **RP-020635**
Biarritz, France
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Agenda Item: **Item**
Source: **Motorola**
Title: **Unit of layer 3 filtering**
Document for: **Discussion**

1. Introduction

At RAN2#31, it became apparent that an ambiguity in 25.331 has resulted in different UE manufacturers making a different assumption as to whether the layer 3 filtering for CPICH RSCP, CPICH Ec/Io and path loss measurements is performed on the linear or logarithmic values.

RAN2#31 could not conclude in which direction the specification should be clarified. Consequently, 2 versions of the change request have been produced so that RAN can make the decision.

This paper discusses the differences between the use of logarithmic filtering (dB filtering) and linear filtering and makes a proposal for the way forward.

2. Discussion

The purpose of the standardised layer 3 filter is to give the network a means to fine tune the measurement reporting. Selection of the filter coefficient is a compromise between:

- The number of events triggered (and consequently the amount reporting over the radio interface)
- Response time for triggering a report

Figures 1-4 show the results of a very simple simulation, which is nevertheless also illustrative of the difference in behaviour between linear and logarithmic ("dB") filtering.

In all cases, the input to the averaging process is the observed power of a single-ray Rayleigh-fading process, observed at 1, 3, 30 and 120km/h respectively in Figures 1-4, assuming a carrier frequency of 1.9GHz. The simulation included a layer 1 filter which averaged the power over a 200ms measurement period. The sampling interval at the point after the layer 1 filter was 200ms as specified in the measurement model. The layer 3 filtering was performed using a single-pole IIR filter with coefficient $\alpha = 0.1$ – i.e. if the observed power process is *p(k)* the filtered output is given by:

$$y(k) = (1-\alpha)y(k-1) + \alpha p(k) \qquad (1.1)$$

In the figures, the filtered output identified as "dB Filtering", corresponds to the output $y(k)$ when *p(k)* is expressed in dB. The filtered output identified as "Linear Filtering" corresponds to expressing $y(k)$ in dB, after equation (1.1) is applied directly to the observed linear power observations.

It can be seen that –regardless of the velocity of the UE – the “dB-average” or dB filtering consistently under-estimates the true linear average of the power observations by between 1-2dB.

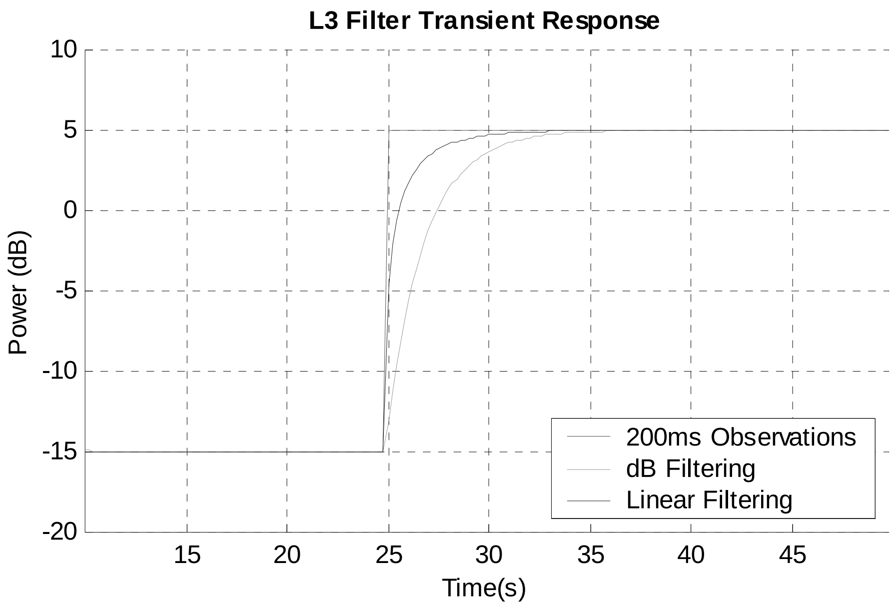
It is expected that this difference will be less apparent in the following cases:

1. For stationary or very slow moving mobiles;
2. With larger values of the filter coefficient;
3. In multipath channel conditions as opposed to the single path channel considered above. This is show by the simulation results for vehicular A channel model in figures 5 - 8.

Based on the illustration above, some comments can be made about the system impact of using “dB filtering” as opposed to true linear filtering:

1. The offset of up to 1-2dB between the linear filtered result and the dB filtered result is likely to have little impact on the triggering of events that are comparisons between different cells as all cells will be subject to a similar offset (for example, events 1a, 1b, 1c, 1d).
2. The offset will have some impact on the triggering of events that are a comparison between a cell measurement and an absolute threshold (for example, events 1e and 1f). Furthermore, as the offset caused by “dB filtering” is not apparent for stationary mobiles, the triggering of these events will have some dependency on whether the mobile is moving.
3. The offset will have an impact on the results reported to the network. As mentioned in point 2 above, the measurements will have some dependency on whether the mobile is moving.

Also provided is a "transient response" curve to *illustrate* the "corner effect" based on a 20dB power step to both filtering methods. It can be observed from this figure that the dB filtering has a slower response to a step change that logarithmic filtering.



Obviously, without extensive system simulations it is very difficult to determine if this will have a significant impact on system capacity, dropped calls, etc. Furthermore, the impact will be dependent on algorithms used within the network. If the purpose of the L3 is used primarily to provide statistical information for network planning this difference is not significant. If however this is used for some form of time critical RRM then the layer 3 filter always introduces some extra delay with the dB filter filtering performing worse in this respect.

It should also be indicated that the measurement performance requirements in RAN4 are currently specified with layer 3 filtering switch OFF.

3. Conclusions

This paper has described the difference in behaviour between dB filtering and linear filtering. It has been shown that for moving mobiles, dB filtering can produce an output that can underestimates the true linear average by up to 1-2dB.

It is recommended that the linear filtering should be used for the layer 3 filtering of CPICH RSCP, CPICH Ec/Io and path loss measurements, and RAN should agree CR 1517r1to 25.331

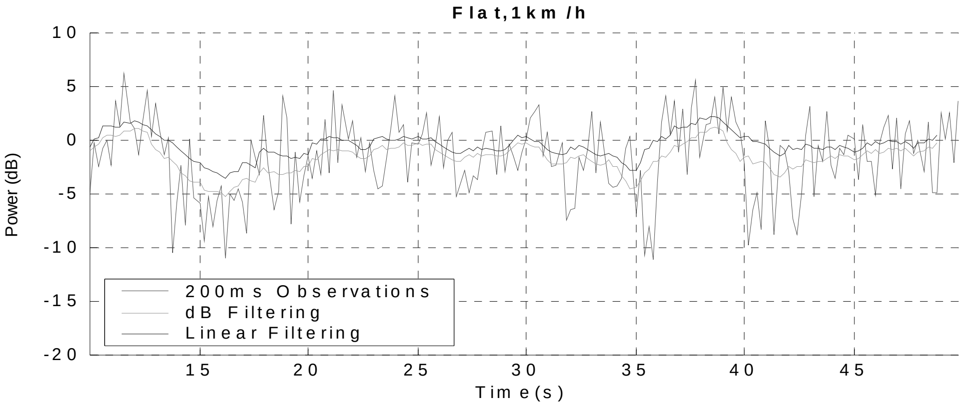


Figure 1: 1 km/h single-ray Raleigh-fading process

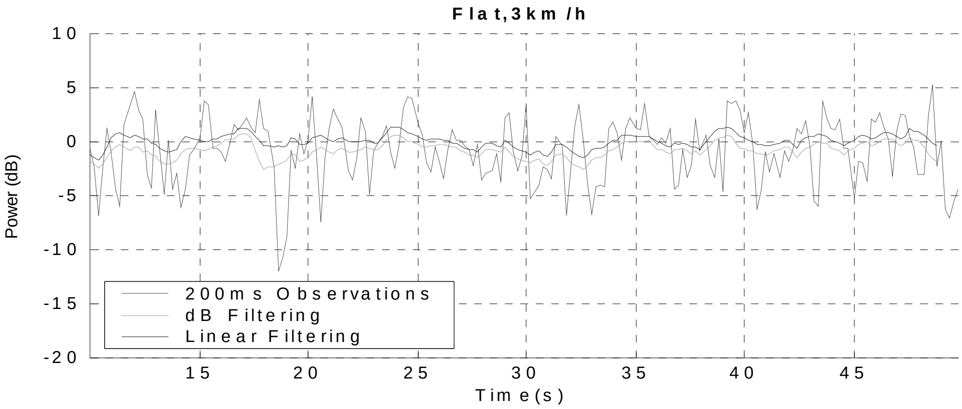


Figure 2: 3 km/h single-ray Raleigh-fading process

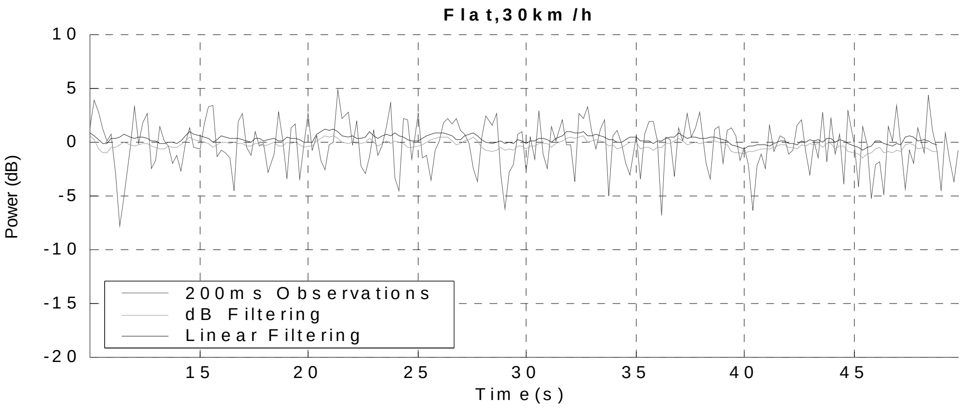


Figure 3: 30 km/h single-ray Raleigh-fading process

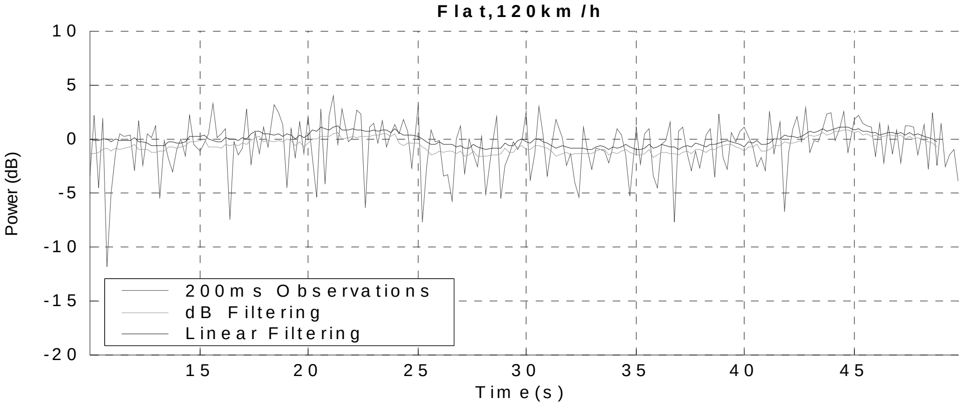


Figure 4: 120 km/h single-ray Raleigh-fading process

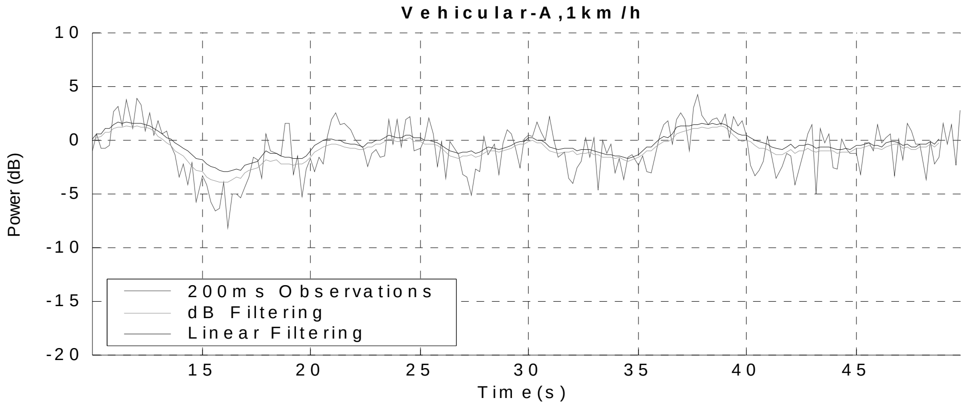


Figure 5: 1 km/h Veh A Channel model

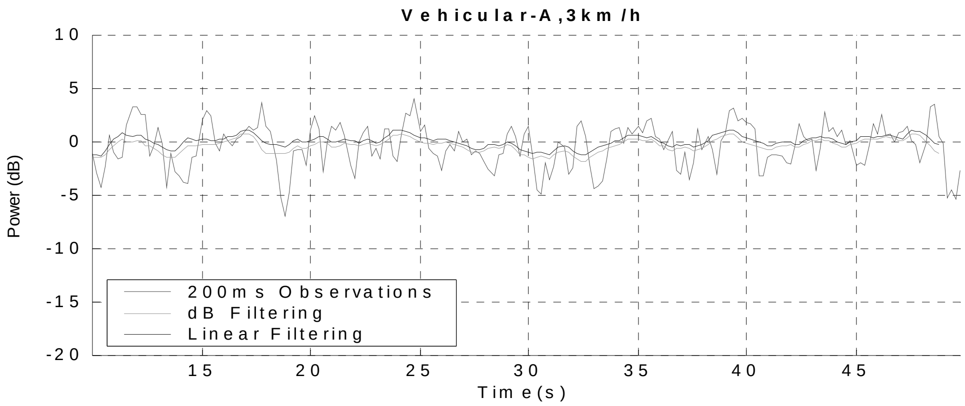


Figure 6: 3 km/h Veh A Channel model

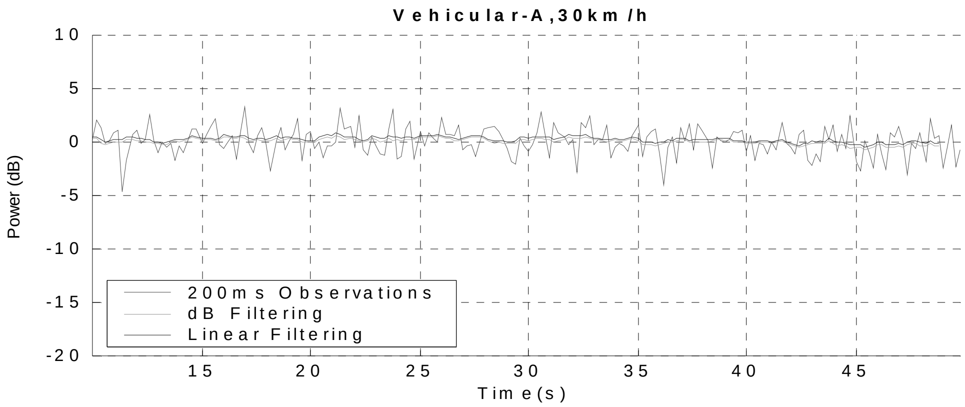


Figure 7: 30 km/h Veh A Channel model

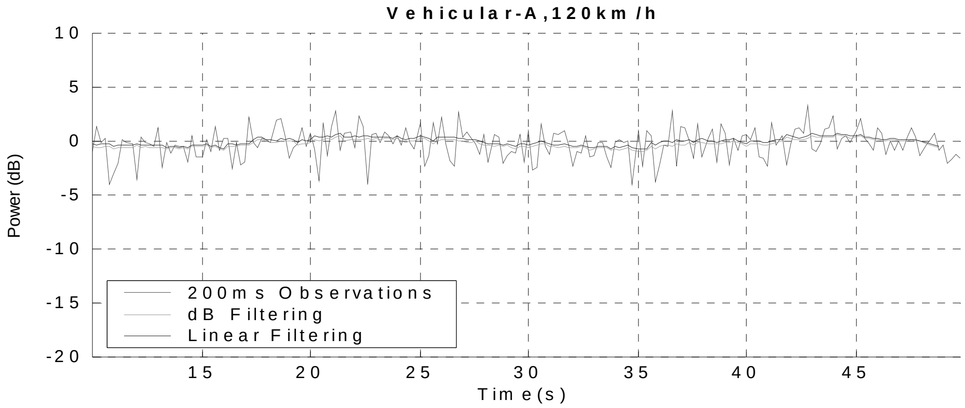


Figure 8: 120 km/h Veh A Channel model