TSG-RAN Working Group1 meeting #18 TSGR1#18(01)0115

Boston, MA, January, 15th – 18th, 2001

Agenda Item : **AH27 : radio link performance enhancements**

Source : **Nortel Networks**

Title : **Impact of the introduction of improved power control at power control limits**

Document for : **Discussion**

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1. Introduction

During RAN1 #17 Siemens presented [1] which described a proposal to improve the behaviour of the UE when it reaches its power control limits either upper and lower. It was generally acknowledged that this proposed feature is an improvement compared to the existing release 99 behaviour.

Indeed the current standardised UE behaviour can lead to increased intra-cell interference when the UE is operating near its lower power control limits and switches from high bit rate to low bit rate TFCs and back again to high bit rate as was shown in several previous papers by Siemens. In the upper limit case the impact is not so critical since only the considered connection between UE and UTRAN is impacted : the UE will in certain cases use a too low power thus degrading its own communication but not the others from the same cell.

In the papers which were presented the proposed behaviour was described in details and simulations results were provided which showed that the link quality is improved when using this scheme.

This papers analyses the possible ways of introducing this feature in release 4 and the potential impact on the system performance in particular when considering power management at the RNC level.

2. Alternatives for introducing the proposed improved UE behaviour in the physical layer specifications

?? The first possibility is to simply replace in Release 4 specifications, namely 25.214, the UE behaviour at power control limits by the proposed scheme. This would impact only 25.214 section 5.1.2.6 “maximum and minimum power limits”. This implies that when operating close to the power control limits release 99 UEs and release 4 and after would have a different behaviour. This might not be a problem from the link quality point-of view since the new behaviour will reduce the intra-cell interference and limit the link quality degradation when the UE switches rate while operating close to its maximum power limit (see detailed explanations in [1]).

?? The second possibility is to allow the network to configure the UE behaviour when it operates close to power control limits : either a Release 99 behaviour or a behaviour as proposed in [1]. The UTRAN could configure this mode of operation via RRC signalling. This implies that all Release 4 UEs would have to implement both modes of operation (in case this functionality is mandatory in the UE for Release 4, otherwise it would depend on the UE capability).

The rational behind considering the second alternative, though the proposed UE behaviour is always an improvement compared to Release 99 behaviour from the link quality point-of-view, is explained in the following section.

3. Introduction of the proposed UE behaviour in release 4 and release 99 networks.

If we consider only the gains on the link quality and interference conditions then there is no doubt that the first alternative should be chosen to implement this feature in the standard. However, from the power management point-of-view at the RNC level there might be a difference.

Although it is clear that power management issues at the RNC level are implementation matters, for an efficient power management at the RNC it is essential that the RNC is fully aware of the UE behaviour.

Let us consider the different cases that the UTRAN, either Release 99 or Release 4, will have to manage

?? Naturally when a Release 4 UTRAN is communicating with a Release 4 UE implementing the proposed feature there is no ambiguity in either of the proposed alternatives. In alternative 1, the UTRAN will expect the new behaviour of the UE at power control limits in any case and take this into account in its power management algorithms. In alternative 2, the UTRAN has configured the UE behaviour and then, of course, it knows how it will behave.

?? When a Release 99 UTRAN is communicating with a Release 4 UE implementing the proposed feature, the situation is different. In alternative 1, the UTRAN might know it is not a Release 99 UE but it does not know in what way it is different from a Release 99 UE. This means that it will expect a certain UE behaviour when the UE operates close to power control limits but the UE will not behave so. It is difficult at this point to predict how this could affect power management at the cell level depending on the proportion of Release 99 and Release 4 UEs implementing the feature in the cell. Alternative 2 might provide the solution since the UE can implement both behaviours (Release 99 and Release 4) but the UE would have to autonomously determine whether the UTRAN is Release 99 (and then behave as a Release 99 UE) or Release 4 (and then behave as required by the UTRAN in the configuration phase). A way for the UE to determine this could be e.g. to analyse the content of padding bits in the Release 99 configuration message. If these bit are all zero then it means the UTRAN is Release 99 otherwise the UTRAN is Release 4 or later. But there might be a need to study this aspect in more details and seek for RAN2 guidance for the implementation aspect and RAN4 guidance for the performance aspect.

4. Conclusion

This paper raises the issue of the introduction of the improved power control behaviour for the UE in Release 99 networks. Indeed the proposed feature brings some gain from the link performance point-of-view, however, it should be kept in mind that for an efficient power management at the RNC level the RNC has to be fully aware of the UE behaviour. This might not systematically be the case with the approach taken so far for the introduction of this feature in Release 4 specifications. We would like RAN1 to consider seeking guidance from other working groups (RAN2 and RAN4) on the implementation of the proposed feature and its impact on radio resource management performance.

5. References

[1] : R1-01-1447 , Siemens, improved uplink power control at power control limits.