TSG-RAN Working Group 1 meeting #3 **TSGR1#7(99)a78**

Hannover (Germany), Aug 30th - Sept 3rd 99

Agenda Item	**:**	ad-hoc 9 physical meeting
Source	**:**	ad-hoc 9 Chairman[1]
Title	**:**	Report on ad-hoc 9 activities between WG1#6 and WG1#7
Document for	**:**	Approval

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1. Introduction

This document reports on the discussions that have taken place on the RAN WG1 reflector in the framework of ad-hoc 9 (Closed loop power control for FDD) between 3GPP RAN WG1#6 and 3GPP RAN WG1#7 meeting.

The discussion on the reflector dealt with the following topics :

1) Step size in the uplink
2) 0 dB power control in normal mode
3) Emulated step power control in normal mode
4) Power control in compressed mode
5) Downlink power control in soft handover
6) Open loop power control
7) Clarification of the open issues
8) Slow power control
9) Power control timing issues

2. Summary of the discussions

2.1 Step size in the uplink

Ericsson reminded ad-hoc 9 of one of the open issues related to the set of step sizes to be used in normal mode. Indeed 1 and 2 dB are allowed but it is still FFS whether the 3dB which is to be supported for the compressed mode is also allowed for the normal mode. Ericsson suggested to strict ourselves only to 1 and 2dB. This was not commented. This should be raised at the meeting, so that a conclusion is reached.

2.2 0 dB power control in normal mode

Philips tried to reproduce the results from Panasonic on the 0 dB power control step, but could not. Information was exchange on simulation models in order to better understand the differences. No conclusion could be reached though. Contributions expected on this topic during the ad-hoc 9 physical meeting.

2.3 Emulated step power control in normal mode

Comments and clarification on the emulated step power control algorithm (algo 2) were asked by Nokia and answered to by Philips. It was in particular clarified that the power control commands are hard detected on a

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[1] Evelyne Le Strat, Nortel Networks

Further results from Philips expected at the meeting on the optimum concatenation period and robustness to errors.

Comparison between the 0dB power control step and emulates step was initiated by Motorola and clarification requested on whether the 0 dB step power control could fulfil the same functionality as the emulated step, if yes allowing hence to remove the emulated step and hence simplifying the specifications. Clarification by Panasonic that the behaviour was difference and comparison on signalling was not straightforward since the emulated step required to know the speed, the emulated step algorithm indeed being use of low and high speeds.

2.4 Power control in compressed mode

Contribution R1-99c24 from Alcatel provided results on the fixed vs. Adaptive recovery period for the compressed mode. Philips commented that the results were identical to those contained in R1-99884 and questioned the possibility to reach a final conclusion on the basis of the results. Alcatel agreed that only partial results were available. However Alcatel believes that results are a good starting point, and is in favour of using a fixed recovery period rather that adaptive recovery period.

2.5 Downlink power control in soft handover

Comments and clarification on the proposal from Nortel Networks to decrease the Power control rate on the downlink in soft handover (see R1-99951) were made by Nokia and answered by Nortel Networks.

As far as the simulations conditions are concerned, it was clarified by Nortel that the simulations had been conducted at a speed of 50 km/h. the Transmit power synchronisation scheme used in the simulations was explained by Nortel. The Tx transmit power of all cells in the active set is aligned to the transmit power of te cell with the best uplink SIR, since this should be the cell with lowest uplink TPC error.

On the proposal itself Nokia commented that they did not see a clear benefit wit the proposal since the UTRAN access point does not have to react to individual commands sent by the UE. Nokia suggested that the BTS consider a serie of consecutive commands from the UE before reacting., which would not require any change in the standard.

Nortel Networks clarified their proposal does consist in concatenating several commands at the node B, the difference with what Nokia suggest is that the commands sent by the UE are forced to be identical rather than possibly different and the SIR estimation can be performed in a higher number of slots, allowing hence some improvement on the SIR estimation accuracy. Nortel believes that this is little additional complexity in the specification. Also they insisted on the fact that the proposal aimed at ensuring that the difference cell s transmit at comparable power in spite of TPC errors, the average transmit power not being sufficient to evaluate the benefit of the proposal.

2.6 Open loop power control

2.6.1. New proposal

A proposal for the open loop power control for the initial RACH transmission was made by Ericsson and is further developed in contribution R1-99c14 to be presented during the ad-hoc physical meeting. The proposal consists in changing the original formula to be found in 25.214 in order to avoid the explicit indication of the transmitted power at the node B, although some operators had indicated they did not mind broadcasting such information. It further allows to parametrise the output power at the UE e.g. when there is already a connection established between the end B and UE. The formula is as follows :

P_RACH = A - RSCP_CPICH + B [dBm],

Where

- RSCP_CPICH is measured received RSCP of CPICH at UE,

- A is a value broadcast on BCCH and B can be individually set via L3 signalling.
- B has some default value (0 dB) when no signalling connection has been set up to assign it a new value.

2.6.2. Comments

Comments were received by Vodafone. Vodafone indicated that they did not seen any problem with the broadcasting of the transmitted power of the node B. They understood some the gain in signalling with the Ericsson proposal and would be ready to support such proposal provided that this does not degrade the path-loss estimation accuracy, indicated to be +/-9dN in normal conditions and +/-12 dB in extreme conditions by RAN WG4.

Late comment provided by Nortel Networks are as follows :

- Is B set only via some layer 3 dedicated signalling meaning that it is UE specific and would be use only f the RACH is not used for initial access but e.g. for short packet transmission ?
- A accounts for the indication of the transmit power and the interference level as measured by the BTS. Work should be pursued on the interference aspects in order to determine the updating rate of A as well as its range in order to provide clear indication on the signalling requirements to WG2.
- It is the understanding of Nortel Networks that the proposal from Ericsson would not alter the accuracy of the setting of the transmit power at the UE.

2.7 Clarification of the open issues

Clarification on some open issues that were listed in R1-99a09 (and reproduced in annex 1 of this report) were asked by Ericsson as follows :

2.7.1. Issue 6:

WG4 only defines the power steps that results from the inner loop power control, meaning that WG1 should not be restricted in this issue according to Ericsson. Ericsson asked for the reference to the WG4 liaison in the open issue list.

Answer from Chairman : The problem or item to check further could be best described by an example.

Assuming that at a point in time, e.g. last slot of a frame, there are two channels, one DPCCH and one DPDCH and the DPDCH is the one with highest power. Then consequence of the current 25.213 specification is that total power is

$P_1 = A_1(b_1 + b_2)$ where $b_1 \leq 1$ is the gain of the DPCCH, $b_2 = 1$ is the gain of the DPDCH and A1 is a scaling factor in the RF stage, all powers being expressed in the linear scale

For the following slot that belongs to another frame, DTX is used, that is to say the DPDCH is switched off, and only the DPCCH is transmitted.

$P_2 = A_2$, since the $b = 1$ for the DPCCH (it is the only and hence highest power channel), all powers being expressed in the linear scale

The variation of the DPCCH power is $\Delta P_{DPCCH} = A_2 / A_1 b_1$

The variation of the total power is : $\Delta P = A_2 / A_1(b_1 + b_2)$

According to the WG4 specification ΔP varies in steps, so ΔP must be a multiple of the minimum step : $\Delta P = 10^{0.1*k*step}$. According to the WG1 specifications the UE increases of decreases the power of the DPCCH and DPDCH in step also. This could be interpreted as the fact that if combined with DTX the DPCCH

power would then vary in steps. $\Delta P_{DPCCH} = 10^{0.1*k'*step}$, where kŝtep corresponds to the power control step for this UE.

Then we would have $\Delta P_{DPCCH} / \Delta P = \frac{b_1 + b_2}{b_1} = 10^{0.1*(k-k')step)}$.

The question to Ericsson who provided the Beta table is whether this equation is valid in any case with the presently documented Beta table.

2.7.2. Issue 10, last paragraph and issue 8:

Item 10 and 8 indicates that ad-hoc 09 had concluded that the BTS may monitor the DPDCH in addition to the DPCCH. Ericsson could not find any clear reference to that conclusion. Ericsson expressed concerns on the impact on the TFCI encoding, monitoring on the DPDCH may indeed require to have the TFCI apply on the following frame rather than the current frame, introducing delay and potentially error propagation.

Nortel Networks clarified that this conclusion was reached by the ad-hoc 09 on the reflector between WG#4 and WG1#5 and confirmed at WG1#5. The reason to allow the node B to measure the DPDCH in addition to the DPCCH was that a power control relying solely on the SIR estimation on the DPCCH was not optimum when there is a large power/rate difference between the DPCCH and DPDCH. Since these measurements are done at the node B this is a manufacturer issue.

Ericsson asked for further clarification on how this would work in the case of variable rate and does not anticipate any significant gain.

Clarification from Chairman : I confirm the explanations provided by my colleagues. Measuring the DPDCH is an option and is not mandatory. The objective is not to modify the encoding and mapping of the TFCI. It is correct that no proposal was made so far on how to address the variable rate. As far as the estimate gain is concerned, contribution R1-99460 Power Control on Multi-code Channels for the UTRA/FDD Uplink may be referred to.

2.8 Slow power control

NEC provided a list of scenarios where slow power control would be most useful.

- Transmission of a large amount of downlink data with long breaks
- Transmission of a large amount of downlink data with short breaks

This was not commented. Contributions address in more details the slow power control as listed in section 3.

2.9 Power control timing issues

Proposal from the 25.214 editor to move the power control timing diagram presently located in 25.211 to 25.214. This was supported by the 25.211 editor.

Clarification on the absence of transmit power change for the downlink was requested by the 25.214 to one of the originators (Nortel Networks) of the change request on power control agreed at the last meeting R1-99axx.

3. List of contributions for the WG1#7 ad-hoc 9 physical meeting

3.1 Liaisons from other groups

- R1-99a93, Liaison statement to WG1 on fast closed loop power control in FDD mode, RAN WG4
- R1-99c43, Reply to LS from WG1 on power control issues, RAN WG2
- R1-99c39, LS on status of the work on power control issues, RAN WG2
- R1-99c42, Liaison statement on Slow transmit power control, RAN WG2

3.2 Power control in normal mode

- R1-99b80 Power limits for downlink power control, Ericsson
- R1-99b41, Algorithm 2 Power Control in Normal Mode, Philips
- R1-99b42, Text Proposal on Power Control, Philips
- R1-99b43, Optimal Performance of Tri-State TPC, Philips
- R1-99c62, Power Control Scheme with Adaptive Step, SK Telecom

3.3 Power control in soft handover

- R1-99a88, Downlink Power Balancing: Additional Slow Loop, Alcatel
- R1-99b15, DownLink Power Control Rate Reduction during Soft Handover, Nortel Networks
- R1-99b16, Text proposal for Specifications 25.214 and 25.211on downlink power control, Nortel Networks

3.4 On power control in compressed mode

- R1-99c24, Comparison between algorithms with fixed and adaptive recovery period for fast power control in compressed mode, Alcatel
- R1-99c05, Simulation results for outer-loop power control in compressed mode, Alcatel
- R1-99c25, Initial Transmit Power Level after Transmission Gap in Compressed Mode

3.5 On open loop power control

- R1-99c14 RACH open loop power control, Ericsson

3.6 Slow power control

- R1-99c00, Text modification for slow transmit power control in 25.211, 25.212 and 25.214, NEC
- R1-99c01, Benefits of slow transmit power control, NEC
- R1-99c16, A New Power Control Ratio Measurement for Slow Transmit Power Control

4. Annex 1 : Status and list of items for further study or requiring further work

A list of items requiring further study was presented by the chairman at the last meeting WG1#6 and is copied here for reference

The progress of the work that had been produced before the meeting was reviewed in order to identify what remains to be done by WG1 and the areas where it should be made sure that some specification is available, these areas being mostly under the responsibility of WG2. The updated progress status is a follows.

Item number	Item	Description of item or identified problem and progress status
1	Minimum power control step size at the UE, and set of step sizes	• A minimum power control step size of 1dB is to be supported by all UE an no other smaller step size shall be supported by the standard for Release 99. • All step sizes should be a multiple of the minimum power control step size. • The maximum power control step size is 3 dB.

		25.214 needs some redrafting in order to fully reflect our decision
2	Minimum power control step sizes at the BTS, and set of BTS step sizes	Although it is not fully clear what level of standardisation is required for the downlink power control, WG1 agreed that a 1 dB minimum power control step size shall be supported by all BTS. 0.5 dB is optional. WG4 updated its documentation to reflex the decision from WG1. 25.214 needs some redrafting in order to fully reflect our decision.
3	Step sizes for the uplink power control	The step size is a UE specific parameter. That step size shall be used in the normal mode. For the compressed mode another step size may be used but will be derived from the PC scheme to be used in compressed mode.
4	Step sizes for the downlink power control	Although the downlink power control is not part of the specification, it should be clarified whether there is a maximum range on the downlink power control step, in relation with constraints on the UE processing.
5	Limits on the fast (inner) loop power control	The WG3 specifications indicate a minimum and maximum power between which inner loop power control allows to vary the power. This is no reflected in the WG1 specifications.
6	Relationship between DPCCH/DPDCH ratios and power control steps at the UE	Ratio of power between the DPCCH and DPDCH (β) takes a limited set. At rate changes (e.g. from DTX to non DTX) the β value is updated in order to take into account rate matching ratio. However output power of the UE (sum of output power of DPCCH and DPDCH) (see WG4 answer) can vary only in steps (down from the maximum power ?). How compatible is this with current description, where the power of DPCCH only is monitored, since the DPCCH absolute power may changed in an autonomous manner as β changes? **This problem was identified from March but no progress has been doe so far.**
7	Uplink fast closed loop power control in compressed mode	The compressed mode interrupts the transmission in the downlink for a number of slots and possibly also in the uplink dependent on the co-ordination between uplink and downlink slotted mode The uplink power control in downlink compressed mode is partly agreed as indicated in section 4. The recovery period is still FFS.
7	Downlink fast closed loop power control in compressed mode	The downlink power control is outside the scope of the specification, however the scheme for the uplink may be used as an example.
8	Fast closed loop power control for Variable rate in the uplink	• Setting of the TPC by the BTS In relation with item 6, β changes at most every frame. If the measurements are based only on DPCCH then it is like 6. If measurements are done in addition on DDPCH then the BTS does not know about the rate change before a frame. • Change of DPDCH power As the rate changes of the DPDCH(s) the β changes. What is the

		rule to set the β.Are the β provided at call set up or as part of the outer loop power control ? Nothing is to be found in the WG2 documentation on that aspects. **This problem was identified from March but no progress has been doe so far.**
10	Fast closed loop power control for multi-code	A number of configuration might correspond to multiple codes in one direction and one or multiple codes in the other direction. The following needs to be documented : • 1 DPDCH in dl and 1 CCtrCH with multiple DPDCH in uplink This configuration was identified at the last WG1 meeting. In this case the multiple DPDCHs in the CCTrCH in the uplink have the same SF, QoS and output power. In such a case the DPCCH on the dl controls the output power of all DPDCHs and DPCCH on uplink. • Multiple DPDCH in dl and 1 DPCCH on uplink This is linked to the work of ad-hoc 4 . It remains to be decided whether the multiple DPDCH on the dl have the same or different SF, are associated one or multiple DPCCH, which measurements are to be done by the UE and where the TPC information is necessarily the same if there are multiple DPCCH. Also it was agreed by ad-hoc 9 that the BTS may measure the DPCCH but also DPDCH on the uplink since the DPCCH is a low rate, low power channel. Its variation are not systematically representative of the variation of the variation of the DPDCH. This was however not documented in 25.214 due to lack of text proposal at WG1#5.
11	Fast closed loop power control in relation with downlink shared channels	Power control for the DSCH when associated with a DCH (itself associated with uplink DCH). Is the DSCH power control based on the power control of the dl DCH (itself controlled by the uplink DCH)? In this case the dl DCH is transmitting continuously. Power control for DCSH when associated with a DSCH control channel and an uplink DCH. In this case the uplink cannot rely on measurements of a power controlled downlink channel, to control the DSCH. Power control for the uplink DCH associated with a DSCH associated with a DSCH control channel. Should the uplink be controlled by the DSCH control channel ? What should be the structure of the DSCH control channel ?
12	Open loop power control	The open loop power control for the RACH is specified as $P_{RACH} = L_{Perch} + I_{BTS} +$ *Constant value* *where,* L_{Perch}*: measured path loss in dB,* I_{BTS}*: interference signal power level at BTS in dBm, which is broadcasted on BCH,* *Constant value: This value shall be designated via Layer 3*

		message (operator matter). The items requiring further study are the following : • The exact path loss cannot be measured since the operator is unlikely to reveal the output power of the cell, so there should be a reference power indication broadcast rather than the true output power. • I BTS measurement is not currently specified. No requirement on the rate of update of the information to be broadcast. • Constant value : the range of such constant value is not defined, neither its possible rate of change • This might need some update due to the introduction of the continuous pilot as a result of the harmonisation.
13	Range of power ramping steps for access and CPCH	Two power ramping steps for the RACH access are currently documented in 25.214 (ΔP_{0} and ΔP_{1}). Their range is needed for final specifications. It should be clarified whether this is a cell specific parameter. A similar question applies for the CPCH.
14	Slow power control	The slow power control is currently documented in 25.214. Discussion started on the reflector and revealed that the WG1 specifications are not consistent since the slow power control would require update of 25.212. WG2 documentation does not mention slow power control. It is to be verified whether slow power control should remain in 25.214. A Liaison will be sent to WG2 in order to clarify the issue.
15	Uplink Power setting for RACH message part	**This item should be a WG2 issue.** The power for the message part of the RACH is not specified. It should normally be related to the power of the last successful preamble and the SF of the RACH.
16	Uplink Power setting at start of transmission on DPDCH	**This item should be a WG2 issue.** However WG2 documentation is currently incomplete on this point. Only the *Uplink DPCH power control info* information element is found in **the RRC CONNECTION SETUP** message**, RADIO ACCESS BEARER SETUP** message and **RADIO ACCESS BEARER RECONFIGURATION** message in 25.331. But the the *Uplink DPCH power control info is defined as "* Interference level measured for a frequency at the UTRAN access point used by UE to set DPCH initial output power." No formula relates however this parameter to the output power. R2-99381 proposes to add "UL target SIR" but again no formula relating the output power to the interference and uplink target SIR is available. The power for the start of the transmission on the DPDCH should normally be related to the power of the message part of the RACH and the transport channel characteristics.
17	Uplink initial power setting for hard handover	**This item should be a WG2 issue.** However WG2 documentation is currently incomplete on this

		point. Only the information element *UL DPCH power control info* is included in the **HANDOVER COMMAND** message in 25.331. Same as for item 13.
18	Power control for packet transmission	Work is currently progressing in ad-hoc 14 on power control at the start of transmission for packet. There should be a unification of the scheme with normal mode or compressed mode or at least a clarification of which scheme applies when.

Table 1: List of items requiring further work and progress status