3GPP TSG RAN WG1 ***TSGR1#10(00)0059***

January 18 – 21, 2000, Beijing, China

Agenda item:

Source: **Philips**

Title: **Clarification of TPC command combining for Algorithm 1**

Document for: **Decision**

Introduction

This CR relates to the uplink power control procedure in soft handover in 25.214.

In a previous CR, 25214-010r1, the description of the process for combining multiple TPC commands was clarified by removing the "example" for the combining function .

The CR contained in this document, CR25214-056, makes an editorial change to remove a remaining reference to the example which was removed.

It would also seem to be necessary to provide some bounds for the output of the combining function in order to restrict the range of possible functions. For example, at present a UE which always increased its power in every slot when in soft handover would be within the specification!

It is generally recognised (e.g. [1]) that the best performance in terms of transmitted power from a UE in soft handover is obtained if the UE reduces its transmitted power if a reliable "down" TPC command is received from any one of the serving cells. In the limiting case of there being only one serving cell, this means that the UE should reduce its power 50% of the time, on average, in the case where the transmitted TPC commands have equal probability of being 0 or 1. This percentage increases as the number of serving cells increases.

It is also logical that if "up" commands are received from all the serving cells, the UE should increase its transmitted power. In the case where the transmitted TPC commands from all the serving cells are 0 or 1 with equal probability, this means that the UE should increase its transmitted power $[1/(2^N)] \times 100$ % of the time, on average.

The 2 cases above can provide useful upper and lower bounds on the output of the function , to ensure that a sensible function is implemented.

A useful way of setting the bounds for is therefore to define minimum probabilities for the frequency of output +1's and –1's occurring when the transmitted TPC commands are random with equal probability of 0 and 1, and uncorrelated between the serving cells. Then the probability that the output of γ is equal to 1 must be greater than or equal to $1/(2^N)$, and the probability that the output of γ is equal to -1 must be greater than or equal to 0.5.

The attached CR introduces these bounds to clarify the definition of .

It may be desirable to place an additional requirement on to define it even more tightly. For example, it could be specified that in the case when the received TPC commands from all the serving cells are reliable, the output of must equal 1 if the TPC commands from all the serving cells are reliably 1, and the output of must equal -1 if the TPC commands from any of the serving cells are reliably 0. This condition could be added as a separate CR if it is considered necessary.

Reference

[1] TSGR1#8(99)j02, *“Soft symbol reliability for uplink PC in soft handover (rev.)”*, Nokia

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e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

25.214	CR	056	Current Version:	3.1.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to:	TSG-RAN #7	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑		for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: *(at least one should be marked with an X)* (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]

Source: Philips **Date:** 2000-01-13

Subject: Clarification of TPC command combining for Algorithm 1

Work item:

Category: *(only one category shall be marked with an X)*

F	Correction		**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature	X		Release 98	
D	Editorial modification			Release 99	X
				Release 00	

Reason for change:
Editorial change to remove of reference to non-existent example.

Minimum bounds placed on output of function , previously undefined.

Clauses affected: 5.1.2.2.2.3 "Combining of TPC commands not known to be the same"

Other specs affected:

Other 3G core specifications	[ ]	→ List of CRs:
Other GSM core specifications	[ ]	→ List of CRs:
MS test specifications	[ ]	→ List of CRs:
BSS test specifications	[ ]	→ List of CRs:
O&M specifications	[ ]	→ List of CRs:

Other comments:


help.doc

<--------- double-click here for help and instructions on how to create a CR.

5.1.2.2.2 Algorithm 1 for processing TPC commands

5.1.2.2.2.1 Derivation of TPC_cmd when only one TPC command is received in each slot

When a UE is not in soft handover, only one TPC command will be received in each slot. In this case, the value of TPC_cmd is derived as follows:

- If the received TPC command is equal to 0 then TPC_cmd for that slot is –1.
- If the received TPC command is equal to 1, then TPC_cmd for that slot is 1.

5.1.2.2.2.2 Combining of TPC commands known to be the same

When a UE is in soft handover, multiple TPC commands may be received in each slot from different cells in the active set. In some cases, the UE has the knowledge that some of the transmitted TPC commands in a slot are the same. This is the case e.g. with receiver diversity or so called softer handover when the UTRAN transmits the same command in all the serving cells the UE is in softer handover with. For these cases, the TPC commands known to be the same are combined into one TPC command, to be further combined with other TPC commands as described in subclause 5.1.2.2.2.3.

5.1.2.2.2.3 Combining of TPC commands not known to be the same

In general in case of soft handover, the TPC commands transmitted in the same slot in the different cells may be different.

This subclause describes the general scheme for combination of the TPC commands not known to be the same. ~~and then provides an example of such a scheme. It is to be further decided what should be subject to detailed standardisation, depending on final requirements. The example might be considered as the scheme from which minimum requirement will be derived or may become the mandatory algorithm.~~

~~5.1.2.2.2.3.1 General scheme~~

First, the UE shall conduct a soft symbol decision on each of the power control commands TPC_i, where i = 1, 2, …, N, where ~~and~~ N is greater than 1 and is the number of TPC commands not known to be the same, that may be the result of a first phase of combination according to subclause 5.1.2.2.2.2.

Then the UE assigns to each of the TPC_i command a reliability figure W_i, where W_i is the soft symbol decision obtained above. Finally, the UE derives a combined TPC command, TPC_cmd, as a function γ of all the N power control commands TPC_i and reliability estimates W_i:

TPC_cmd = γ (W_1, W_2, … W_N, TPC_1, TPC_2, …, TPC_N), where TPC_cmd can take the values 1 or -1.

The function γ shall fulfil the following criteria:

If the N TPC_i commands are random and uncorrelated, with equal probability of being transmitted as “0” or “1”, the probability that the output of γ is equal to 1 shall be greater than or equal to $1/(2^N)$, and the probability that the output of γ is equal to -1 shall be greater than or equal to 0.5.

5.1.2.2.3 Algorithm 2 for processing TPC commands

NOTE: Algorithm 2 makes it possible to emulate smaller step sizes than the minimum power control step specified in section 5.1.2.2.1, or to turn off uplink power control by transmitting an alternating series of TPC commands.

5.1.2.2.3.1 Derivation of TPC_cmd when only one TPC command is received in each slot

When a UE is not in soft handover, only one TPC command will be received in each slot. In this case, the UE shall process received TPC commands on a 5-slot cycle, where the sets of 5 slots shall be aligned to the frame boundaries and there shall be no overlap between each set of 5 slots.

The value of TPC_cmd is derived as follows: