3GPP TSG RAN WG1#9 **Tdoc R1-(99)j59**
Dresden, Germany
November 30th - December 3rd, 1999 **Meeting No. 9**
Agenda Item: Ad Hoc 9

Source: Nokia

Out-of-synch handling in UTRA FDD

1. Introduction.

This contribution proposes to clarify the out-of-synch handling behaviour for the UE operation in TS 25.214.

2. UE operation

The UE operation is specified in connection with the power control section as the out of synch operation directly impacts the UE operation. The following approach is proposed:

- The UE shall monitor the active link(s) to determine if the link is out-of-synchronisation or not. Depending on the situation the UE may use for example CPICH or pilot symbol patterns or combination there off to determine the synchronisation status.

- If N_out_synch_frames_1 frames are passed that have been found to be out-of-synchronisation, the UE shall turn of uplink transmission, the value for N_out_synch_frames_1 given by the higher layers.

This is the basic functionality that is definitely needed. For the power control operation one could then ask whether it makes sense to follow the power control command decoding if the frame is detected to be out-of-synchronisation. Having there an additional parameter gives the option to "freeze" the UE power level. Setting the parameter N_out_synch_frames_2 equal to N_out_synch_frames1 disables the option.

- If N_out_synch_frames2 is detected to be out-of-synchronisation, the UE shall maintain the output power level, controlled by inner loop power control, constant while out-of-synchronisation state lasts or until N_out_synch_frames_1 reached when the transmission shall be turned off.

- During downlink out-of-synchronisation, the TPC command sent in the uplink shall be set as “1” during the period of out-of-synchronisation. (This should be the result of SIR estimation anyway in out-of-synch situation)

This is proposed to be covered together with inner loop uplink power control in 25.214.

3. Node B operation

For Node B the only thing that is recommended to be specified is that Node B gives synch indication to higher layers. The Node B behaviour with respect to the transmission power control behaviour is not proposed to be specified in out-of-synch state. For Node B the main thing is that out-of-synch indication is provided to RNC which can then decide on further actions. The CR attached will not provide text for Node B operation, but if desired such a text can be included based on the received comments to this CR as well.

4. Conclusions

The attached CR-029 is recommended to be to included in 25.214 for cover the UE behaviour in out of synchronisation situation. Further it is worth informing WG2 if the issue that they are aware of the parameters to be handled by higher layers. For the Node B synchronisation indication, WG3 is also involved, thus they should be informed of possible developments with respect to Node B side. Further it is noted that TDD sight needs some considerations as well.

3GPP TSG RAN WG1 Meeting #9
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***Document* R1-99j58**
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**	**029**	Current Version:	3.0.0

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

For submission to:	TSG RAN#6	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: Nokia **Date:** 29.11.1999

Subject: Out-of-synch handling

Work item:

Category:				**Release:**		
	F	Correction			Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature	X		Release 97	
shall be marked	C	Functional modification of feature			Release 98	
with an X)	D	Editorial modification			Release 99	X
					Release 00	

Reason for change: For the out-of-synchronisation situation only empty header exists in 25.214.

Clauses affected:

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 Ordinary transmit power control

5.1.2.2.1 General

The initial uplink transmit power to use is decided using an open-loop power estimate, similar to the random access procedure.

< Editor's note: This needs to be elaborated, how is the estimate derived? >

The maximum transmission power at the maximum rate of DPDCH is designated for uplink and control must be performed within this range.

< Editor's note: The necessity of this range needs to be confirmed. > The maximum transmit power value of the inner-loop TPC is set by the network using higher layer signalling.

The uplink inner-loop power control adjusts the UE transmit power in order to keep the received uplink signal-to-interference ratio (SIR) at a given SIR target, SIR_{target}.

The serving cells (cells in the active set) should estimate signal-to-interference ratio SIR_{est} of the received uplink DPCH . The serving cells then generates TPC commands and transmits the commands once per slot according to the following rule: if $SIR_{est} > SIR_{target}$ then the TPC command to transmit is "0", while if $SIR_{est} < SIR_{target}$ then the TPC command to transmit is "1".

Upon reception of one or more TPC commands in a slot, the UE derives a single TPC command, TPC_cmd, for each slot, combining multiple TPC commands if more than one is received in a slot. Two algorithms shall be supported by the UE for deriving a TPC_cmd, as described in subclauses 5.1.2.2.2 and 5.1.2.2.3. Which of these two algorithms is used is an UE-specific parameter and is under the control of the UTRAN.

The step size Δ_{TPC} is a UE specific parameter, under the control of the UTRAN that can have the values 1 dB or 2 dB.

After deriving of the combined TPC command TPC_cmd using one of the two supported algorithms, the UE shall adjust the transmit power of the uplink dedicated physical channels with a step of Δ_{TPC} dB according to the TPC command. If TPC_cmd equals 1 then the transmit power of the uplink DPCCH and uplink DPDCHs shall be increased by Δ_{TPC} dB. If TPC_cmd equals -1 then the transmit power of the uplink DPCCH and uplink DPDCHs shall be decreased by Δ_{TPC} dB. If TPC_cmd equals 0 then the transmit power of the uplink DPCCH and uplink DPDCHs shall be unchanged.

Any power increase or decrease shall take place immediately before the start of the pilot field on the DPCCH.

5.1.2.2.1.1 Out of synchronisation handling

The UE shall monitor the active link, or links in case of soft handover, to determine if the link is out-of-synchronisation or not. Depending on the situation the UE may use for example CPICH or pilot symbol patterns or combination there off to determine the link synchronisation status.

If N_out_synch_frames_1 frames that have passed have been found to be out-of-synchronisation for all links, the UE shall turn off uplink transmission. The value for N_out_synch_frames_1 is given by the higher layers.

If N_out_synch_frames_2 is detected to be out-of-synchronisation, the UE shall maintain the output power level, controlled by inner loop power control, constant while out-of-synchronisation state lasts or until N_out_synch_frames_1 reached when the transmission shall be turned off. The TPC command sent in the uplink shall be set as "1" during the period of out-of-synchronisation.

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 estimate the signal-to-interference ratio PC_SIR_i on each of the power control commands TPC_i, where i = 1, 2, …, N and N 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 a function β of PC_SIR_i, $W_i = \beta(PC\_SIR_i)$. 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:

$TPC\_cmd = \gamma\ (W_1, W_2, \dots W_N, TPC_1, TPC_2, \dots, TPC_N)$, where TPC_cmd can take the values 1 or -1.

5.1.2.2.2.3.2 Example of the scheme

A particular example of the scheme is obtained when using the following definition of the functions β and γ:

For β: the reliability figure W_i is set to 0 if $PC\_SIR_i < PC\_thr$, otherwise W_i is set to 1. This means that the power control command is assumed unreliable if the signal-to-interference ratio of the TPC commands is lower than a minimum value PC_thr.

For γ: if there is at least one TPC_i command, for which $W_i = 1$ and $TPC_i = 0$, or if $W_i = 0$ and $TPC_i = 0$ for all N TPC_i commands, then TPC_cmd is set to 1, otherwise TPC_cmd is set to 1. Such a function γ means that the power is decreased if at least one cell for which the reliability criterion is satisfied asks for a power decrease.

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:

- For the first 4 slots of a set, TPC_cmd = 0.
- For the fifth slot of a set, the UE uses hard decisions on each of the 5 received TPC commands as follows:
- If all 5 hard decisions within a set are 1 then TPC_cmd = 1 in the 5^{th} slot.
  - If all 5 hard decisions within a set are 0 then TPC_cmd = -1 in the 5^{th} slot.
  - Otherwise, TPC_cmd = 0 in the 5^{th} slot.

5.1.2.2.3.2 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 processed and further combined with any other TPC commands as described in subclause 5.1.2.2.3.3.

5.1.2.2.3.3 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 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.

5.1.2.2.3.3.1 General scheme

The UE shall make a hard decision on the value of each TPC_i, where i = 1, 2, …, N and N 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 5.1.2.2.3.2..

The UE shall follow this procedure for 3 consecutive slots, resulting in N hard decisions for each of the 3 slots.

The sets of 3 slots shall be aligned to the frame boundaries and there shall be no overlap between each set of 3 slots.

The value of TPC_cmd is zero for the first 2 slots. After 3 slots have elapsed, the UE shall determine the value of TPC_cmd for the third slot in the following way:

The UE first determines one temporary TPC command, TPC_temp_i, for each of the N sets of 3 TPC commands as follows:

- If all 3 hard decisions within a set are “1”, $TPC\_temp_i = 1$
- If all 3 hard decisions within a set are “0”, $TPC\_temp_i = -1$
- Otherwise, $TPC\_temp_i = 0$

Finally, the UE derives a combined TPC command for the third slot, TPC_cmd, as a function γ of all the N temporary power control commands TPC_temp_i:

$TPC\_cmd(3^{rd}\ slot) = \gamma\ (TPC\_temp_1, TPC\_temp_2, \ldots, TPC\_temp_N)$, where $TPC\_cmd(3^{rd}\ slot)$ can take the values 1, 0 or –1.

5.1.2.2.3.3.2 Example of the scheme

A particular example of the scheme is obtained when using the following definition of the function γ:

TPC_cmd is set to 1 if $\frac{1}{N}\sum_{i=1}^{N} TPC\_temp_i > 0.5$.

TPC_cmd is set to -1 if $\frac{1}{N}\sum_{i=1}^{N} TPC\_temp_i < -0.5$.

Otherwise, TPC_cmd is set to 0.