3GPP TSG RAN Meeting #19 **RP-030133**
Birmingham, United Kingdom, 11 - 14 March 2003

Title: **CRs (R'el-4 and Rel-5 category A) to TS 25.224**

Source: **TSG-RAN WG1**

Agenda item: **8.1.4**

TS 25.224 **(RP-030133)**

Doc-1st-	Doc-2nd-	Spec	CR	Rev	Subject	Phase	Ca	Versio	Versio	Workitem
RP-030133	R1-030301	25.224	118	2	Corrections to the LCR power control procedure	Rel-4	F	4.7.0	4.8.0	LCRTDDphys
RP-030133	R1-030301	25.224	119	2	Corrections to the LCR power control procedure	Rel-5	A	5.3.0	5.4.0	LCRTDDphys

3GPP TSG-RAN1 Meeting #31
Tokyo, Japan, 18-21 February 2003

Tdoc ⌘R1-030301

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CHANGE REQUEST

⌘ **25.224 CR 118** ⌘**rev** **2** ⌘ Current version: **4.7.0** ⌘

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Proposed change affects: UICC apps⌘ ☐ ME ☒ Radio Access Network ☒ Core Network ☐

Title: ⌘	Corrections to the LCR power control procedure			
Source: ⌘	Siemens			
Work item code: ⌘	LCRTDDphys		***Date:*** ⌘	21/02/2003
Category: ⌘	**F**		***Release:*** ⌘	Rel-4

Use one of the following categories:
F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
C *(functional modification of feature)*
D *(editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:

2	*(GSM Phase 2)*
R96	*(Release 1996)*
R97	*(Release 1997)*
R98	*(Release 1998)*
R99	*(Release 1999)*
Rel-4	*(Release 4)*
Rel-5	*(Release 5)*
Rel-6	*(Release 6)*

Reason for change: ⌘	Currently the LCR TDD closed loop power control procedures in uplink and downlink are ambiguous in their specification, in particular with respect to behaviour during transmission gaps and the minimum power level of the UE
Summary of change: ⌘	The change ensures that the closed loop power control procedure for LCR TDD is correctly specified, including behaviour in transmission gaps and minimum UE power, and avoids specifying implementation of power control to be SIR based. Also the erroneously used word “shall” in section 5.2.1.4 has been correctly replaced by “may”
Consequences if not approved: ⌘	The LCR TDD closed loop power control procedures will remain ambiguous, in particular in respect to behaviour during transmission gaps and lead to implementation irregularities

Clauses affected: ⌘ 5.1.1.1, 5.1.1.4, 5.1.2.4

Other specs affected: ⌘

Y	N		
	N	Other core specifications	⌘
	N	Test specifications	
	N	O&M Specifications	

Other comments: ⌘

4.2.2.3.2 Out of synchronisation handling

As stated in 4.2.3.4 ~~4.2.3.3~~, the association between TPC commands sent on uplink DPCH and PUSCH, with the power controlled downlink DPCH and PDSCH is signaled by higher layers. In the case of multiple DL CCTrCHs it is possible that an UL CCTrCH will provide TPC commands to more than one DL CCTrCH.

In the second phase of synchronisation evaluation, as defined in 4.4.2.1.2, the UE shall shut off the transmission of an UL CCTrCH if the following criteria are fulfilled for any one of the DL CCTrCHs commanded by its TPC:

- The UE estimates the received dedicated channel burst quality over the last 160 ms period to be worse than a threshold Q_{out}, and in addition, no special burst, as defined in 4.5, is detected with quality above a threshold, Q_{sbout}. Q_{out} and Q_{sbout} are defined implicitly by the relevant tests in [2]. If the UE detects the beacon channel reception level [10 dB] above the handover triggering level, then the UE shall use a 320 ms estimation period for the burst quality evaluation and for the Special Burst detection window.

UE shall subsequently resume the uplink transmission of the CCTrCH if the following criteria are fulfilled:

- The UE estimates the received dedicated CCTrCH burst reception quality over the last 160 ms period to be better than a threshold Q_{in} or the UE detects a burst with quality above threshold Q_{sbin} and TFCI decoded to be that of the Special Burst. Q_{in} and Q_{sbin} are defined implicitly by the relevant tests in [2]. If the UE detects the beacon channel reception level [10 dB] above the handover triggering level, then the UE shall use a 320 ms estimation period for the burst quality evaluation and for the Special Burst detection window.

5.1.1 Uplink Control

5.1.1.1 General limits

By means of higher layer signalling, the Maximum_Allowed_UL_TX_ power for uplink may be set to a value lower than what the terminal power class is capable of. The total transmit power shall not exceed the allowed maximum. If this would be the case, then the transmit power of all uplink physical channels in a timeslot is reduced by the same amount in dB.

The UTRAN may not expect the UE to be capable of reducing its total transmit power below the minimum level specified in [2].

5.1.1.2 UpPCH

The transmit power for the UpPCH is set by higher layers based on open loop power control as described in [15].

5.1.1.3 PRACH

The transmit power for the PRACH is set by higher layers based on open loop power control as described in [15].

5.1.1.4 DPCH and PUSCH

The closed loop power control makes use of layer 1 symbols in the DPCH and PUSCH. The power control step can take the values 1,2,3 dB within the overall dynamic range 80dB. The initial transmission power for uplink DPCH and PUSCH is signalled by higher layers.

Closed-loop TPC may be~~is~~ based on SIR. ~~and~~ ~~the~~ TPC ~~processing~~ procedures are described in ~~this~~ the current section.

The node B should estimate signal-to-interference ratio SIR_{est} of the received uplink DPCH or PUSCH, respectively. The node B should then generate TPC commands and transmit the commands according to the following rule: if $SIR_{est} > SIR_{target}$ then the TPC command to transmit is "down", while if $SIR_{est} < SIR_{target}$ then the TPC command to transmit is "up".

At the UE~~, soft~~ ~~decision on the TPC bits is performed, and~~ when ~~it~~ the TPC command is judged as ‘down’, the mobile transmit power shall be reduced by one power control step, whereas if it is judged as ‘up’, the mobile transmit power shall be raised by one power control step. A higher layer outer loop adjusts the target SIR. This scheme allows quality based power control.

The closed loop power control procedure for UL DPCH and PUSCH is not affected by the use of TSTD.

An example of UL power control procedure for DPCH is given in Annex A.2~~3~~.

In the event of no associated uplink data being transmitted between two related downlink TPC commands, the UE shall ignore the resulting TPC command. The transmit power for the next instance of the timeslot/CCTrCH pair shall then be set using the open loop procedure as for initial transmissions.

5.1.1.4.1 Gain Factors

Same as that of 3.84 Mcps TDD, cf. [4.2.2.3.1 Gain Factors].

5.1.1.4.2 Out of synchronization handling

Same as that of 3.84 Mcps TDD, cf.[4.2.2.3.2 ~~4.2.2.3.3~~ Out of synchronisation handling].

5.1.2 Downlink Control

5.1.2.1 P-CCPCH

Same as that of 3.84 Mcps TDD, cf.[4.2.3.1 P-CCPCH].

5.1.2.2 The power of the FPACH

The transmit power for the FPACH is set by the higher layer signalling [16].

5.1.2.3 S-CCPCH, PICH

Same as that of 3.84 Mcps TDD, cf.[4.2.3.2 S-CCPCH , PICH].

5.1.2.4 DPCH, PDSCH

The initial transmission power of the downlink Dedicated Physical Channel is set by the higher layer signalling until the first UL DPCH or PUSCH arrives. After the initial transmission, the node B transits into ~~SIR-based~~ closed-loop TPC.

The UE should estimate signal-to-interference ratio SIR_{est} of the received downlink DPCH or PDSCH, respectively. The UE should then generate TPC commands and transmit the commands according to the following rule: if $SIR_{est} > SIR_{target}$ then the TPC command to transmit is "down", while if $SIR_{est} < SIR_{target}$ then the TPC command to transmit is "up".

At the Node B~~, soft decision on the TPC bits is performed, and~~ when ~~it~~ the TPC command is judged as ‘down’, the transmission power may be reduced by one power control step, whereas if judged as ‘up’, the transmission power ~~shall~~ may be raised by one power control step.

When TSTD is applied, the UE can use two consecutive measurements of the received SIR in two consecutive sub-frames to generate the power control command. An example implementation of DL power control procedure for 1.28 Mcps TDD when TSTD is applied is given in Annex A.3.

The transmission power of one DPCH or PDSCH shall not exceed the limits set by higher layer signalling by means of Maximum_DL_Power (dB) and Minimum_DL_Power (dB). The transmission power is defined as the average power over one timeslot of the complex QPSK (or 8PSK respectively) symbols of a single DPCH or PDSCH before spreading relative to the power of the P-CCPCH.

During a downlink transmission pause, ~~both UE and~~the Node B shall ~~use the same TPC step size, which is signalled by higher layers. The UTRAN may accumulate the~~ignore TPC commands received during the pause. ~~TPC commands that shall be regarded as identical may only be counted once. The initial UTRAN transmission power for the first data transmission after the pause may then be set to the sum of transmission power before the pause and a power offset according to the accumulated TPC commands. Additionally this sum may include a constant set by the operator and a correction term due to uncertainties in the reception of the TPC bits.~~

The total downlink transmission power at the Node B within one timeslot shall not exceed Maximum Transmission Power set by higher layer signalling. If the total transmit power of all channels in a timeslot exceeds this limit, then the transmission power of all downlink DPCHs and PDSCHs shall be reduced by the same amount in dB. The value for this power reduction is determined, so that the total transmit power of all channels in this timeslot is equal to the maximum transmission power.

5.1.2.4.1 Out of synchronisation handling

Same as that of 3.84 Mcps TDD, cf.[4.2.3.4.1 Out of synchronisation handling].

5.2 UL Synchronisation

5.2.1 General Description

Support of UL synchronization is mandatory for the UE.

5.2.1.1 Preparation of uplink synchronization (downlink synchronization)

When a UE is powered on, it first needs to establish the downlink synchronisation with the cell. Only after the UE has established the downlink synchronisation, it shall start the uplink synchronisation procedure.

5.2.1.2 Establishment of uplink synchronization

The establishment of uplink synchronization is done during the random access procedure and involves the UpPCH and the PRACH.

Although the UE can receive the downlink signal from the Node B, the distance to Node B is still uncertain. This would lead to unsynchronised uplink transmission. Therefore, the first transmission in the uplink direction is performed in a special time-slot UpPTS to reduce interference in the traffic time-slots.

The timing used for the UpPCH is set e.g., ~~e.g.~~ according to the received power level of DwPCH and/or P-CCPCH.

After the detection of the SYNC-UL sequence in the searching window, the Node B will evaluate the timing, and reply by sending the adjustment information to the UE to modify its timing for next transmission. This is done with the FPACH within the following 4 sub-frames. After sending the PRACH the uplink synchronization is established. The uplink synchronisation procedure shall also be used for the re-establishment of the uplink synchronisation when uplink is out of synchronisation.

5.2.1.3 Maintenance of uplink synchronisation

Uplink synchronization is maintained in 1.28 ~~1,28~~ Mcps TDD by sending the uplink advanced in time with respect to the timing of the received downlink.

For the maintenance of the uplink synchronization, the midamble field of each uplink burst can be used.

In each uplink time slot the midamble for each UE is different. The Node B may estimate the timing by evaluating the channel impulse response of each UE in the same time slot. Then, in the next available downlink time slot, the Node B will signal Synchronisation Shift (SS) commands to enable the UE to properly adjust its Tx timing.

5.2.2 UpPCH

Open loop uplink synchronisation control is used for UpPCH.

The UE may estimate the propagation delay Δt_p based upon the path loss using the received P-CCPCH and/or DwPCH power.

The UpPCH is sent to the Node B advanced in time according to the timing of the received DwPCH. The time of the beginning of the UpPCH $T_{TX\text{-}UpPCH}$ is given by:

$$T_{TX\text{-}UpPCH} = T_{RX\text{-}DwPCH} - 2\Delta t_p + 12*16\ T_C$$

in multiple of 1/8 chips, where

$T_{TX\text{-}UpPCH}$ is the beginning time of UpPCH transmission with the UE’s timing,

$T_{RX\text{-}DwPCH}$ is the received beginning time of DwPCH with the UE’s timing,

$2\Delta t_p$ is the timing advance of the UpPCH ($UpPCH_{ADV}$).

5.2.3 PRACH

The Node B shall measure the received SYNC-UL timing deviation $UpPCH_{POS}$. $UpPCH_{POS}$ is sent in the FPACH and is represented as an 11 bit number (0-2047) being the multiple of 1/8 chips which is nearest to received position of the UpPCH.

Time of the beginning of the PRACH $T_{TX\text{-}PRACH}$ is given by:

$$T_{TX\text{-}PRACH} = T_{RX\text{-}PRACH} -(UpPCH_{ADV} + UpPCH_{POS} - 8*16\ T_C)$$

in multiple of 1/8 chips, where

$T_{TX\text{-}PRACH}$ is the beginning time of PRACH transmission with the UE's timing,

$T_{RX\text{-}PRACH}$ is the beginning time of PRACH reception with the UE's timing if the PRACH was a DL channel.

5.2.4 DPCH and PUSCH

The closed loop uplink synchronisation control uses layer 1 symbols (SS commands) for DPCH and PUSCH. After establishment of the uplink synchronisation, NodeB and UE start to use the closed loop UL synchronisation control procedure. This procedure is continuous during connected mode.

The Node B will continuously measure the timing of the UE and send the necessary synchronisation shift commands in each sub-frame. The UE shall derive a single SS command separately for each controlled uplink timeslot by combining all received SS commands that are related to the controlled time slot (cf. [8]) and that are received within the last up to M sub-frames. The value of the "Uplink synchronisation frequency" M (1..8) is configured by higher layers.

When the combined SS command is judged as 'down', the UE transmit timing for the controlled UL timeslot shall be delayed by one timing adjustment step of k/8 chips. When the command is judged as 'up', the UE transmit timing for the controlled UL timeslot shall be advanced by one timing adjustment step of k/8 chips. When the command is judged as 'do nothing', the timing shall not be changed. The value of the "Uplink synchronisation step size" k (1..8) is configured by higher layers.

The timing adjustment shall take place in each sub-frame satisfying the following equation:

$$SFN' \bmod M = 0$$

where

SFN' is the system frame number counting the sub-frames. The system frame number of the radio frames (SFN) can be derived from SFN' by

SFN=SFN' div 2, where div is the remainder free division operation.

During a 1.28 Mcps TDD to 1.28 Mcps TDD hand-over the UE shall transmit in the new cell with timing advance TA adjusted by the relative timing difference Δt between the new and the old cell if indicated by higher layers:

$$TA_{new} = TA_{old} + 2\Delta t.$$

5.2.4.1 Out of synchronization handling

Same as that of 3,84 Mcps TDD, cf.[4.2.2.3.2 ~~4.2.2.3.3~~ Out of synchronisation handling.]

5.6.3.1 The use and generation of the information fields transmitted in the FPACH

The Fast Physical Access CHannel (FPACH) is used by the Node B to carry, in a single burst, the acknowledgement of a detected signature with timing and power level adjustment indication to a user equipment.

The length and coding of the information fields is explained in TS25.221 sub-clause 5A.3.3.1 ~~6.3.3.1~~.

A.2 Example Implementation of Closed Loop Uplink Power Control in Node B for 1.28 ~~1,28~~ Mcps TDD

The measurement of received SIR shall be carried out periodically at Node B. When the measured value is higher than the target SIR value, TPC command = "down". When the measurement is lower than or equal to the target SIR, TPC command = "up".

In case of an uplink transmission pause on DPCH, the initial uplink transmission power of DPCH after the pause can be determined by an open loop power control. After the initial transmission after the pause, a closed loop uplink power control procedure can resume.

A.3 Example Implementation of Downlink Power Control in UE for 1.28 ~~1,28~~ Mcps TDD when TSTD is used

When TSTD is applied, the UE can use the consec~~q~~utive measurements of SIR to calculate SIR_{AVG}:

$$SIR_{AVG}(i) = w_1 SIR(i-1) + w_2 SIR(i),$$

where, $w_1 + w_2 = 1$, $w_1 >= 0$, $w_2 >= 0$, and SIR(i) is the measurement of SIR in sub-frame i and $SIR_{AVG}(i)$ is the measurement of SIR_{AVG} in sub-frame i. If SIR_{AVG} is greater than the target SIR value, TPC command = "down". If the SIR_{AVG} is smaller than the target SIR value, TPC command = "up".

In case of a downlink transmission pause on the DPCH, the example in Annex A.1 can be used for DL power control with $RSCP_{virt}(i)$ and ISCP(i) replaced by $RSCP_{AVG}(i)$ and $ISCP_{AVG}(i)$, where

$$RSCP_{AVG}(i) = w_1 RSCP_{virt}(i-1) + w_2 RSCP_{virt}(i),$$

$$ISCP_{AVG}(i) = w_1 ISCP(i-1) + w_2 ISCP(i).$$

A.4 Example Implementation of open Loop Power Control for access procedure for 1.28 ~~1,28~~ Mcps TDD

The higher layer signals (on BCH) a power increment that is applied only for the access procedure. At each new transmission of a SYNC-UL burst during the access procedure, the transmit power level can be increased by this power increment.

Annex C (informative):
Cell search procedure for 3.84 ~~3,84~~ Mcps TDD

During the cell search, the UE searches for a cell and determines the downlink scrambling code, basic midamble code and frame synchronisation of that cell. The cell search is typically carried out in three steps:

Step 1: Primary synchronisation code acquisition

During the first step of the cell search procedure, the UE uses the SCH's primary synchronisation code to find a cell. This is typically done with a single matched filter (or any similar device) matched to the primary synchronisation code which is common to all cells. A cell can be found by detecting peaks in the matched filter output.

Note that for a cell of SCH slot configuration case 1, the SCH can be received periodically every 15 slots. In case of a cell of SCH slot configuration case 2, the following SCH slot can be received at offsets of either 7 or 8 slots from the previous SCH slot.

Step 2: Code group identification and slot synchronisation

During the second step of the cell search procedure, the UE uses the SCH's secondary synchronisation codes to identify 1 out of 32 code groups for the cell found in the first step. This is typically done by correlating the received signal with the secondary synchronisation codes at the detected peak positions of the first step. The primary synchronisation code provides the phase reference for coherent detection of the secondary synchronisation codes. The code group can then uniquely be identified by detection of the maximum correlation values.

Each code group indicates a different t_{offset} parameter and 4 specific cell parameters. Each of the cell parameters is associated with one particular downlink scrambling code and one particular long and short basic midamble code. When the UE has determined the code group, it can unambiguously derive the slot timing of the found cell from the detected peak position in the first step and the t_{offset} parameter of the found code group in the second step.

Note that the modulation of the secondary synchronisation codes also indicates the position of the SCH slot within a 2 frames period, e.g. a frame with even or odd SFN. Additionally, in the case of SCH slot configuration following case 2, the SCH slot position within one frame, e.g. first or last SCH slot, can be derived from the modulation of the secondary synchronisation codes.

Step 3: Downlink scrambling code, basic midamble code identification and frame synchronisation

During the third and last step of the cell search procedure, the UE determines the exact downlink scrambling code, basic midamble code and frame timing used by the found cell. The long basic midamble code can be identified by correlation over the P-CCPCH (or any other beacon channel) with the 4 possible long basic midamble codes of the code group found in the second step. A P-CCPCH (or any other beacon channel) always uses the midamble $m^{(1)}$ (and in case of SCTD also midamble $m^{(2)}$) derived from the long basic midamble code and always uses a fixed and pre-assigned channelisation code.

When the long basic midamble code has been identified, downlink scrambling code and cell parameter are also known. The UE can read system and cell specific BCH information and acquire frame synchronisation.

Note that even for an initial cell parameter assignment, a cell cycles through a set composed of 2 different cell parameters according to the SFN of a frame, e.g. the downlink scrambling code and the basic midamble code of a cell alternate for frames with even and odd SFN. Cell parameter cycling leaves the code group of a cell unchanged.

If the UE has received information about which cell parameters or SCH configurations to search for, cell search can be simplified.

Annex CA (informative):
Cell search procedure for 1.28 ~~1,28~~ Mcps TDD

During the initial cell search, the UE searches for a cell. It then determines the DwPTS synchronization, scrambling and basic midamble code identification, control multi-frame synchronisation and then reads the contents in BCH. This initial cell search is carried out in 4 steps:

Step 1: Search for DwPTS

During the first step of the initial cell search procedure, the UE uses the SYNC-DL (in DwPTS) to acquire DwPTS synchronization to a cell. This is typically done with one or more matched filters (or any similar device) matched to the received SYNC-DL which is chosen from PN sequences set. A single or more matched filter (or any similar device) is used for this purpose. During this procedure, the UE needs to identify which of the 32 possible SYNC-DL sequences is used.

Step 2: Scrambling and basic midamble code identification

During the second step of the initial cell search procedure, the UE receives the midamble of the P-CCPCH.The P-CCPCH is followed by the DwPTS. In the 1.28 ~~1,28~~ Mcps TDD each DwPTS code corresponds to a group of 4 different basic midamble code. Therefore there are total 128 midamble codes and these codes are not overlapping with each other. Basic midamble code number divided by 4 gives the SYNC-DL code number. Since the SYNC-DL and the group of basic midamble codes of the P-CCPCH are related one by one (i.e, once the SYNC-DL is detected, the 4 midamble codes can be determined), the UE knows which 4 basic midamble codes are used. Then the UE can determine the used basic midamble code using a try and error technique. The same basic midamble code will be used throughout the frame. As each basic midamble code is associated with a scrambling code, the scrambling code is also known by that time. According to the result of the search for the right midamble code, UE may go to next step or go back to step 1.

Step 3: Control multi-frame synchronisation

During the third step of the initial cell search procedure, the UE searches for the MIB(Master Indication Block) of multi-frame of the BCH in the P-CCPCH indicated by QPSK phase modulation of the DwPTS with respect to the P-CCPCH midamble. The control multi-frame is positioned by a sequence of QPSK symbols modulated on the DwPTS. [n] consecutive DwPTS are sufficient for detecting the current position in the control multi-frame. According to the result of the control multi-frame synchronisation for the right midamble code, UE may go to next step or go back to step 2.

Step 4: Read the BCH

The (complete) broadcast information of the found cell in one or several BCHs is read. According to the result the UE may move back to previous steps or the initial cell search is finished.

Annex CB (informative): Examples random access procedure for 1.28 ~~1,28~~ Mcps TDD

Table CB.1: One PRACH, TTI=5ms, WT=4, L =1, SF4 PRACH

Sub-frame Number	0	1	2	3	4	5	6	7	8	9	10
Users sending on UpPCH	1 2	3 4	5 6	7 8							
Acknowledged user on FPACH		1	2	3	4	5	6	7			
User sending on PRACH 0				1	2	3	4	5	6	7	

User 8 is not granted because more than 5 sub-frames would have passed since the UpPCH.

Table CB.2: Two PRACHs, TTI=10ms, WT=4, L =2, SF8 PRACH

Sub-frame Number	0	1	2	3	4	5	6	7	8	9	10	11
Users sending on UpPCH	1 2	3 4	5 6	7 8								
Acknowledged user on FPACH		1	2	3	4	5	6	7				
User sending on PRACH 0					2	2	4	4	6	6		
User sending on PRACH 1					1	1	3	3	5	5	7	7

User 8 is not granted because more than 5 sub-frames would have passed since the UpPCH.

Table CB.3: Four PRACHs, TTI=20ms, WT=4, L =4, SF16 PRACH

Sub-frame Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Users sending on UpPCH	1 2	3 4	5 6	7 8										
Acknowledged user on FPACH		1	2	3	4	5	6	7						
User sending on PRACH 0							4	4	4	4				
User sending on PRACH 1					1	1	1	1	5	5	5	5		
User sending on PRACH 2					2	2	2	2	6	6	6	6		
User sending on PRACH 3							3	3	3	3	7	7	7	7

User 8 is not granted because more than 5 sub-frames would have passed since the UpPCH.

Table CB.4: Two PRACHs, TTI=20ms, WT=4, L =4, SF16 PRACH

Sub-frame Number	0	1	2	3	4	5	6	7	8	9	10	11	12
Users sending on UpPCH	1 2	3 4	5 6	7 8									
Acknowledged user on FPACH	X	1			2	3			X	X			
User sending on PRACH 0							2	2	2	2			
User sending on PRACH 1					1	1	1	1	3	3	3	3	

The FPACH is used ONLY in sub-frames 0, 1, 4, 5, 8, 9,… because they correspond to the used RACH resources.

The FPACH in sub-frame 0 is not used because no UpPCH is preceding.

The FPACH in sub-frames 8,9 is not used because no UpPCH is preceding in the last 4 sub-frames.

In contrast to the previous examples users 4,5,6,7 are not granted because they would not ~~no~~ lead to a RACH anyway. In this example their grant ~~grand~~ would come too late.

User 8 is not granted because more than 4 sub-frames would have passed since the UpPCH.

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CHANGE REQUEST

⌘	**25.224**	**CR**	**119**	⌘ **rev**	**2**	⌘	Current version:	**5.3.0** ⌘

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Proposed change affects: UICC apps⌘ ☐ ME ☒ Radio Access Network ☒ Core Network ☐

Title:	⌘	Corrections to the LCR power control procedure		
Source:	⌘	Siemens		
Work item code:	⌘	LCRTDDphys	***Date:*** ⌘	12/02/2003
Category:	⌘	**A**	***Release:*** ⌘	Rel-5
		Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

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Clauses affected:	⌘	5.1.1.1, 5.1.1.4, 5.1.2.4				
		Y	**N**			
Other specs Affected:	⌘		**N**	Other core specifications	⌘	
			N	Test specifications		
			N	O&M Specifications		
Other comments:	⌘					

4.2.2.3.2 Out of synchronisation handling

As stated in 4.2.3.4 ~~4.2.3.3~~, the association between TPC commands sent on uplink DPCH and PUSCH, with the power controlled downlink DPCH and PDSCH is signaled by higher layers. In the case of multiple DL CCTrCHs it is possible that an UL CCTrCH will provide TPC commands to more than one DL CCTrCH.

In the second phase of synchronisation evaluation, as defined in 4.4.2.1.2, the UE shall shut off the transmission of an UL CCTrCH if the following criteria are fulfilled for any one of the DL CCTrCHs commanded by its TPC:

- The UE estimates the received dedicated channel burst quality over the last 160 ms period to be worse than a threshold Q_{out}, and in addition, no special burst, as defined in 4.5, is detected with quality above a threshold, Q_{sbout}. Q_{out} and Q_{sbout} are defined implicitly by the relevant tests in [2]. If the UE detects the beacon channel reception level [10 dB] above the handover triggering level, then the UE shall use a 320 ms estimation period for the burst quality evaluation and for the Special Burst detection window.

UE shall subsequently resume the uplink transmission of the CCTrCH if the following criteria are fulfilled:

- The UE estimates the received dedicated CCTrCH burst reception quality over the last 160 ms period to be better than a threshold Q_{in} or the UE detects a burst with quality above threshold Q_{sbin} and TFCI decoded to be that of the Special Burst. Q_{in} and Q_{sbin} are defined implicitly by the relevant tests in [2]. If the UE detects the beacon channel reception level [10 dB] above the handover triggering level, then the UE shall use a 320 ms estimation period for the burst quality evaluation and for the Special Burst detection window.

4.9.3 Steady-State Phase

The steady-state phase is used to maintain the required synchronisation accuracy. With the start of the steady-state phase, traffic is supported in a cell. A procedure that may be used for the steady-state phase involves cell synch bursts [10] that are transmitted and received without effect on existing traffic. Higher layers signal the transmit parameters, i.e.,~~i. e.~~ when to transmit which code and code offset, and which transmit power to use. The higher layers also signal to appropriate cells the receive parameters i. e. which codes and code offsets to measure in a certain timeslot. Upon determination of errors in timing, the RNC may adjust the timing of a cell or cells.

5.1.1 Uplink Control

5.1.1.1 General limits

By means of higher layer signalling, the Maximum_Allowed_UL_TX_ power for uplink may be set to a value lower than what the terminal power class is capable of. The total transmit power shall not exceed the allowed maximum. If this would be the case, then the transmit power of all uplink physical channels in a timeslot is reduced by the same amount in dB.

The UTRAN may not expect the UE to be capable of reducing its total transmit power below the minimum level specified in [2].

5.1.1.2 UpPCH

The transmit power for the UpPCH is set by higher layers based on open loop power control as described in [15]

5.1.1.3 PRACH

The transmit power for the ~~UpPCH~~ PRACH is set by higher layers based on open loop power control as described in [15].

5.1.1.4 DPCH and PUSCH

The closed loop power control makes use of layer 1 symbols in the DPCH and PUSCH. The power control step can take the values 1,2,3 dB within the overall dynamic range 80dB. The initial transmission power for uplink DPCH and PUSCH is signalled by higher layers.

Closed-loop TPC may be~~is~~ based on SIR. ~~and the~~ TPC processing procedures are described in ~~this~~ the current section.

The node B should estimate signal-to-interference ratio SIR_{est} of the received uplink DPCH or PUSCH, respectively. The node B should then generate TPC commands and transmit the commands according to the following rule: if $SIR_{est} > SIR_{target}$ then the TPC command to transmit is "down", while if $SIR_{est} < SIR_{target}$ then the TPC command to transmit is "up".

At the UE~~, soft decision on the TPC bits is performed, and~~ when ~~it~~ the TPC command is judged as ‘down’, the mobile transmit power shall be reduced by one power control step, whereas if it is judged as ‘up’, the mobile transmit power shall be raised by one power control step. A higher layer outer loop adjusts the target SIR. This scheme allows quality based power control.

The closed loop power control procedure for UL DPCH and PUSCH is not affected by the use of TSTD.

An example of UL power control procedure for DPCH is given in Annex A.2~~3~~.

In the event of no associated uplink data being transmitted between two related downlink TPC commands, the UE shall ignore the resulting TPC command. The transmit power for the next instance of the timeslot/CCTrCH pair shall then be set using the open loop procedure as for initial transmissions.

5.1.1.4.1 Gain Factors

Same as that of 3.84 Mcps TDD, cf. [4.2.2.3.1 Gain Factors].

5.1.1.4.2 Out of synchronization handling

Same as that of 3.84 Mcps TDD, cf.[4.2.2.3.2 ~~4.2.2.3.3~~ Out of synchronisation handling].

5.1.1.5 HS-SICH

The transmit power of the HS-SICH shall be set by the UE according to the procedures described below. In the case that an ACK is being transmitted on the HS-SICH, the UE shall apply a power offset to the transmit power of the entire HS-SICH. This power offset shall be signalled by higher layers.

On receipt of a TPC command in the HS-SCCH, the UE shall adjust the HS-SICH transmit power according to the power control step size specified by higher layers. However, for the first HS-SICH transmission following the first detected HS-SCCH transmission, or the first HS-SICH transmission following a gap of one or more detected HS-SCCH transmissions to the UE, the UE shall use open loop power control to set the HS-SICH transmit power for that transmission. In this case, the transmit power of the HS-SICH, $P_{\text{HS-SICH}}$, shall be calculated using the following equation:

$$P_{\text{HS-SICH}} = L_{\text{P-CCPCH}} + PRX_{\text{HS-SICH,des}}$$

where $L_{\text{P-CCPCH}}$ is the measured pathloss from the NodeB (based on the P-CCPCH received power level) and $PRX_{\text{HS-SICH,des}}$ is the desired receive power level on the HS-SICH when a NAK is being transmitted, which shall be signalled to the UE by higher layers.

5.1.2.1 Downlink Control

5.1.2.1 P-CCPCH

Same as that of 3.84 Mcps TDD, cf.[4.2.3.1 P-CCPCH].

5.1.2.2 The power of the FPACH

The transmit power for the FPACH is set by the higher layer signalling [16].

5.1.2.3 S-CCPCH, PICH

Same as that of 3.84 Mcps TDD, cf.[4.2.3.2 S-CCPCH , PICH].

5.1.2.4 DPCH, PDSCH

The initial transmission power of the downlink Dedicated Physical Channel is set by the higher layer signalling until the first UL DPCH or PUSCH arrives. After the initial transmission, the node B transits into ~~SIR based~~ closed-loop TPC.

The UE should estimate signal-to-interference ratio SIR_{est} of the received downlink DPCH or PDSCH, respectively. The UE should then generate TPC commands and transmit the commands according to the following rule: if $SIR_{est} > SIR_{target}$ then the TPC command to transmit is "down", while if $SIR_{est} < SIR_{target}$ then the TPC command to transmit is "up".

At the Node B~~, soft decision on the TPC bits is performed, and~~ when ~~it~~ the TPC command is judged as ‘down’, the transmission power may be reduced by one power control step, whereas if judged as ‘up’, the transmission power ~~shall~~ may be raised by one power control step.

When TSTD is applied, the UE can use two consecutive measurements of the received SIR in two consecutive sub-frames to generate the power control command. An example implementation of DL power control procedure for 1.28 Mcps TDD when TSTD is applied is given in Annex A.3.

The transmission power of one DPCH or PDSCH shall not exceed the limits set by higher layer signalling by means of Maximum_DL_Power (dB) and Minimum_DL_Power (dB). The transmission power is defined as the average power over one timeslot of the complex QPSK (or 8PSK respectively) symbols of a single DPCH or PDSCH before spreading relative to the power of the P-CCPCH.

During a downlink transmission pause, ~~both UE and~~the Node B shall ~~use the same TPC step size, which is signalled by higher layers. The UTRAN may accumulate the~~ignore TPC commands received during the pause. ~~TPC commands that shall be regarded as identical may only be counted once. The initial UTRAN transmission power for the first data transmission after the pause may then be set to the sum of transmission power before the pause and a power offset according to the accumulated TPC commands. Additionally this sum may include a constant set by the operator and a correction term due to uncertainties in the reception of the TPC bits.~~

The total downlink transmission power at the Node B within one timeslot shall not exceed Maximum Transmission Power set by higher layer signalling. If the total transmit power of all channels in a timeslot exceeds this limit, then the transmission power of all downlink DPCHs and PDSCHs shall be reduced by the same amount in dB. The value for this power reduction is determined, so that the total transmit power of all channels in this timeslot is equal to the maximum transmission power.

5.1.2.4.1 Out of synchronisation handling

Same as that of 3.84 Mcps TDD, cf.[4.2.3.4.1 Out of synchronisation handling].

5.1.2.5 HS-PDSCH

The power control for HS-PDSCH for 1.28 Mcps TDD is the same as for 3.84 Mcps, see section 4.2.3.5

5.1.2.6 HS-SCCH

The power control for HS-SCCH for 1.28 Mcps TDD is the same as for 3.84 Mcps, see section 4.2.3.6

5.2.1.2 Establishment of uplink synchronization

The establishment of uplink synchronization is done during the random access procedure and involves the UpPCH and the PRACH.

Although the UE can receive the downlink signal from the Node B, the distance to Node B is still uncertain. This would lead to unsynchronised uplink transmission. Therefore, the first transmission in the uplink direction is performed in a special time-slot UpPTS to reduce interference in the traffic time-slots.

The timing used for the UpPCH is set e.g., according to the received power level of DwPCH and/or P-CCPCH.

After the detection of the SYNC-UL sequence in the searching window, the Node B will evaluate the timing, and reply by sending the adjustment information to the UE to modify its timing for next transmission. This is done with the FPACH within the following 4 sub-frames. After sending the PRACH the uplink synchronization is established. The uplink synchronisation procedure shall also be used for the re-establishment of the uplink synchronisation when uplink is out of synchronisation.

5.2.1.3 Maintenance of uplink synchronisation

Uplink synchronization is maintained in 1.28 ~~1,28~~ Mcps TDD by sending the uplink advanced in time with respect to the timing of the received downlink.

For the maintenance of the uplink synchronization, the midamble field of each uplink burst can be used.

In each uplink time slot the midamble for each UE is different. The Node B may estimate the timing by evaluating the channel impulse response of each UE in the same time slot. Then, in the next available downlink time slot, the Node B will signal Synchronisation Shift (SS) commands to enable the UE to properly adjust its Tx timing.

5.2.4.1 Out of synchronization handling

Same as that of 3,84 Mcps TDD, cf.[4.2.2.3.2 ~~4.2.2.3.3~~ Out of synchronisation handling.]

5.6.3.1 The use and generation of the information fields transmitted in the FPACH

The Fast Physical Access CHannel (FPACH) is used by the Node B to carry, in a single burst, the acknowledgement of a detected signature with timing and power level adjustment indication to a user equipment.

The length and coding of the information fields is explained in TS25.221 sub-clause 5A.3.3.1 ~~6.3.3.1~~.

5.9 HS-DSCH Procedure

The HS-DSCH procedure is the same as that of 3.84 ~~3,84~~ Mcps TDD, cf. 4.11 HS-DSCH Procedure.

A.2 Example Implementation of Closed Loop Uplink Power Control in Node B for 1.28 ~~1,28~~ Mcps TDD

The measurement of received SIR shall be carried out periodically at Node B. When the measured value is higher than the target SIR value, TPC command = "down". When the measurement is lower than or equal to the target SIR, TPC command = "up".

In case of an uplink transmission pause on DPCH, the initial uplink transmission power of DPCH after the pause can be determined by an open loop power control. After the initial transmission after the pause, a closed loop uplink power control procedure can resume.

A.3 Example Implementation of Downlink Power Control in UE for 1.28 ~~1,28~~ Mcps TDD when TSTD is used

When TSTD is applied, the UE can use the consec~~q~~utive measurements of SIR to calculate SIR_{AVG}:

$$SIR_{AVG}(i) = w_1 SIR(i-1) + w_2 SIR(i),$$

where, $w_1 + w_2 = 1$, $w_1 >= 0$, $w_2 >= 0$, and SIR(i) is the measurement of SIR in sub-frame i and $SIR_{AVG}(i)$ is the measurement of SIR_{AVG} in sub-frame i. If SIR_{AVG} is greater than the target SIR value, TPC command = "down". If the SIR_{AVG} is smaller than the target SIR value, TPC command = "up".

In case of a downlink transmission pause on the DPCH, the example in Annex A.1 can be used for DL power control with $RSCP_{virt}(i)$ and ISCP(i) replaced by $RSCP_{AVG}(i)$ and $ISCP_{AVG}(i)$, where

$$RSCP_{AVG}(i) = w_1 RSCP_{virt}(i-1) + w_2 RSCP_{virt}(i),$$

$$ISCP_{AVG}(i) = w_1 ISCP(i-1) + w_2 ISCP(i).$$

A.4 Example Implementation of open Loop Power Control for access procedure for 1.28 ~~1,28~~ Mcps TDD

The higher layer signals (on BCH) a power increment that is applied only for the access procedure. At each new transmission of a SYNC-UL burst during the access procedure, the transmit power level can be increased by this power increment.

Annex C (informative):
Cell search procedure for 3.84 ~~3,84~~ Mcps TDD

During the cell search, the UE searches for a cell and determines the downlink scrambling code, basic midamble code and frame synchronisation of that cell. The cell search is typically carried out in three steps:

Step 1: Primary synchronisation code acquisition

During the first step of the cell search procedure, the UE uses the SCH's primary synchronisation code to find a cell. This is typically done with a single matched filter (or any similar device) matched to the primary synchronisation code which is common to all cells. A cell can be found by detecting peaks in the matched filter output.

Note that for a cell of SCH slot configuration case 1, the SCH can be received periodically every 15 slots. In case of a cell of SCH slot configuration case 2, the following SCH slot can be received at offsets of either 7 or 8 slots from the previous SCH slot.

Step 2: Code group identification and slot synchronisation

During the second step of the cell search procedure, the UE uses the SCH's secondary synchronisation codes to identify 1 out of 32 code groups for the cell found in the first step. This is typically done by correlating the received signal with the secondary synchronisation codes at the detected peak positions of the first step. The primary synchronisation code provides the phase reference for coherent detection of the secondary synchronisation codes. The code group can then uniquely be identified by detection of the maximum correlation values.

Each code group indicates a different t_{offset} parameter and 4 specific cell parameters. Each of the cell parameters is associated with one particular downlink scrambling code and one particular long and short basic midamble code. When the UE has determined the code group, it can unambiguously derive the slot timing of the found cell from the detected peak position in the first step and the t_{offset} parameter of the found code group in the second step.

Note that the modulation of the secondary synchronisation codes also indicates the position of the SCH slot within a 2 frames period, e.g. a frame with even or odd SFN. Additionally, in the case of SCH slot configuration following case 2, the SCH slot position within one frame, e.g. first or last SCH slot, can be derived from the modulation of the secondary synchronisation codes.

Step 3: Downlink scrambling code, basic midamble code identification and frame synchronisation

During the third and last step of the cell search procedure, the UE determines the exact downlink scrambling code, basic midamble code and frame timing used by the found cell. The long basic midamble code can be identified by correlation over the P-CCPCH (or any other beacon channel) with the 4 possible long basic midamble codes of the code group found in the second step. A P-CCPCH (or any other beacon channel) always uses the midamble $m^{(1)}$ (and in case of SCTD also midamble $m^{(2)}$) derived from the long basic midamble code and always uses a fixed and pre-assigned channelisation code.

When the long basic midamble code has been identified, downlink scrambling code and cell parameter are also known. The UE can read system and cell specific BCH information and acquire frame synchronisation.

Note that even for an initial cell parameter assignment, a cell cycles through a set composed of 2 different cell parameters according to the SFN of a frame, e.g. the downlink scrambling code and the basic midamble code of a cell alternate for frames with even and odd SFN. Cell parameter cycling leaves the code group of a cell unchanged.

If the UE has received information about which cell parameters or SCH configurations to search for, cell search can be simplified.

Annex CA (informative):
Cell search procedure for 1.28 ~~1,28~~ Mcps TDD

During the initial cell search, the UE searches for a cell. It then determines the DwPTS synchronization, scrambling and basic midamble code identification, control multi-frame synchronisation and then reads the contents in BCH. This initial cell search is carried out in 4 steps:

Step 1: Search for DwPTS

During the first step of the initial cell search procedure, the UE uses the SYNC-DL (in DwPTS) to acquire DwPTS synchronization to a cell. This is typically done with one or more matched filters (or any similar device) matched to the received SYNC-DL which is chosen from PN sequences set. A single or more matched filter (or any similar device) is used for this purpose. During this procedure, the UE needs to identify which of the 32 possible SYNC-DL sequences is used.

Step 2: Scrambling and basic midamble code identification

During the second step of the initial cell search procedure, the UE receives the midamble of the P-CCPCH.The P-CCPCH is followed by the DwPTS. In the 1.28 ~~1,28~~ Mcps TDD each DwPTS code corresponds to a group of 4 different basic midamble code. Therefore there are total 128 midamble codes and these codes are not overlapping with each other. Basic midamble code number divided by 4 gives the SYNC-DL code number. Since the SYNC-DL and the group of basic midamble codes of the P-CCPCH are related one by one (i.e, once the SYNC-DL is detected, the 4 midamble codes can be determined), the UE knows which 4 basic midamble codes are used. Then the UE can determine the used basic midamble code using a try and error technique. The same basic midamble code will be used throughout the frame. As each basic midamble code is associated with a scrambling code, the scrambling code is also known by that time. According to the result of the search for the right midamble code, UE may go to next step or go back to step 1.

Step 3: Control multi-frame synchronisation

During the third step of the initial cell search procedure, the UE searches for the MIB(Master Indication Block) of multi-frame of the BCH in the P-CCPCH indicated by QPSK phase modulation of the DwPTS with respect to the P-CCPCH midamble. The control multi-frame is positioned by a sequence of QPSK symbols modulated on the DwPTS. [n] consecutive DwPTS are sufficient for detecting the current position in the control multi-frame. According to the result of the control multi-frame synchronisation for the right midamble code, UE may go to next step or go back to step 2.

Step 4: Read the BCH

The (complete) broadcast information of the found cell in one or several BCHs is read. According to the result the UE may move back to previous steps or the initial cell search is finished.

Annex CB (informative): Examples random access procedure for 1.28 ~~1,28~~ Mcps TDD

Table CB.1: One PRACH, TTI=5ms, WT=4, L =1, SF4 PRACH

Sub-frame Number	0	1	2	3	4	5	6	7	8	9	10
Users sending on UpPCH	1 2	3 4	5 6	7 8							
Acknowledged user on FPACH		1	2	3	4	5	6	7			
User sending on PRACH 0				1	2	3	4	5	6	7	

User 8 is not granted because more than 5 sub-frames would have passed since the UpPCH.

Table CB.2: Two PRACHs, TTI=10ms, WT=4, L =2, SF8 PRACH

Sub-frame Number	0	1	2	3	4	5	6	7	8	9	10	11
Users sending on UpPCH	1 2	3 4	5 6	7 8								
Acknowledged user on FPACH		1	2	3	4	5	6	7				
User sending on PRACH 0					2	2	4	4	6	6		
User sending on PRACH 1					1	1	3	3	5	5	7	7

User 8 is not granted because more than 5 sub-frames would have passed since the UpPCH.

Table CB.3: Four PRACHs, TTI=20ms, WT=4, L =4, SF16 PRACH

Sub-frame Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Users sending on UpPCH	1 2	3 4	5 6	7 8										
Acknowledged user on FPACH		1	2	3	4	5	6	7						
User sending on PRACH 0							4	4	4	4				
User sending on PRACH 1					1	1	1	1	5	5	5	5		
User sending on PRACH 2					2	2	2	2	6	6	6	6		
User sending on PRACH 3							3	3	3	3	7	7	7	7

User 8 is not granted because more than 5 sub-frames would have passed since the UpPCH.

Table CB.4: Two PRACHs, TTI=20ms, WT=4, L =4, SF16 PRACH

Sub-frame Number	0	1	2	3	4	5	6	7	8	9	10	11	12
Users sending on UpPCH	1 2	3 4	5 6	7 8									
Acknowledged user on FPACH	X	1			2	3			X	X			
User sending on PRACH 0							2	2	2	2			
User sending on PRACH 1					1	1	1	1	3	3	3	3	

The FPACH is used ONLY in sub-frames 0, 1, 4, 5, 8, 9,… because they correspond to the used RACH resources.

The FPACH in sub-frame 0 is not used because no UpPCH is preceding.

The FPACH in sub-frames 8,9 is not used because no UpPCH is preceding in the last 4 sub-frames.

In contrast to the previous examples users 4,5,6,7 are not granted because they would not ~~no~~ lead to a RACH anyway. In this example their grant ~~grand~~ would come too late.

User 8 is not granted because more than 4 sub-frames would have passed since the UpPCH.