

**TSG-RAN Meeting #8  
Düsseldorf, Germany, 21-23 June 2000**

**RP-000268**

**Title:** Agreed CRs to TS 25.214(1)

**Source:** TSG-RAN WG1

**Agenda item:** 5.1.3

No.	Doc #	Spec	CR	Rev	Subject	Cat	Current_v	New_v
1	R1-000499	25.214	084	-	Addition of CSICH power parameter	B	3.2.0	3.3.0
2	R1-000500	25.214	085	-	Correction to power control in compressed mode	F	3.2.0	3.3.0
3	R1-000566	25.214	086	1	Revisions to power control for CPCH	F	3.2.0	3.3.0
4	R1-000502	25.214	087	-	Corrections to uplink DCH power control sections	F	3.2.0	3.3.0
5	R1-000726	25.214	090	3	Level of specification of downlink power control	C	3.2.0	3.3.0
6	R1-000564	25.214	091	1	Clarification of TX diversity power setting	F	3.2.0	3.3.0
7	R1-000563	25.214	092	-	PICH undefined bits	C	3.2.0	3.3.0
8	R1-000761	25.214	095	1	DPDCH/DPCCH gain factors	F	3.2.0	3.3.0
9	R1-000787	25.214	096	3	Correction to RACH subchannel definition	F	3.2.0	3.3.0
10	R1-000588	25.214	097	1	The power setting of the CCC field of DL DPCCH	F	3.2.0	3.3.0
11	R1-000799	25.214	098	4	Procedure for end of transmission indicator in	B	3.2.0	3.3.0
12	R1-000607	25.214	099	-	Downlink inner-loop power control in compressed	C	3.2.0	3.3.0
13	R1-000617	25.214	100	-	Definition of vector transmission weight entity	F	3.2.0	3.3.0
14	R1-000783	25.214	101	1	Number of slots for DPCCH power control	C	3.2.0	3.3.0
15	R1-000658	25.214	102	-	Clarification of UTRAN Tx diversity response timing	F	3.2.0	3.3.0
16	R1-000742	25.214	103	2	Corrections to transmit diversity section	F	3.2.0	3.3.0
17	R1-000762	25.214	104	1	Corrections to uplink power control in compressed	F	3.2.0	3.3.0
18	R1-000699	25.214	105	-	Clarification of downlink power control mode	F	3.2.0	3.3.0
19	R1-000700	25.214	106	-	Clarification of radio link set	F	3.2.0	3.3.0
20	R1-000725	25.214	107	1	Clarification of radio link synchronisation	C	3.2.0	3.3.0

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**25.214 CR 084**

Current Version: **3.2.0**

GSM (AA.BB) or 3G (AA.BBB) specification number ↑

↑ CR number as allocated by MCC support team

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

**Source:**    TSG RAN WG1    **Date:**    2000-03-31

**Subject:**    Addition of CSICH Power Parameter

**Work item:**    \_\_\_\_\_

<b>Category:</b>	F Correction <input type="checkbox"/> A Corresponds to a correction in an earlier release <input type="checkbox"/> B Addition of feature <input checked="" type="checkbox"/> C Functional modification of feature <input type="checkbox"/> D Editorial modification <input type="checkbox"/>		<b>Release:</b>	Phase 2 <input type="checkbox"/> Release 96 <input type="checkbox"/> Release 97 <input type="checkbox"/> Release 98 <input type="checkbox"/> Release 99 <input checked="" type="checkbox"/> Release 00 <input type="checkbox"/>
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(only one category shall be marked with an X)

**Reason for change:**    Detection performance of CSICH can be optimised with power information

**Clauses affected:**    5.2.6

<b>Other specs affected:</b>	Other 3G core specifications <input type="checkbox"/> Other GSM core specifications <input type="checkbox"/> MS test specifications <input type="checkbox"/> BSS test specifications <input type="checkbox"/> O&M specifications <input type="checkbox"/>	→ List of CRs: → List of CRs: → List of CRs: → List of CRs: → List of CRs:	
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**Other comments:**    \_\_\_\_\_



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## 5.2 Downlink power control

The transmit power of the downlink channels is determined by the network. In general the ratio of the transmit power between different downlink channels is not specified and may change with time. However, regulations exist as described in the following subclauses.

### 5.2.1 DPCCH/DPDCH

#### 5.2.1.1 General

The downlink transmit power control procedure controls simultaneously the power of a DPCCH and its corresponding DPDCHs. The power control loop adjusts the power of the DPCCH and DPDCHs with the same amount, i.e. the relative power difference between the DPCCH and DPDCHs is not changed.

The relative transmit power offset between DPCCH fields and DPDCHs is determined by the network. The TFCI, TPC and pilot fields of the DPCCH are offset relative to the DPDCHs power by PO1, PO2 and PO3 dB respectively. The power offsets may vary in time.

#### 5.2.1.2 Ordinary transmit power control

The UE shall generate TPC commands to control the network transmit power and send them in the TPC field of the uplink DPCCH. An example on how to derive the TPC commands is given in Annex B.2.

When the UE is not in soft handover the TPC command generated is transmitted in the first available TPC field in the uplink DPCCH.

When the UE is in soft handover it should check the downlink power control mode (DPC\_MODE) before generating the TPC command:

- if DPC\_MODE = 0 : the UE sends a unique TPC command in each slot and the TPC command generated is transmitted in the first available TPC field in the uplink DPCCH;
- if DPC\_MODE = 1 : the UE repeats the same TPC command over 3 slots and the new TPC command is transmitted such that there is a new command at the beginning of the frame.

The DPC\_MODE parameter is a UE specific parameter controlled by the UTRAN.

As a response to the received TPC commands, UTRAN may adjust the downlink DPCCH/DPDCH power. The average power of transmitted DPDCH symbols over one timeslot shall not exceed Maximum\_DL\_Power(dBm), nor shall it be below Minimum\_DL\_Power (dBm). Transmitted DPDCH symbol means here a complex QPSK symbol before spreading which does not contain DTX. Maximum\_DL\_Power and Minimum\_DL\_Power are power limits for one spreading code.

Changes of power shall be a multiple of the minimum step size  $\Delta_{\text{TPC,min}}$  dB. It is mandatory for UTRAN to support  $\Delta_{\text{TPC,min}}$  of 1 dB, while support of 0.5 dB is optional.

UTRAN may further employ following method. If the value of *Limited Power Raise Used* parameter is 'Used', UTRAN shall not increase the DL power of the RL if it would exceed by more than *Power\_Raise\_Limit* dB the averaged DL power used in the last *DL\_Power\_Averaging\_Window\_Size* timeslots of the same RL. This shall only be applied after the first *DL\_Power\_Averaging\_Window\_Size* timeslots after the activation of this method.

*Power\_Raise\_Limit* and *DL\_Power\_Averaging\_Window\_Size* are parameters configured in the UTRAN.

When TPC commands cannot be generated in the UE due to downlink out-of-synchronisation, the TPC command transmitted shall be set as "1" during the period of out-of-synchronisation.

#### 5.2.1.3 Power control in compressed mode

The aim of downlink power control in uplink or/and downlink compressed mode is to recover as fast as possible a signal-to-interference ratio (SIR) close to the target SIR after each transmission gap.

The UE behaviour is the same in compressed mode as in normal mode, described in subclause 5.2.1.2.

The UTRAN behaviour during compressed mode is not specified. As an example, the algorithm can be similar to uplink power control in downlink compressed mode as described in subclause 5.1.2.3.

In downlink compressed mode or in simultaneous downlink and uplink compressed mode, the transmission of downlink DPCCH and DPDCH(s) is stopped.

## 5.2.1.4 Site selection diversity transmit power control

### 5.2.1.4.1 General

Site selection diversity transmit power control (SSDT) is an optional macro diversity method in soft handover mode.

Operation is summarised as follows. The UE selects one of the cells from its active set to be 'primary', all other cells are classed as 'non primary'. The main objective is to transmit on the downlink from the primary cell, thus reducing the interference caused by multiple transmissions in a soft handover mode. A second objective is to achieve fast site selection without network intervention, thus maintaining the advantage of the soft handover. In order to select a primary cell, each cell is assigned a temporary identification (ID) and UE periodically informs a primary cell ID to the connecting cells. The non-primary cells selected by UE switch off the transmission power. The primary cell ID is delivered by UE to the active cells via uplink FBI field. SSDT activation, SSDT termination and ID assignment are all carried out by higher layer signalling.

#### 5.2.1.4.1.1 Definition of temporary cell identification

Each cell is given a temporary ID during SSDT and the ID is utilised as site selection signal. The ID is given a binary bit sequence. There are three different lengths of coded ID available denoted as "long", "medium" and "short". The network decides which length of coded ID is used. Settings of ID codes for 1-bit FBI are exhibited in table 3 and table 4, respectively.

**Table 3: Settings of ID codes for 1 bit FBI**

ID label	ID code		
	"long"	"medium"	"short"
a	0000000000000000	(0)0000000	00000
b	101010101010101	(0)1010101	01001
c	011001100110011	(0)0110011	11011
d	110011001100110	(0)1100110	10010
e	000111100001111	(0)0001111	00111
f	101101001011010	(0)1011010	01110
g	011110000111100	(0)0111100	11100
h	110100101101001	(0)1101001	10101

**Table 4: Settings of ID codes for 2 bit FBI**

ID label	ID code (Column and Row denote slot position and FBI-bit position.)		
	"long"	"medium"	"short"
a	(0)0000000	(0)000	000
	(0)0000000	(0)000	000
b	(0)0000000	(0)000	000
	(1)1111111	(1)111	111
c	(0)1010101	(0)101	101
	(0)1010101	(0)101	101
d	(0)1010101	(0)101	101
	(1)0101010	(1)010	010
e	(0)0110011	(0)011	011
	(0)0110011	(0)011	011
f	(0)0110011	(0)011	011
	(1)1001100	(1)100	100
g	(0)1100110	(0)110	110
	(0)1100110	(0)110	110
h	(0)1100110	(0)110	110
	(1)0011001	(1)001	001

ID must be terminated within a frame. If FBI space for sending a given ID cannot be obtained within a frame, hence if the entire ID is not transmitted within a frame but must be split over two frames, the first bit(s) of the ID is(are) punctured. The relating bit(s) to be punctured are shown with brackets in table 3 and table 4.

#### 5.2.1.4.2 TPC procedure in UE

The TPC procedure of the UE in SSdT is identical to that described in subclause 5.2.1.2 or 5.2.1.3 in compressed mode.

#### 5.2.1.4.3 Selection of primary cell

The UE selects a primary cell periodically by measuring the RSCP of CPICHs transmitted by the active cells. The cell with the highest CPICH RSCP is detected as a primary cell.

#### 5.2.1.4.4 Delivery of primary cell ID

The UE periodically sends the ID code of the primary cell via portion of the uplink FBI field assigned for SSdT use (FBI S field). A cell recognises its state as non-primary if the following conditions are fulfilled simultaneously:

- the received primary ID code does not match with the own ID code;
- the received uplink signal quality satisfies a quality threshold,  $Q_{th}$ , a parameter defined by the network;
- and when the use of uplink compressed mode does not result in excessive levels of puncturing on the coded ID. The acceptable level of puncturing on the coded ID is less than  $(\text{int})N_{ID}/3$  symbols in the coded ID, where  $N_{ID}$  is the length of the coded ID.

Otherwise the cell recognises its state as primary.

The state of the cells (primary or non-primary) in the active set is updated synchronously. If a cell receives the last portion of the coded ID in uplink slot  $j$ , the state of cell is updated in downlink slot  $(j+1+T_{os}) \bmod 15$ , where  $T_{os}$  is defined as a constant of 2 time slots. The updating of the cell state is not influenced by the operation of downlink compressed mode.

At the UE, the primary ID code to be sent to the cells is segmented into a number of portions. These portions are distributed in the uplink FBI S-field. The cell in SSdT collects the distributed portions of the primary ID code and then detects the transmitted ID. The period of the primary cell update depends on the settings of the code length and the number of FBI bits assigned for SSdT use as shown in table 5.

**Table 5: Period of primary cell update**

code length	The number of FBI bits per slot assigned for SSDT	
	1	2
"long"	1 update per frame	2 updates per frame
"medium"	2 updates per frame	4 updates per frame
"short"	3 updates per frame	5 updates per frame

#### 5.2.1.4.5 TPC procedure in the network

In SSDT, a non-primary cell can switch off its DPDCH output (i.e. no transmissions).

The cell manages two downlink transmission power levels, P1, and P2. Power level P1 is used for downlink DPCCH transmission power level and this level is updated as the same way specified in 5.2.1.2 or 5.2.1.3 in compressed mode regardless of the selected state (primary or non-primary). The actual transmission power of TFCI, TPC and pilot fields of DPCCH is set by adding P1 and the offsets PO1, PO2 and PO3, respectively, as specified in 5.2.1.1. P2 is used for downlink DPDCH transmission power level and this level is set to P1 if the cell is selected as primary, otherwise P2 is switched off. The cell updates P1 first and P2 next, and then the two power settings P1 and P2 are maintained within the power control dynamic range. Table 6 summarizes the updating method of P1 and P2.

**Table 6: Updating of P1 and P2**

State of cell	P1 (DPCCH)	P2 (DPDCH)
non primary	Updated by the same way as specified in 5.2.1.2 or 5.2.1.3 in compressed mode	Switched off
primary		= P1

## 5.2.2 PDSCH

The PDSCH power control can be based on the following solutions, which are selectable, by the network:

- Inner-loop power control based on the power control commands sent by the UE on the uplink DPCCH.
- Slow power control.

## 5.2.3 AICH

The UE is informed about the relative transmit power of the AICH (measured as the power per transmitted acquisition indicator) compared to the primary CPICH transmit power by the higher layers.

## 5.2.4 PICH

The UE is informed about the relative transmit power of the PICH (measured as the power over the transmitted paging indicators, excluding the undefined part of the PICH frame) compared to the primary CPICH transmit power by the higher layers.

## 5.2.5 S-CCPCH

The TFCI and pilot fields may be offset relative to the power of the data field. The power offsets may vary in time.

## 5.2.6 CSICH

The UE is informed about the relative transmit power of the CSICH (measured as the power per transmitted status indicator) compared to the primary CPICH transmit power by the higher layers.

<b>CHANGE REQUEST</b>			Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.
<b>25.214</b>	<b>CR</b>	<b>085</b>	Current Version: <span style="background-color: yellow;">3.2.0</span>
GSM (AA.BB) or 3G (AA.BBB) specification number ↑		↑ CR number as allocated by MCC support team	
For submission to: <span style="background-color: yellow;">TSG-RAN #8</span> <i>list expected approval meeting # here</i>	for approval for information	<input checked="" type="checkbox"/> <input type="checkbox"/>	strategic <input type="checkbox"/> non-strategic <input type="checkbox"/> (for SMG use only)

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

**Source:** TSG RAN WG1                      **Date:** 2000-03-31

**Subject:** Correction to Power Control in Compressed Mode Recovery Period

**Work item:**  

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

**Reason for change:** Clarification of power control behaviour in compressed mode recovery period when a transmission gap starts within the recovery period

**Clauses affected:** 5.1.2.3

<b>Other specs affected:</b>	Other 3G core specifications <input type="checkbox"/> → List of CRs: Other GSM core specifications <input type="checkbox"/> → List of CRs: MS test specifications <input type="checkbox"/> → List of CRs: BSS test specifications <input type="checkbox"/> → List of CRs: O&M specifications <input type="checkbox"/> → List of CRs:	
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**Other comments:**  



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### 5.1.2.3 Transmit power control in compressed mode

In compressed mode, some frames are compressed and contain transmission gaps. The uplink power control procedure is as specified in clause 5.1.2.2, using the same UTRAN supplied parameters for Power Control Algorithm and step size ( $\Delta_{\text{TPC}}$ ), but with additional features which aim to recover as rapidly as possible a signal-to-interference ratio (SIR) close to the target SIR after each transmission gap.

In compressed mode, compressed frames may occur in either the uplink or the downlink or both. In uplink compressed frames, the transmission of uplink DPDCH(s) and DPCCH shall both be stopped during transmission gaps.

Due to the transmission gaps in compressed frames, there may be missing TPC commands in the downlink. If no downlink TPC command is transmitted, the corresponding TPC\_cmd derived by the UE shall be set to zero.

Compressed and non-compressed frames in the uplink DPCCH may have a different number of pilot bits per slot. A change in the transmit power of the uplink DPCCH would be needed in order to compensate for the change in the total pilot energy. Therefore at the start of each slot the UE shall derive the value of a power offset  $\Delta_{\text{PILOT}}$ . If the number of pilot bits per slot in the uplink DPCCH is different from its value in the most recently transmitted slot,  $\Delta_{\text{PILOT}}$  (in dB) shall be given by:

$$\Delta_{\text{PILOT}} = 10 \text{Log}_{10} (N_{\text{pilot,prev}}/N_{\text{pilot,curr}})$$

where  $N_{\text{pilot,prev}}$  is the number of pilot bits in the most recently transmitted slot, and  $N_{\text{pilot,curr}}$  is the number of pilot bits in the current slot. Otherwise, including during transmission gaps in the downlink,  $\Delta_{\text{PILOT}}$  shall be zero.

Unless otherwise specified, in every slot during compressed mode the UE shall adjust the transmit power of the uplink DPCCH with a step of  $\Delta_{\text{DPCCH}}$  (in dB) which is given by:

$$\Delta_{\text{DPCCH}} = \Delta_{\text{TPC}} \times \text{TPC\_cmd} + \Delta_{\text{PILOT}}$$

At the start of the first slot after an uplink transmission gap the UE shall apply a change in the transmit power of the uplink DPCCH by an amount  $\Delta_{\text{DPCCH}}$  (in dB), with respect to the uplink DPCCH power in the most recently transmitted uplink slot, where

$$\Delta_{\text{DPCCH}} = \Delta_{\text{RESUME}} + \Delta_{\text{PILOT}}$$

The value of  $\Delta_{\text{RESUME}}$  (in dB) shall be determined by the UE according to the Initial Transmit Power mode (ITP). The ITP is a UE specific parameter, which is signalled by the network with the other compressed mode parameters (see TS 25.215). The different modes are summarised in table 1.

**Table 1: Initial Transmit Power modes during compressed mode**

Initial Transmit Power mode	Description
0	$\Delta_{\text{RESUME}} = \Delta_{\text{TPC}} \times \text{TPC\_cmd}_{\text{gap}}$
1	$\Delta_{\text{RESUME}} = \delta_{\text{last}}$

In the case of a transmission gap in the uplink,  $\text{TPC\_cmd}_{\text{gap}}$  shall be the value of TPC\_cmd derived in the first slot of the uplink transmission gap, if a downlink TPC\_command is transmitted in that slot. Otherwise  $\text{TPC\_cmd}_{\text{gap}}$  shall be zero.

If a downlink TPC command is transmitted in the first slot of a downlink transmission gap, then  $\delta_{\text{last}}$  shall be equal to the value of  $\delta_i$  computed in the first slot of the downlink transmission gap. Otherwise  $\delta_{\text{last}}$  shall be equal to the value of  $\delta_i$  computed in the last slot before the downlink transmission gap.  $\delta_i$  shall be updated according to the following recursive relations, which shall be executed in all slots with simultaneous uplink and downlink DPCCH transmission and in the first slot of a downlink transmission gap if a downlink TPC command is transmitted in that slot:

$$\begin{aligned} \delta_i &= 0.9375\delta_{i-1} - 0.96875\text{TPC\_cmd}_i\Delta_{\text{TPC}} \\ \delta_{i-1} &= \delta_i \end{aligned}$$



$TPC\_cmd_i$  is the most recent power control command derived by the UE.

$\delta_{i-1}$  is the value of  $\delta_i$  computed for the previous slot. The value of  $\delta_{i-1}$  shall be initialised to zero when the uplink DPCCH is activated, and also at the end of the first slot after each downlink transmission gap. After a transmission gap in either the uplink or the downlink, the period following resumption of simultaneous uplink and downlink DPCCH transmission is called a recovery period. RPL is the recovery period length and is expressed as a number of slots. RPL is equal to the minimum value out of the transmission gap length and 7 slots. If a transmission gap is scheduled to start before RPL slots have elapsed, then the recovery period shall end at the start of the gap, and the value of RPL shall be reduced accordingly.

During the recovery period, 2 modes are possible for the power control algorithm. The Recovery Period Power control mode (RPP) is signalled with the other compressed mode parameters (see TS 25.215). The different modes are summarised in the table 2:

**Table 2: Recovery Period Power control modes during compressed mode**

Recovery Period power control mode	Description
0	Transmit power control is applied using the algorithm determined by the value of PCA, as in subclause 5.1.2.2 with step size $\Delta_{TPC}$
1	Transmit power control is applied using algorithm 1 (see subclause 5.1.2.2.2) with step size $\Delta_{RP-TPC}$ during RPL slots after each transmission gap.

For RPP mode 0, the step size is not changed during the recovery period and ordinary transmit power control is applied (see subclause 5.1.2.2), using the algorithm for processing TPC commands determined by the value of PCA (see subclauses 5.1.2.2.2 and 5.1.2.2.3).

For RPP mode 1, during RPL slots after each transmission gap, power UE control algorithm 1 is applied with a step size  $\Delta_{RP-TPC}$  instead of  $\Delta_{TPC}$ , regardless of the value of PCA. The change in uplink DPCCH transmit power (except for the first slot after the transmission gap) is given by

$$\Delta_{DPCCH} = \Delta_{RP-TPC} \times TPC\_cmd + \Delta_{PILOT}$$

$\Delta_{RP-TPC}$  is called the recovery power control step size and is expressed in dB. If PCA has the value 1,  $\Delta_{RP-TPC}$  is equal to the minimum value of 3 dB and  $2\Delta_{TPC}$ . If PCA has the value 2,  $\Delta_{RP-TPC}$  is equal to 1 dB.

After the recovery period, ordinary transmit power control resumes using the algorithm specified by the value of PCA and with step size  $\Delta_{TPC}$ .

If PCA has the value 2, the sets of slots over which the TPC commands are processed shall remain aligned to the frame boundaries in the compressed frame. For both RPP mode 0 and RPP mode 1, if the transmission gap or the recovery period results in any incomplete sets of TPC commands,  $TPC\_cmd$  shall be zero for those sets of slots which are incomplete.

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**25.214 CR 086r1**

Current Version: **3.2.0**

*GSM (AA.BB) or 3G (AA.BBB) specification number ↑*

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**Proposed change affects:**

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(U)SIM     ME     UTRAN / Radio     Core Network

**Source:**

**TSG RAN WG1**

**Date:**

**2000-04-12**

**Subject:**

**Revisions to Power Control for CPCH**

**Work item:**

**Category:**

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

F Correction   
 A Corresponds to a correction in an earlier release   
 B Addition of feature   
 C Functional modification of feature   
 D Editorial modification

**Release:**

Phase 2   
 Release 96   
 Release 97   
 Release 98   
 Release 99   
 Release 00

**Reason for change:**

To be consistent with changes agreed for uplink power control in other parts of Clause 5.1 ;  
 To clarify the relative power offsets of data and control parts of the CPCH message part;  
 To clarify the relative powers of the CPCH AP, CD preamble and power control preamble / message part.

**Clauses affected:**

**5.1.3 PCPCH, 6.2 CPCH Access Procedures**

**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:**



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## 5.1.3 PCPCH

### 5.1.3.1 General

The power control during the PCPCH access procedure is described in clause 6.2. The inner loop power control for the PCPCH is described in the following sub-clauses.

### 5.1.3.2 Power control in the message part

The uplink transmit power control procedure simultaneously controls the power of a PCPCH control part and its corresponding PCPCH data part. The relative transmit power offset between the PCPCH control part and the PCPCH data part is determined by the network and is computed according to sub-clause 5.1.2.5 using the gain factors signalled to the UE using higher-layer signalling, with the difference that:

- $\beta_c$  is the gain factor for the PCPCH control part (similar to DPCCCH);
- $\beta_d$  is the gain factor for the PCPCH data part (similar to DPDCH).

The gain factors are applied as shown in sub clause 4.2.3.2 of 25.213.

The operation of the inner power control loop adjusts the power of the PCPCH control part and PCPCH data part by the same amount, provided there are no changes in gain factors.

Any change in the uplink PCPCH control part transmit power shall take place immediately before the start of the pilot field on the control part of the message part. The change in PCPCH control part power with respect to its value in the previous slot is derived by the UE and is denoted by  $\Delta_{PCPCH-CP}$  (in dB).

During the operation of the uplink power control procedure the UE transmit power shall not exceed a maximum allowed value which is the lower out of the maximum output power of the terminal power class and a value which may be set by higher layer signalling.

Uplink power control shall be performed while the UE transmit power is below the maximum allowed output power. If the UE transmit power is below the required minimum output power [as defined in TS 25.101] and the derived value of  $\Delta_{PCPCH-CP}$  is less than zero, the UE may reduce the magnitude of  $\Delta_{PCPCH-CP}$ .

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,  $SIR_{target}$ , which is set by the higher layer outer loop.

The network should estimate the signal-to-interference ratio  $SIR_{est}$  of the received PCPCH. The network should then generate 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".

The UE derives a TPC command,  $TPC_{cmd}$ , for each slot. Two algorithms shall be supported by the UE for deriving a  $TPC_{cmd}$ , as described in subclauses 5.1.2.2.2.1 and 5.1.2.2.3.1. Which of these two algorithms is used is a higher-layer parameter under the control of the UTRAN. Which of these two algorithms is used is determined by a higher-layer parameter, "PowerControlAlgorithm", and is under the control of the UTRAN. If "PowerControlAlgorithm" indicates "algorithm1", then the layer 1 parameter PCA shall take the value 1 and if "PowerControlAlgorithm" indicates "algorithm2" then PCA shall take the value 2.

If PCA has the value 1, Algorithm 1, described in subclause 5.1.2.2.2, shall be used for processing TPC commands.

If PCA has the value 2, Algorithm 2, described in subclause 5.1.2.2.3, shall be used for processing TPC commands.

The step size  $\Delta_{TPC}$  is a layer 1 parameter which is derived from the higher-layer parameter "TPC-StepSize" which is under the control of the UTRAN. If "TPC-StepSize" has the value "dB1", then the layer 1 parameter  $\Delta_{TPC}$  shall take, that can have the values 1 dB and if "TPC-StepSize" has the value "dB2", then  $\Delta_{TPC}$  shall take the value ~~or~~ 2 dB.

After deriving the TPC command  $TPC_{cmd}$  using one of the two supported algorithms, the UE shall adjust the transmit power of the uplink PCPCH control part with a step of  $\Delta_{TPCPCPCH-CP}$  (in dB) which is given by:

$$\Delta_{\text{PCPCH-CP}} = \Delta_{\text{TPC}} \times \text{TPC\_cmd}$$

according to the TPC command. If TPC\_cmd equals 1 then the transmit power of the uplink PCPCH shall be increased by  $\Delta_{\text{TPC}}$  dB. If TPC\_cmd equals -1 then the transmit power of the uplink PCPCH shall be decreased by  $\Delta_{\text{TPC}}$  dB. If TPC\_cmd equals 0 then the transmit power of the uplink PCPCH shall be unchanged.

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

### 5.1.3.25.1.3.3 Power control in the power control preamble

The UE commences the power control preamble using the same power level as was used for the CD preamble.

The initial power control step size used in the power control preamble differs from that used in the message part: if inner loop power control algorithm 1 is to be used in the message part, then the initial step size in the power control preamble is  $\Delta_{\text{TPC-init}}$  where  $\Delta_{\text{TPC-init}}$  is equal to the minimum value out of 3 dB and  $2\Delta_{\text{TPC}}$ , where  $\Delta_{\text{TPC}}$  is the power control step size used for the message part. If inner loop power control algorithm 2 is to be used in the message part, then inner loop power control algorithm 1 is used initially in the power control preamble, with a step size of 2dB. In either case, the power control algorithm and step size revert to those used for the message part as soon as the sign of the TPC commands reverses for the first time.

A power control preamble may be used for initialisation of a PCPCH. Both the UL PCPCH control part and associated DL DPCCH shall be transmitted during the uplink power control preamble. The uplink PCPCH data part shall not commence before the end of the power control preamble.

The length of the power control preamble is a higher layer parameter,  $L_{\text{pc-preamble}}$  (see section 6.2), and can take the value 0 slots or 8 slots.

If  $L_{\text{pc-preamble}} > 0$ , the details of power control used during the power control preamble differ from the ordinary power control which is used afterwards. After the first slot of the power control preamble the change in uplink PCPCH control part transmit power shall initially be given by:

$$\Delta_{\text{PCPCH-CP}} = \Delta_{\text{TPC-init}} \times \text{TPC\_cmd}$$

If the value of PCA is 1 then  $\Delta_{\text{TPC-init}}$  is equal to the minimum value out of 3 dB and  $2\Delta_{\text{TPC}}$ .

If the value of PCA is 2 then  $\Delta_{\text{TPC-init}}$  is equal to 2dB.

TPC\_cmd is derived according to algorithm 1 as described in sub clause 5.1.2.2.2, regardless of the value of PCA.

Power control as defined for the message part (see sub-clause 5.1.3.2), with the power control algorithm determined by the value of PCA and step size  $\Delta_{\text{TPC}}$  shall be used as soon as the sign of TPC\_cmd reverses for the first time, or at the end of the power control preamble if the power control preamble ends first.

## 6.2 CPCH Access Procedures

For each CPCH physical channel in a CPCH set allocated to a cell the following physical layer parameters are included in the System Information message: L1 shall receive the following information from the higher layers (RRC).

- UL Access Preamble (AP) scrambling code.
- UL Access Preamble signature set
- The Access preamble slot sub-channels group
- AP- AICH preamble channelization code.
- UL Collision Detection(CD) preamble scrambling code.
- CD Preamble signature set
- CD preamble slot sub-channels group
- CD-AICH preamble channelization code.
- CPCH UL scrambling code.
- DPCCH DL channelization code.([512] chip)

NOTE: There may be some overlap between the AP signature set and CD signature set if they correspond to the same scrambling code.

The following physical layer parameters are received from the RRC layer:

- 1)  $N_{AP\_retrans\_max}$  = Maximum Number of allowed consecutive access attempts (retransmitted preambles) if there is no AICH response. This is a CPCH parameter and is equivalent to Preamble\_Retrans\_Max in RACH.
- 2)  $P_{RACH} = P_{CPCH}$  = Initial open loop power level for the first CPCH access preamble sent by the UE.  
[RACH/CPCH parameter]
- 3)  $\Delta P_0$  = Power step size for each successive CPCH access preamble.  
[RACH/CPCH parameter]
- 4)  $\Delta P_1$  = Power step size for each successive RACH/CPCH access preamble in case of negative AICH. A timer is set upon receipt of a negative AICH. This timer is used to determine the period after receipt of a negative AICH when  $\Delta P_1$  is used in place of  $\Delta P_0$ .  
[RACH/CPCH parameter]
- 5)  $\Delta P_{p-m} = P_{message-control} - P_{cd}$ , measured in dB. This is the power offset between the transmit power of the CD preamble and the initial transmit power of the CPCH power control preamble (or the control part of the CPCH message part if the power control preamble length is 0 slots).  
[CPCH parameter]
- 56)  $T_{cpch}$  = CPCH transmission timing parameter: This parameter is identical to PRACH/AICH transmission timing parameter.  
[RACH/CPCH parameter]
- 67)  $L_{pc-preamble}$  = Length of power control preamble (0 or 8 slots)  
[CPCH parameter]
- 78)  $N_{Start\_Message}$  = Number of frames for the transmission of Start of Message Indicator in DL-DPCCH for CPCH
- 89) The set of Transport Format parameters. This includes a Transport Format to PCPCH mapping table.

L1 shall receive the following information from MAC prior to packet transmission:

- 1) Transport Format of the message part.
- 2) The data to be transmitted is delivered to L1 once every TTI until the data buffer is empty.

The overall CPCH -access procedure consists of two parts:

- 1) Upon receipt of a Status-REQ message from the MAC layer, the UE shall start monitoring the CSICH to determine the availability of the transport formats in the transport format subset included in the Status-REQ message. UTRAN transmits availability of each PCPCH or maximum available data rate with availability of each PCPCH over the CSICH in case CA is active. Upper layers will supply the UE with information to map the transport formats to the PCPCHs. The UE shall send a Status-CNF message to the MAC layer containing the transport format subset listing the transport formats of the requested subset which are currently indicated as 'available'.

The actual access procedure is then:

- 2) Upon receipt of the Access-REQ message from the MAC layer, which contains an identified transport format from the available ones, the following sequence of events occur. The use of step 2a or 2b depends on whether availability of each PCPCH or the Maximum available data rate along with the availability of each PCPCH is transmitted over CSICH. Note that in the first case, each access resource combination (AP signatures and access subchannel group) maps to each PCPCH resource and in the second case each access resource combination maps to each data rate.
  - 2a) (In case CA is not Active) The UE shall test the value(s) of the most recent transmission of the CSICH Status Indicator(s) corresponding to the PCPCH channel(s) for the identified transport format included in the Access-REQ message. If this indicates that no channel is 'available' the UE shall abort the access attempt and send a failure message to the MAC layer. The UE shall also retain the availability status of the each PCPCH for further verification in a later phase.
  - 2b) (In case CA is active) The CSICH Status Indicators indicate the maximum available data rate along with individual PCPCH availability. The UE shall test the value of the most recent transmission of the Status Indicator(s). If this indicates that the maximum available data rate is less than the requested data rate, the UE shall abort the access attempt and send a failure message to the MAC layer. The PHY provides the availability information to the MAC. The UE shall also retain the availability status of the each PCPCH for further channel assignment message verification in a later phase in case of success.
- 3) The UE sets the preamble transmit power to the value  $P_{\text{CPCH}}$  which is supplied by the MAC layer for initial power level for this CPCH access attempt.
- 4) The UE sets the AP Retransmission Counter to  $N_{\text{AP\_Retrans\_Max}}$ .
- 5a) In the case CA is not active, the uplink access slot and signature to be used for the CPCH-AP transmission are selected in the following steps:
  - a) The UE selects randomly one PCPCH from the set of available PCPCH channel(s) as indicated on the CSICH and supporting the identified transport format included in the Access-REQ message. The random function shall be such that each of the allowed selections is chosen with equal probability.
  - b) The UE randomly selects a CPCH-AP signature from the set of available signatures in the access resource combination corresponding to the selected PCPCH in step a). The random function shall be such that each of the allowed selections is chosen with equal probability.
  - c) Using the AP access slot sub-channel group of the access resource combination corresponding to selected PCPCH in step a), the UE derives the available CPCH-AP access slots in the next two frames, defined by SFN and SFN+1 with the help of SFN and table 7 in section 6.1. The UE randomly selects one access slot from the available access slots in the next frame, defined by SFN, if there is one available. If there is no access slot available in the next frame, defined by SFN then, randomly selects one access slot from the

available access slots in the following frame, defined by SFN+1. The random function shall be such that each of the allowed selections is chosen with equal probability.

- 5b) In the case CA is active, the uplink access slot and signature to be used for the CPCH-AP transmission are selected in the following steps:
- a) The UE randomly selects a CPCH-AP signature from the set of available signatures in the access resource combination corresponding to the transport format identified in the Access-REQ message. The random function shall be such that each of the allowed selections is chosen with equal probability.
  - b) Using the AP access slot sub-channel group of the access resource combination corresponding to the transport format identified in the Access-REQ message, the UE derives the available CPCH-AP access slots in the next two frames, defined by SFN and SFN+1 with the help of SFN and table 7 in section 6.1. The UE randomly selects one access slot from the available access slots in the next frame, defined by SFN, if there is one available. If there is no access slot available in the next frame, defined by SFN then, randomly selects one access slot from the available access slots in the following frame, defined by SFN+1. The random function shall be such that each of the allowed selections is chosen with equal probability.
- 6) The UE transmits the AP using the selected uplink access slot and signature, and MAC supplied initial preamble transmission power. The following sequence of events occur based on whether availability of each PCPCH or the Maximum available data rate along with the availability of each PCPCH is transmitted over CSICH.
- 6a) (In case CA is not Active) The UE shall test the value of the most recent transmission of the Status Indicator corresponding to the identified CPCH transport channel immediately before AP transmission. If this indicates that the channel is 'not available' the UE shall abort the access attempt and send a failure message to the MAC layer. Otherwise the UE transmits the AP using the UE selected uplink signature and access slot, and the initial preamble transmission power from step 3, above.
- 6b) (In case CA is active) The Status Indicator indicates the maximum available data rate as well as the availability of each PCPCH. The UE shall test the value of the Status Indicator. If this indicates that the maximum available data rate is less than the requested data rate, the UE shall abort the access attempt and send a failure message to the MAC layer. Otherwise the UE shall transmit the AP using the UE selected uplink access slot, the MAC supplied signature and initial preamble transmission power from step 3, above.
- 7) If the UE does not detect the positive or negative acquisition indicator corresponding to the selected signature in the downlink access slot corresponding to the selected uplink access slot, the UE shall test the value of the most recent transmission of the Status Indicator corresponding to the selected PCPCH immediately before AP transmission. If this indicates that the PCPCH is 'not available' the UE shall abort the access attempt and send a failure message to the MAC layer. Otherwise the following steps shall be executed:
- a) Selects the new uplink access slot from the available access slot, i.e, next access slot in the sub-channel group used. There must be a minimum distance of three or four (per Tcpch parameter) access slots from the uplink access slot in which the last preamble was transmitted depending on the CPCH/AICH transmission timing parameter.
  - b) Increases the preamble transmission power with the specified offset  $\Delta P$ . Power offset  $\Delta P_0$  is used unless the negative AICH timer is running, in which case  $\Delta P_1$  is used instead.
  - c) Decrease the AP Retransmission Counter by one.
  - d) If the AP Retransmission Counter  $< 0$ , the UE aborts the access attempt and sends a failure message to the MAC layer.
- 8) If the UE detects the AP-AICH\_nak (negative acquisition indicator) corresponding to the selected signature in the downlink access slot corresponding to the selected uplink access slot, the UE aborts the access attempt and sends a failure message to the MAC layer. The UE sets the negative AICH timer to indicate use of  $\Delta P_1$  use as the preamble power offset until timer expiry
- 9) Upon reception of AP-AICH\_ack with matching signature, the access segment ends and the contention resolution segment begins. In this segment, the UE randomly selects a CD signature from the CD signature set and also selects one CD access slot sub-channel from the CD sub-channel group supported in the cell and transmits a CD Preamble at the same power as the last AP, then waits for a CD/CA-ICH and the channel assignment (CA) (in case CA is active) message from the Node B. The slot selection procedure is as follows:

- a) The next available slot when the PRACH and PCPCH scrambling code are not shared. Furthermore, the PCPCH AP preamble scrambling code and CD Preamble scrambling codes are different.
- b) When the PRACH and PCPCH AP preamble scrambling code and CD preamble scrambling code are shared, the UE randomly selects one of the available access slots in the next 12 access slots. Number of CD sub-channels will be greater than 2.
- 10) If the UE does not receive a CD/CA-ICH in the designated slot, the UE aborts the access attempt and sends a failure message to the MAC layer.
- 11) If the UE receives a CD/CA-ICH in the designated slot with a signature that does not match the signature used in the CD Preamble, the UE aborts the access attempt and sends a failure message to the MAC layer.
- 12a) (In case CA is not Active) If the UE receives a CDI from the CD/CA-ICH with a matching signature, the UE transmits the power control preamble  $\tau_{cd-p-pc-p}$  ms later as measured from initiation of the CD Preamble. The initial transmission power of the power control preamble shall be  $\Delta P_{p-m}$  [dB] higher than the power of the CD preamble. The inner loop power control in the power control preamble is described in sub clause 5.1.3.3. The transmission of the message portion of the burst starts immediately after the power control preamble. Power control in the message part is described in sub clause 5.1.3.2.
- 12b) (In case CA is active) If the UE receives a CDI from the CD/CA-ICH with a matching signature and CA message that points out to one of the PCPCH's (mapping rule is in [5]) that were indicated to be free by the last received CSICH broadcast, the UE transmits the power control preamble  $\tau_{cd-p-pc-p}$  ms later as measured from initiation of the CD Preamble. The initial transmission power of the power control preamble shall be  $\Delta P_{p-m}$  [dB] higher than the power of the CD preamble. The inner loop power control in the power control preamble is described in sub clause 5.1.3.3. The transmission of the message portion of the burst starts immediately after the power control preamble. Power control in the message part is described in sub clause 5.1.3.2. If the CA message received points out the channel that was indicated to be busy on the last status information transmission received on the CSICH, the UE shall abort the access attempt and send a failure message to the MAC layer.
- NOTE: If the  $L_{pc-preamble}$  parameter indicates a zero length preamble, then there is not power control preamble and the message portion of the burst starts  $\tau_{cd-p-pc-p}$  ms after the initiation of the CD Preamble. In this case the initial transmission power of the control part of the message part shall be  $\Delta P_{p-m}$  [dB] higher than the power of the CD preamble. Power control in the message part is described in sub clause 5.1.3.2
- 13) The UE shall test the value of Start of Message Indicator received from DL-DPCCH for CPCH during the first  $N_{Start\_Message}$  frames after Power Control preamble. Start of Message Indicator is a known sequence repeated on a frame by frame basis. The value of  $N_{Start\_Message}$  shall be provided by the higher layers.
- 14) If the UE does not detect Start of Message Indicator in the first  $N_{Start\_Message}$  frames of DL-DPCCH for CPCH after Power Control preamble, the UE aborts the access attempt and sends a failure message to the MAC layer. Otherwise, UE continuously transmits the packet data.
- 15) During CPCH Packet Data transmission, the UE and UTRAN perform inner-loop power control on both the CPCH UL and the DPCCH DL, as described in sub clause 5.1.3.
- 16) After the first  $N_{Start\_Message}$  frames after Power Control preamble, upon the detection of an Emergency Stop command sent by UTRAN, the UE halts CPCH UL transmission, aborts the access attempt and sends a failure message to the MAC layer.
- 17) If the UE detects loss of DPCCH DL during transmission of the power control preamble or the packet data, the UE halts CPCH UL transmission, aborts the access attempt and sends a failure message to the MAC layer.
- 18) If the UE completes the transmission of the packet data, the UE sends a success message to the MAC layer.



**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 087**

Current Version: **3.2.0**

GSM (AA.BB) or 3G (AA.BBB) specification number ↑

↑ CR number as allocated by MCC support team

For submission to: **TSG-RAN #8**  
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for approval   
for information

strategic   
non-strategic  *(for SMG use only)*

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

**Source:** TSG RAN WG1 **Date:** 2000-03-31

**Subject:** Corrections to uplink DCH power control sections

**Work item:**

<b>Category:</b>	F Correction	<input checked="" type="checkbox"/>	<b>Release:</b>	Phase 2	<input type="checkbox"/>
<i>(only one category shall be marked with an X)</i>	A Corresponds to a correction in an earlier release	<input type="checkbox"/>		Release 96	<input type="checkbox"/>
	B Addition of feature	<input type="checkbox"/>		Release 97	<input type="checkbox"/>
	C Functional modification of feature	<input type="checkbox"/>		Release 98	<input type="checkbox"/>
	D Editorial modification	<input type="checkbox"/>		Release 99	<input checked="" type="checkbox"/>
				Release 00	<input type="checkbox"/>

**Reason for change:** Editorial corrections to punctuation; Clarification of relation between layer 1 and higher-layer parameters for power control algorithms and steps sizes, and correction to naming of power control algorithm parameter.

**Clauses affected:** 5.1.2.2.1, 5.1.2.2.2.3, 5.1.2.2.3.2, 5.1.2.3

<b>Other specs affected:</b>	Other 3G core specifications	<input type="checkbox"/>	→ List of CRs:	
	Other GSM core specifications	<input type="checkbox"/>	→ List of CRs:	
	MS test specifications	<input type="checkbox"/>	→ List of CRs:	
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**Other comments:**



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

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## 5 Power control

### 5.1 Uplink power control

#### 5.1.1 PRACH

##### 5.1.1.1 General

The power control during the physical random access procedure is described in clause 6. The setting of power of the message control and data parts is described in the next sub-clause.

##### 5.1.1.2 Setting of PRACH control and data part power difference

The message part of the uplink PRACH channel shall employ gain factors to control the control/data part relative power similar to the uplink dedicated physical channels. Hence, section 5.1.2.5 applies also for the RACH message part, with the differences that:

- $\beta_c$  is the gain factor for the control part (similar to DPCCH),
- $\beta_d$  is the gain factor for the data part (similar to DPDCH),
- no inner loop power control is performed.

#### 5.1.2 DPCCH/DPDCH

##### 5.1.2.1 General

The initial uplink DPCCH transmit power is set by higher layers. Subsequently the uplink transmit power control procedure simultaneously controls the power of a DPCCH and its corresponding DPDCHs (if present). The relative transmit power offset between DPCCH and DPDCHs is determined by the network and is computed according to sub clause 5.1.2.5 using the gain factors signalled to the UE using higher layer signalling.

The operation of the inner power control loop, described in sub clause 5.1.2.2, adjusts the power of the DPCCH and DPDCHs by the same amount, provided there are no changes in gain factors. Additional adjustments to the power of the DPCCH associated with the use of compressed mode are described in sub clause 5.1.2.3.

Any change in the uplink DPCCH transmit power shall take place immediately before the start of the pilot field on the DPCCH. The change in DPCCH power with respect to its previous value is derived by the UE and is denoted by  $\Delta_{\text{DPCCH}}$  (in dB). The previous value of DPCCH power shall be that used in the previous slot, except in the event of an interruption in transmission due to the use of compressed mode, when the previous value shall be that used in the last slot before the transmission gap.

During the operation of the uplink power control procedure the UE transmit power shall not exceed a maximum allowed value which is the lower out of the maximum output power of the terminal power class and a value which may be set by higher layer signalling.

Uplink power control shall be performed while the UE transmit power is below the maximum allowed output power. If the UE transmit power is below the required minimum output power [as defined in TS 25.101] and the derived value of  $\Delta_{\text{DPCCH}}$  is less than zero, the UE may reduce the magnitude of  $\Delta_{\text{DPCCH}}$ .

## 5.1.2.2 Ordinary transmit power control

### 5.1.2.2.1 General

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 should then generate TPC commands and transmit 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 shall derive 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  $TPC_{cmd}$ . Which of these two algorithms is used is determined by a UE-specific higher-layer parameter, "Power-Control-Algorithm", and is under the control of the UTRAN. If "Power-Control-Parameter-Algorithm" indicates "algorithm-1", then the layer 1 parameter PCA shall take the value 1 and if "Power-Control-Parameter-Algorithm" indicates "algorithm-2" then PCA shall take the value 2.

If PCA has the value 1, Algorithm 1, described in subclause 5.1.2.2.2, shall be used for processing TPC commands.

If PCA has the value 2, Algorithm 2, described in subclause 5.1.2.2.3, shall be used for processing TPC commands.

The step size  $\Delta_{TPC}$  is a layer 1 parameter which is derived from the UE-specific higher-layer parameter "TPC-StepSize" which is, under the control of the UTRAN. If "TPC-StepSize" has the value "dB1", then the layer 1 parameter  $\Delta_{TPC}$  shall take that can have the values 1 dB and if "TPC-StepSize" has the value "dB2", then  $\Delta_{TPC}$  shall take the value of 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 DPCCCH with a step of  $\Delta_{DPCCCH}$  (in dB) which is given by:

$$\Delta_{DPCCCH} = \Delta_{TPC} \times TPC_{cmd}$$

#### 5.1.2.2.1.1 Out of synchronisation handling

The UE shall shut its transmitter off when the UE estimates the DPCCCH quality over the last 200 ms period to be worse than a threshold  $Q_{out}$ . This criterion is never fulfilled during the first 200 ms of the dedicated channel's existence.  $Q_{out}$  is defined implicitly by the relevant tests in TS 25.101.

The UE can turn its transmitter on when the UE estimates the DPCCCH quality over the last 200 ms period to be better than a threshold  $Q_{in}$ . This criterion is always fulfilled during the first 200 ms of the dedicated channel's existence.  $Q_{in}$  is defined implicitly by the relevant tests in TS 25.101. When transmission is resumed, the power of the DPCCCH shall be the same as when the UE transmitter was shut off.

### 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  $TPC_{cmd}$  shall be 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 shall be

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.

First, the UE shall conduct a soft symbol decision  $W_i$  on each of the power control commands  $TPC_i$ , where  $i = 1, 2, \dots, N$ , where  $N$  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.

Finally, the UE derives a combined TPC command,  $TPC\_cmd$ , as a function  $\gamma$  of all the  $N$  soft symbol decisions  $W_i$ :

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

The function  $\gamma$  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  $\gamma$  is equal to 1 shall be greater than or equal to  $1/(2^N)$ , and the probability that the output of  $\gamma$  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  $TPC\_cmd$  shall be 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<sup>th</sup> slot.
  - If all 5 hard decisions within a set are 0 then  $TPC\_cmd = -1$  in the 5<sup>th</sup> slot.
  - Otherwise,  $TPC\_cmd = 0$  in the 5<sup>th</sup> 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~~ shall be 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.

The UE shall make a hard decision on the value of each  $TPC_i$ , where  $i = 1, 2, \dots, N$  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  $\gamma$  of all the  $N$  temporary power control commands  $TPC\_temp_i$ :

$TPC\_cmd(3^{rd} \text{ slot}) = \gamma(TPC\_temp_1, TPC\_temp_2, \dots, TPC\_temp_N)$ , where  $TPC\_cmd(3^{rd} \text{ slot})$  can take the values 1, 0 or -1, and  $\gamma$  is given by the following definition:

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

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

Otherwise,  $TPC\_cmd$  is set to 0.

### 5.1.2.3 Transmit power control in compressed mode

In compressed mode, some frames are compressed and contain transmission gaps. The uplink power control procedure is as specified in clause 5.1.2.2, using the same UTRAN supplied parameters for Power Control Algorithm and step size ( $\Delta_{TPC}$ ), but with additional features which aim to recover as rapidly as possible a signal-to-interference ratio (SIR) close to the target SIR after each transmission gap.

In compressed mode, compressed frames may occur in either the uplink or the downlink or both. In uplink compressed frames, the transmission of uplink DPDCH(s) and DPCCH shall both be stopped during transmission gaps.

Due to the transmission gaps in compressed frames, there may be missing TPC commands in the downlink. If no downlink TPC command is transmitted, the corresponding  $TPC\_cmd$  derived by the UE shall be set to zero.

Compressed and non-compressed frames in the uplink DPCCH may have a different number of pilot bits per slot. A change in the transmit power of the uplink DPCCH would be needed in order to compensate for the change in the total pilot energy. Therefore at the start of each slot the UE shall derive the value of a power offset  $\Delta_{PILOT}$ . If the number of pilot bits per slot in the uplink DPCCH is different from its value in the most recently transmitted slot,  $\Delta_{PILOT}$  (in dB) shall be given by:

$$\Delta_{PILOT} = 10 \text{Log}_{10} (N_{pilot,prev} / N_{pilot,curr})$$

where  $N_{pilot,prev}$  is the number of pilot bits in the most recently transmitted slot, and  $N_{pilot,curr}$  is the number of pilot bits in the current slot. Otherwise, including during transmission gaps in the downlink,  $\Delta_{PILOT}$  shall be zero.

Unless otherwise specified, in every slot during compressed mode the UE shall adjust the transmit power of the uplink DPCCH with a step of  $\Delta_{DPCCH}$  (in dB) which is given by:

$$\Delta_{DPCCH} = \Delta_{TPC} \times TPC\_cmd + \Delta_{PILOT}$$

At the start of the first slot after an uplink transmission gap the UE shall apply a change in the transmit power of the uplink DPCCCH by an amount  $\Delta_{\text{DPCCCH}}$  (in dB), with respect to the uplink DPCCCH power in the most recently transmitted uplink slot, where

$$\Delta_{\text{DPCCCH}} = \Delta_{\text{RESUME}} + \Delta_{\text{PILOT}}$$

The value of  $\Delta_{\text{RESUME}}$  (in dB) shall be determined by the UE according to the Initial Transmit Power mode (ITP). The ITP is a UE specific parameter, which is signalled by the network with the other compressed mode parameters (see TS 25.215). The different modes are summarised in table 1.

**Table 1: Initial Transmit Power modes during compressed mode**

Initial Transmit Power mode	Description
0	$\Delta_{\text{RESUME}} = \Delta_{\text{TPC}} \times \text{TPC\_cmd}_{\text{gap}}$
1	$\Delta_{\text{RESUME}} = \delta_{\text{last}}$

In the case of a transmission gap in the uplink,  $\text{TPC\_cmd}_{\text{gap}}$  shall be the value of  $\text{TPC\_cmd}$  derived in the first slot of the uplink transmission gap, if a downlink  $\text{TPC\_command}$  is transmitted in that slot. Otherwise  $\text{TPC\_cmd}_{\text{gap}}$  shall be zero.

If a downlink TPC command is transmitted in the first slot of a downlink transmission gap, then  $\delta_{\text{last}}$  shall be equal to the value of  $\delta_i$  computed in the first slot of the downlink transmission gap. Otherwise  $\delta_{\text{last}}$  shall be equal to the value of  $\delta_i$  computed in the last slot before the downlink transmission gap.  $\delta_i$  shall be updated according to the following recursive relations, which shall be executed in all slots with simultaneous uplink and downlink DPCCCH transmission and in the first slot of a downlink transmission gap if a downlink TPC command is transmitted in that slot:

$$\begin{aligned} \delta_i &= 0.9375\delta_{i-1} - 0.96875\text{TPC\_cmd}_i\Delta_{\text{TPC}} \\ \delta_{i-1} &= \delta_i \end{aligned}$$

$\text{TPC\_cmd}_i$  is the most recent power control command derived by the UE.

$\delta_{i-1}$  is the value of  $\delta_i$  computed for the previous slot. The value of  $\delta_{i-1}$  shall be initialised to zero when the uplink DPCCCH is activated, and also at the end of the first slot after each downlink transmission gap.

After a transmission gap in either the uplink or the downlink, the period following resumption of simultaneous uplink and downlink DPCCCH transmission is called a recovery period. RPL is the recovery period length and is expressed as a number of slots. RPL is equal to the minimum value out of the transmission gap length and 7 slots.

During the recovery period, 2 modes are possible for the power control algorithm. The Recovery Period Power control mode (RPP) is signalled with the other compressed mode parameters (see TS 25.215). The different modes are summarised in the table 2:

**Table 2: Recovery Period Power control modes during compressed mode**

Recovery Period power control mode	Description
0	Transmit power control is applied using the algorithm determined by the value of PCA, as in subclause 5.1.2.2 with step size $\Delta_{\text{TPC}}$
1	Transmit power control is applied using algorithm 1 (see subclause 5.1.2.2.2) with step size $\Delta_{\text{RP-TPC}}$ during RPL slots after each transmission gap.

For RPP mode 0, the step size is not changed during the recovery period and ordinary transmit power control is applied (see subclause 5.1.2.2), using the algorithm for processing TPC commands determined by the value of PCA (see subclauses 5.1.2.2.2 and 5.1.2.2.3).

For RPP mode 1, during RPL slots after each transmission gap, power control algorithm 1 is applied with a step size  $\Delta_{\text{RP-TPC}}$  instead of  $\Delta_{\text{TPC}}$ , regardless of the value of PCA. The change in uplink DPCCCH transmit power (except for the first slot after the transmission gap) is given by

$$\Delta_{\text{DPCCCH}} = \Delta_{\text{RP-TPC}} \times \text{TPC\_cmd} + \Delta_{\text{PILOT}}$$

$\Delta_{RP-TPC}$  is called the recovery power control step size and is expressed in dB. If PCA has the value 1,  $-\Delta_{RP-TPC}$  is equal to the minimum value of 3 dB and  $2\Delta_{TPC}$ . If PCA has the value 2,  $\Delta_{RP-TPC}$  is equal to 1 dB.

After the recovery period, ordinary transmit power control resumes using the algorithm specified by the value of PCA and with step size  $\Delta_{TPC}$ .

If PCA has the value 2, the sets of slots over which the TPC commands are processed shall remain aligned to the frame boundaries in the compressed frame. For both RPP mode 0 and RPP mode 1, if the transmission gap or the recovery period results in any incomplete sets of TPC commands, TPC\_cmd shall be zero for those sets of slots which are incomplete.

<b>CHANGE REQUEST</b>		Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.
<b>25.214</b>	<b>CR</b>	<b>090r3</b>
GSM (AA.BB) or 3G (AA.BBB) specification number ↑		↑ CR number as allocated by MCC support team
For submission to: <b>TSG-RAN #8</b> <small>list expected approval meeting # here ↑</small>	for approval <input checked="" type="checkbox"/> for information <input type="checkbox"/>	Current Version: <b>3.2.0</b>  strategic <input type="checkbox"/> non-strategic <input type="checkbox"/> <small>(for SMG use only)</small>

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

**Source:** TSG RAN WG1 **Date:** 2000-05-23

**Subject:** Level of specification of downlink power control

**Work item:**

<b>Category:</b>	F Correction <input type="checkbox"/> A Corresponds to a correction in an earlier release <input type="checkbox"/> B Addition of feature <input type="checkbox"/> C Functional modification of feature <input checked="" type="checkbox"/> D Editorial modification <input type="checkbox"/>	<b>Release:</b>	Phase 2 <input type="checkbox"/> Release 96 <input type="checkbox"/> Release 97 <input type="checkbox"/> Release 98 <input type="checkbox"/> Release 99 <input checked="" type="checkbox"/> Release 00 <input type="checkbox"/>
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(only one category shall be marked with an X)

**Reason for change:** Node B behaviour needs to be specified to ensure interoperability. This is done by specifying Node B's response to TPC commands. Changes:

- How DL power shall be updated is specified in 5.2.1.2. The calculation includes both inner loop and power balancing loop behaviour.
- The limited power raise function is explained more in detail.
- The power control step size is defined to be 0.5, 1, 1.5 or 2 dB (no longer minimum step size), with mandatory support of a step size of 1 dB .
- In case of congestion the TPC commands from the UE may be ignored.
- The UE shall not make any assumption about the downlink power, to not prohibit other improved Node B algorithms.
- Clarifications to Annex B.3, to make sure the same terminology is used in WG3 and WG1 specifications, and the same terminology is used in 5.2.1.2 and Annex B.3.
- Editorial changes to 5.2.1.2 and Annex B.1.

**Clauses affected:** 5.2.1.2, B.1, B.3

<b>Other specs affected:</b>	Other 3G core specifications <input type="checkbox"/> Other GSM core specifications <input type="checkbox"/> MS test specifications <input type="checkbox"/> BSS test specifications <input type="checkbox"/> O&M specifications <input type="checkbox"/>	→ List of CRs: → List of CRs: → List of CRs: → List of CRs: → List of CRs:
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**Other comments:**



## 5.2 Downlink power control

The transmit power of the downlink channels is determined by the network. In general the ratio of the transmit power between different downlink channels is not specified and may change with time. However, regulations exist as described in the following subclauses.

### 5.2.1 DPCCH/DPDCH

#### 5.2.1.1 General

The downlink transmit power control procedure controls simultaneously the power of a DPCCH and its corresponding DPDCHs. The power control loop adjusts the power of the DPCCH and DPDCHs with the same amount, i.e. the relative power difference between the DPCCH and DPDCHs is not changed.

The relative transmit power offset between DPCCH fields and DPDCHs is determined by the network. The TFICI, TPC and pilot fields of the DPCCH are offset relative to the DPDCHs power by PO1, PO2 and PO3 dB respectively. The power offsets may vary in time.

#### 5.2.1.2 Ordinary transmit power control

##### 5.2.1.2.1 UE behaviour

The UE shall generate TPC commands to control the network transmit power and send them in the TPC field of the uplink DPCCH. An example on how to derive the TPC commands is given in Annex B.2.

When the UE is not in soft handover the TPC command generated is transmitted in the first available TPC field in the uplink DPCCH.

When the UE is in soft handover it should check the downlink power control mode (DPC\_MODE) before generating the TPC command:

- if DPC\_MODE = 0 : the UE sends a unique TPC command in each slot and the TPC command generated is transmitted in the first available TPC field in the uplink DPCCH;
- if DPC\_MODE = 1 : the UE repeats the same TPC command over 3 slots and the new TPC command is transmitted such that there is a new command at the beginning of the frame.

The DPC\_MODE parameter is a UE specific parameter controlled by the UTRAN.

The UE shall not make any assumptions on how the downlink power is set by UTRAN, in order to not prohibit usage of other UTRAN power control algorithms than what is defined in subclause 5.2.1.2.2.

When TPC commands cannot be generated in the UE due to downlink out-of-synchronisation, the TPC command transmitted shall be set as "1" during the period of out-of-synchronisation.

##### 5.2.1.2.2 UTRAN behaviour

Upon receiving the TPC commands UTRAN shall adjust its downlink DPCCH/DPDCH power accordingly. For DPC\_MODE = 0, UTRAN shall estimate the transmitted TPC command  $TPC_{est}$  to be 0 or 1, and shall update the power every slot. If DPC\_MODE = 1, UTRAN shall estimate the transmitted TPC command  $TPC_{est}$  over three slots to be 0 or 1, and shall update the power every three slots.

After estimating the  $k$ :th TPC command, UTRAN shall adjust the current downlink power  $P(k-1)$  [dB] to a new power  $P(k)$  [dB] according to the following formula:

$$P(k) = P(k-1) + P_{TPC}(k) + P_{bal}(k),$$

where  $P_{TPC}(k)$  is the  $k$ :th power adjustment due to the inner loop power control, and  $P_{bal}(k)$  [dB] is a correction according to the downlink power control procedure for balancing radio link powers towards a common reference power.

The power balancing procedure and control of the procedure is described in TS 25.433, and an example of how  $P_{bal}(k)$  can be calculated is given in Annex B.3.

$P_{TPC}(k)$  is calculated according to the following.

If the value of *Limited Power Raise Used* parameter is 'Not used', then

$$P_{TPC}(k) = \begin{cases} +\Delta_{TPC} & \text{if } TPC_{est}(k) = 1 \\ -\Delta_{TPC} & \text{if } TPC_{est}(k) = 0 \end{cases} \text{ [dB]} \quad (1)$$

If the value of *Limited Power Raise Used* parameter is 'Used', then the  $k$ :th inner loop power adjustment shall be calculated as:

$$P_{TPC}(k) = \begin{cases} +\Delta_{TPC} & \text{if } TPC_{est}(k) = 1 \text{ and } \Delta_{sum}(k) + \Delta_{TPC} < \text{Power\_Raise\_Limit} \\ 0 & \text{if } TPC_{est}(k) = 1 \text{ and } \Delta_{sum}(k) + \Delta_{TPC} \geq \text{Power\_Raise\_Limit} \\ -\Delta_{TPC} & \text{if } TPC_{est}(k) = 0 \end{cases} \text{ [dB]} \quad (2)$$

where

$$\Delta_{sum}(k) = \sum_{i=k-DL\_Power\_Averaging\_Window\_Size+1}^{k-1} P_{TPC}(i)$$

is the temporary sum of the last *DL Power Averaging Window Size* inner loop power adjustments (in dB).

For the first (*DL Power Averaging Window Size* - 1) adjustments after the activation the limited power raise method, formula (1) shall be used instead of formula (2). *Power Raise Limit* and *DL Power Averaging Window Size* are parameters configured in the UTRAN.

The power control step size  $\Delta_{TPC}$  can take four values: 0.5, 1, 1.5 or 2 dB. It is mandatory for UTRAN to support  $\Delta_{TPC}$  of 1 dB, while support of other step sizes is optional.

In addition to the above described formulas on how the downlink power is updated, the restrictions below apply.

In case of congestion (commanded power not available), UTRAN may disregard the TPC commands from the UE. As a response to the received TPC commands, UTRAN may adjust the downlink DPCCCH/DPDCH power.

The average power of transmitted DPDCH symbols over one timeslot shall not exceed *Maximum\_DL\_Power* (dBm), nor shall it be below *Minimum\_DL\_Power* (dBm). Transmitted DPDCH symbol means here a complex QPSK symbol before spreading which does not contain DTX. *Maximum\_DL\_Power* and *Minimum\_DL\_Power* are power limits for one spreading-channelisation code.

Changes of power shall be a multiple of the minimum step size  $\Delta_{TPC,min}$  dB. It is mandatory for UTRAN to support  $\Delta_{TPC,min}$  of 1 dB, while support of 0.5 dB is optional.

UTRAN may further employ following method. If the value of *Limited Power Raise Used* parameter is 'Used', UTRAN shall not increase the DL power of the RL if it would exceed by more than *Power\_Raise\_Limit* dB the averaged DL power used in the last *DL\_Power\_Averaging\_Window\_Size* timeslots of the same RL. This shall only be applied after the first *DL\_Power\_Averaging\_Window\_Size* timeslots after the activation of this method.

*Power\_Raise\_Limit* and *DL\_Power\_Averaging\_Window\_Size* are parameters configured in the UTRAN.

When TPC commands cannot be generated in the UE due to downlink out-of-synchronisation, the TPC command transmitted shall be set as "1" during the period of out-of-synchronisation.

### 5.2.1.3 Power control in compressed mode

The aim of downlink power control in uplink or/and downlink compressed mode is to recover as fast as possible a signal-to-interference ratio (SIR) close to the target SIR after each transmission gap.

The UE behaviour is the same in compressed mode as in normal mode, described in subclause 5.2.1.2.

The UTRAN behaviour during compressed mode is not specified. As an example, the algorithm can be similar to uplink power control in downlink compressed mode as described in subclause 5.1.2.3.

In downlink compressed mode or in simultaneous downlink and uplink compressed mode, the transmission of downlink DPCCH and DPDCH(s) is stopped.

# Annex B (Informative): Downlink power control

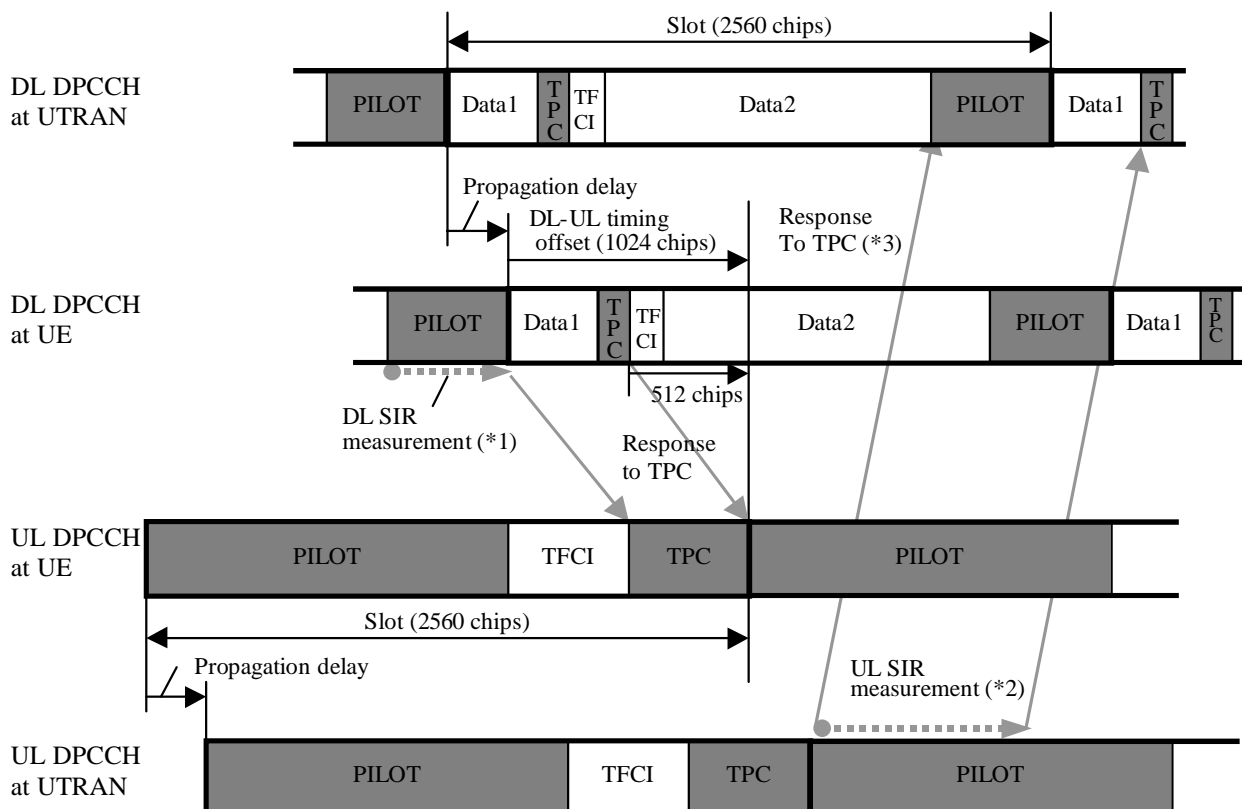
## B.1 Power control timing

The power control timing described in this annex should be seen as an example on how the control bits have to be placed in order to permit a short TPC delay.

In order to maximise the cell radius distance within which one-slot control delay is achieved, the frame timing of an uplink DPCH is delayed by 1024 chips from that of the corresponding downlink DPCH measured at the UE antenna.

Responding to a downlink TPC command, the UE shall change its uplink DPCH output power at the beginning of the first uplink pilot field after the TPC command reception. Responding to an uplink TPC command, the UTRAN access point shall change its DPCH output power at the beginning of the next downlink pilot field after the reception of the whole TPC command. Note that in soft handover, the TPC command is sent over one slot when `DPC_MODE` is 0 and over three slots when `DPC_MODE` is 1. Note also that the delay from the uplink TPC command reception to the power change timing is not specified for UTRAN. The UE shall decide and send TPC commands on the uplink based on the downlink SIR measurement. The TPC command field on the uplink starts, when measured at the UE antenna, 512 chips after the end of the downlink pilot field. The UTRAN access point shall decide and send TPC commands based on the uplink SIR measurement. However, the SIR measurement periods are not specified either for UE nor UTRAN.

Figure B.1 illustrates an example of transmitter power control timings.



\*1,2 The SIR measurement periods illustrated here are examples. Other ways of measurement are allowed to achieve accurate SIR estimation.

\*3 If there is not enough time for UTRAN to respond to the TPC, the action can be delayed until the next slot.

**Figure B.1: Transmitter power control timing**

## B.2 Example of implementation in the UE

The downlink inner-loop power control adjusts the network transmit power in order to keep the received downlink SIR at a given SIR target,  $SIR_{target}$ . A higher layer outer loop adjusts  $SIR_{target}$  independently for each connection.

The UE should estimate the received downlink DPCCH/DPDCH power of the connection to be power controlled. Simultaneously, the UE should estimate the received interference. The obtained SIR estimate  $SIR_{est}$  is then used by the UE to generate TPC commands according to the following rule: if  $SIR_{est} > SIR_{target}$  then the TPC command to transmit is "0", requesting a transmit power decrease, while if  $SIR_{est} < SIR_{target}$  then the TPC command to transmit is "1", requesting a transmit power increase.

## B.3 Radio link power balancing Adjustment loop

In case of soft handover, UTRAN may employ downlink radio link power balancing, that tries to balance the radio link powers towards reference power. An example of a power balancing adjustment loop is given below.

The UTRAN access point radio link transmission power is adjusted by the power balancing term  $P_{bal}(i)$  [dB], in which they change their calculated transmission powers  $P(i)$  which is calculated in every slot according to the following equation:

$$P(i+1) = P(i) + S_{INNER}(i) + S_{ADJ}(i);$$

$$S_{P_{balADJ}}(i) = \text{sign}\{(1-r)(P_{REF} - P(i))\} \times \min\{|(1-r)(P_{REF} - P(i))|, P_{S_{bal,maxADJ\_MAX}}\};$$

where:

- $P(i)$ : calculated transmission power of UTRAN access point in dBm;
- $S_{INNER}(i)$ : inner loop control in dB;
- $S_{P_{balADJ}}(i)$ : radio link power balancing adjustment loop control in dB;
- $\text{sign}\{x\}$ : sign function of the value  $x$ , i.e. +1 when  $x > 0$ , 0 when  $x = 0$ , and -1 when  $x < 0$ ;
- $r$ : convergence coefficient ( $0 \leq r \leq 1$ );
- $P_{REF}$ : reference transmission power in dBm;
- $P_{S_{bal,maxADJ\_MAX}}$ : maximum power change limit for radio link power balancing control by adjustment loop in dB.

The actual transmission power level shall be a value which is the nearest allowed power level to  $P(i)$ . The parameters  $r$ ,  $P_{REF}$ , and  $P_{S_{bal,maxADJ\_MAX}}$  are shall be signalled by higher layers.  $P_{S_{bal,maxADJ\_MAX}}$  shall be a multiple of the minimum power control step size  $\Delta_{TPC,min}$  dB.

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**25.214 CR 091r1**

Current Version: **3.2.0**

GSM (AA.BB) or 3G (AA.BBB) specification number ↑

↑ CR number as allocated by MCC support team

For submission to: **TSG-RAN #8**

list expected approval meeting # here ↑

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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

UTRAN / Radio

Core Network

**Source:** TSG RAN WG1

**Date:** 2000-04-11

**Subject:** Clarification of TX diversity power setting

**Work item:**

**Category:**

(only one category shall be marked with an X)

- F Correction
- A Corresponds to a correction in an earlier release
- B Addition of feature
- C Functional modification of feature
- D Editorial modification

**Release:**

- Phase 2
- Release 96
- Release 97
- Release 98
- Release 99
- Release 00

**Reason for change:**

Clarify that power setting corresponds to the total power for two antennas in case of transmit diversity.

**Clauses affected:** 5.2.1.1

**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:**

## 5.2 Downlink power control

The transmit power of the downlink channels is determined by the network. In general the ratio of the transmit power between different downlink channels is not specified and may change with time. However, regulations exist as described in the following subclauses.

Higher layer power settings shall be interpreted as setting of the total power, i.e. the sum of the power from the two antennas in case of transmit diversity.

### 5.2.1 DPCCH/DPDCH

#### 5.2.1.1 General

The downlink transmit power control procedure controls simultaneously the power of a DPCCH and its corresponding DPDCHs. The power control loop adjusts the power of the DPCCH and DPDCHs with the same amount, i.e. the relative power difference between the DPCCH and DPDCHs is not changed.

The relative transmit power offset between DPCCH fields and DPDCHs is determined by the network. The TFCI, TPC and pilot fields of the DPCCH are offset relative to the DPDCHs power by PO1, PO2 and PO3 dB respectively. The power offsets may vary in time.

#### 5.2.1.2 Ordinary transmit power control

The UE shall generate TPC commands to control the network transmit power and send them in the TPC field of the uplink DPCCH. An example on how to derive the TPC commands is given in Annex B.2.

When the UE is not in soft handover the TPC command generated is transmitted in the first available TPC field in the uplink DPCCH.

When the UE is in soft handover it should check the downlink power control mode (DPC\_MODE) before generating the TPC command:

- if DPC\_MODE = 0 : the UE sends a unique TPC command in each slot and the TPC command generated is transmitted in the first available TPC field in the uplink DPCCH;
- if DPC\_MODE = 1 : the UE repeats the same TPC command over 3 slots and the new TPC command is transmitted such that there is a new command at the beginning of the frame.

The DPC\_MODE parameter is a UE specific parameter controlled by the UTRAN.

As a response to the received TPC commands, UTRAN may adjust the downlink DPCCH/DPDCH power. The average power of transmitted DPDCH symbols over one timeslot shall not exceed Maximum\_DL\_Power (dBm), nor shall it be below Minimum\_DL\_Power (dBm). Transmitted DPDCH symbol means here a complex QPSK symbol before spreading which does not contain DTX. Maximum\_DL\_Power and Minimum\_DL\_Power are power limits for one spreading code.

Changes of power shall be a multiple of the minimum step size  $\Delta_{\text{TPC,min}}$  dB. It is mandatory for UTRAN to support  $\Delta_{\text{TPC,min}}$  of 1 dB, while support of 0.5 dB is optional.

UTRAN may further employ following method. If the value of *Limited Power Raise Used* parameter is 'Used', UTRAN shall not increase the DL power of the RL if it would exceed by more than *Power\_Raise\_Limit* dB the averaged DL power used in the last *DL\_Power\_Averaging\_Window\_Size* timeslots of the same RL. This shall only be applied after the first *DL\_Power\_Averaging\_Window\_Size* timeslots after the activation of this method.

*Power\_Raise\_Limit* and *DL\_Power\_Averaging\_Window\_Size* are parameters configured in the UTRAN.

When TPC commands cannot be generated in the UE due to downlink out-of-synchronisation, the TPC command transmitted shall be set as "1" during the period of out-of-synchronisation.

### 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 092

Current Version: 3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑

↑ CR number as allocated by MCC support team

For submission to: <b>TSG-RAN #8</b> <i>list expected approval meeting # here</i> ↑	for approval <input checked="" type="checkbox"/>	strategic <input type="checkbox"/>	<i>(for SMG use only)</i>
	for information <input type="checkbox"/>	non-strategic <input type="checkbox"/>	

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

**Source:** TSG RAN WG1      **Date:** 2000-04-07

**Subject:** PICH undefined bits

**Work item:**

<u><b>Category:</b></u>	F Correction <input type="checkbox"/> A Corresponds to a correction in an earlier release <input type="checkbox"/> B Addition of feature <input type="checkbox"/> C Functional modification of feature <input checked="" type="checkbox"/> D Editorial modification <input type="checkbox"/>	<u><b>Release:</b></u>	Phase 2 <input type="checkbox"/> Release 96 <input type="checkbox"/> Release 97 <input type="checkbox"/> Release 98 <input type="checkbox"/> Release 99 <input checked="" type="checkbox"/> Release 00 <input type="checkbox"/>
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*(only one category shall be marked with an X)*

**Reason for change:** The last 12 bits in each PICH frame are undefined in Release 99 and it is proposed that those bits shall not be transmitted. Hence, it is not necessary to mention that the PICH power shall be measured over the undefined bits.

**Clauses affected:** 5.2.4

<u><b>Other specs affected:</b></u>	Other 3G core specifications <input type="checkbox"/> Other GSM core specifications <input type="checkbox"/> MS test specifications <input type="checkbox"/> BSS test specifications <input type="checkbox"/> O&M specifications <input type="checkbox"/>	→ List of CRs: → List of CRs: → List of CRs: → List of CRs: → List of CRs:
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**Other comments:**



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



## 5.2.4 PICH

The UE is informed about the relative transmit power of the PICH (measured as the power over the ~~transmitted~~ paging indicators, ~~excluding the undefined part of the PICH frame~~) compared to the primary CPICH transmit power by the higher layers.

<b>CHANGE REQUEST</b>		Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.	
<b>25.214</b>	<b>CR</b>	<b>095r1</b>	Current Version: <b>3.2.0</b>
GSM (AA.BB) or 3G (AA.BBB) specification number ↑		↑ CR number as allocated by MCC support team	
For submission to: <b>TSG RAN#8</b> <i>list expected approval meeting # here ↑</i>	for approval <input checked="" type="checkbox"/>	strategic <input type="checkbox"/>	(for SMG use only)
	for information <input type="checkbox"/>	non-strategic <input type="checkbox"/>	

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

**Source:**      TSG RAN WG1      **Date:**      24.5.2000

**Subject:**      DPDCH/DPCCH gain factors

**Work item:**      \_\_\_\_\_

<b>Category:</b>	F Correction	<input checked="" type="checkbox"/>	<b>Release:</b>	Phase 2	<input type="checkbox"/>
(only one category shall be marked with an X)	A Corresponds to a correction in an earlier release	<input type="checkbox"/>		Release 96	<input type="checkbox"/>
	B Addition of feature	<input type="checkbox"/>		Release 97	<input type="checkbox"/>
	C Functional modification of feature	<input type="checkbox"/>		Release 98	<input type="checkbox"/>
	D Editorial modification	<input type="checkbox"/>		Release 99	<input checked="" type="checkbox"/>
				Release 00	<input type="checkbox"/>

**Reason for change:**      If the computed DPDCH/DPCCH gain factor value that is to be rounded is exactly one of the B values in TS 25.213 Table 1 it is unnecessarily rounded one step down.

**Clauses affected:**      5.1.2.5.3 and 5.1.2.5.4

<b>Other specs affected:</b>	Other 3G core specifications	<input type="checkbox"/>	→ List of CRs: _____
	Other GSM core specifications	<input type="checkbox"/>	→ List of CRs: _____
	MS test specifications	<input type="checkbox"/>	→ List of CRs: _____
	BSS test specifications	<input type="checkbox"/>	→ List of CRs: _____
	O&M specifications	<input type="checkbox"/>	→ List of CRs: _____

**Other comments:**      \_\_\_\_\_

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

### 5.1.2.5 Setting of the uplink DPCCH/DPDCH power difference

#### 5.1.2.5.1 General

The uplink DPCCH and DPDCH(s) are transmitted on different codes as defined in subclause 4.2.1 of TS 25.213. The gain factors  $\beta_c$  and  $\beta_d$  may vary for each TFC. There are two ways of controlling the gain factors of the DPCCH code and the DPDCH codes for different TFCs in normal (non-compressed) frames:

- $\beta_c$  and  $\beta_d$  are signalled for the TFC, or
- $\beta_c$  and  $\beta_d$  is computed for the TFC, based on the signalled settings for a reference TFC.

Combinations of the two above methods may be used to associate  $\beta_c$  and  $\beta_d$  values to all TFCs in the TFCS. The two methods are described in subclauses 5.1.2.5.2 and 5.1.2.5.3 respectively. Several reference TFCs may be signalled from higher layers.

The gain factors may vary on radio frame basis depending on the current TFC used. Further, the setting of gain factors is independent of the inner loop power control.

The UE shall scale the total transmit power of the DPCCH and DPDCH(s), such that the DPCCH output power follows the changes required by the power control procedure with power adjustments of  $\Delta_{\text{DPCCH}}$  dB, unless this would result in a UE transmit power above the maximum allowed power. In this case the UE shall scale the total transmit power so that it is equal to the maximum allowed power.

The gain factors during compressed frames are based on the gain factors defined in normal frames, as specified in subclause 5.1.2.5.4.

#### 5.1.2.5.2 Signalled gain factors

When the gain factors  $\beta_c$  and  $\beta_d$  are signalled by higher layers for a certain TFC, the signalled values are used directly for weighting of DPCCH and DPDCH(s).

#### 5.1.2.5.3 Computed gain factors

The gain factors  $\beta_c$  and  $\beta_d$  may also be computed for certain TFCs, based on the signalled settings for a reference TFC.

Let  $\beta_{c,ref}$  and  $\beta_{d,ref}$  denote the signalled gain factors for the reference TFC. Further, let  $\beta_{c,j}$  and  $\beta_{d,j}$  denote the gain factors used for the  $j$ :th TFC. Also let  $L_{ref}$  denote the number of DPDCHs used for the reference TFC and  $L_j$  denote the number of DPDCHs used for the  $j$ :th TFC.

Define the variable

$$K_{ref} = \sum_i RM_i \cdot N_i ;$$

where  $RM_i$  is the semi-static rate matching attribute for transport channel  $i$  (defined in TS 25.212 subclause 4.2.7),  $N_i$  is the number of bits output from the radio frame segmentation block for transport channel  $i$  (defined in TS 25.212 subclause 4.2.6.1), and the sum is taken over all the transport channels  $i$  in the reference TFC.

Similarly, define the variable

$$K_j = \sum_i RM_i \cdot N_i ;$$

where the sum is taken over all the transport channels  $i$  in the  $j$ :th TFC.

The variable  $A_j$  is then computed as:

$$A_j = \frac{\beta_{d,ref}}{\beta_{c,ref}} \cdot \sqrt{\frac{L_{ref}}{L_j}} \sqrt{\frac{K_j}{K_{ref}}} .$$

The gain factors for the  $j$ :th TFC are then computed as follows:

- If  $A_j > 1$ , then  $\beta_{d,j} = 1.0$  and  $\beta_{c,j} = \lfloor 1/A_j \rfloor$ , where  $\lfloor \bullet \rfloor$  means rounding to closest lower quantized  $\beta$ -value.  $\beta_{c,j}$  is the largest quantized  $\beta$ -value, for which the condition  $\beta_{c,j} \leq 1/A_j$  holds. Since  $\beta_{c,j}$  may not be set to zero, if the above rounding results in a zero value,  $\beta_{c,j}$  shall be set to the lowest quantized amplitude ratio of  $1/15$  ~~0.0667~~ as specified in TS 25.213.
- If  $A_j \leq 1$ , then  $\beta_{d,j}$  is the smallest quantized  $\beta$ -value, for which the condition  $\beta_{d,j} \geq A_j$  holds.  $\beta_{d,j} = \lceil A_j \rceil$  and  $\beta_{c,j} = 1.0$ , where  $\lceil \bullet \rceil$  means rounding to closest higher quantized  $\beta$ -value.

The quantized  $\beta$ -values are defined in TS 25.213 subclause 4.2.1, table 1.

#### 5.1.2.5.4 Setting of the uplink DPCCH/DPDCH power difference in compressed mode

The gain factors used during a compressed frame for a certain TFC are calculated from the gain factors used in normal (non-compressed) frames for that TFC. Let  $\beta_{c,j}$  and  $\beta_{d,j}$  denote the gain factors for the  $j$ :th TFC in a normal frame. Further, let  $\beta_{c,C,j}$  and  $\beta_{d,C,j}$  denote the gain factors used for the  $j$ :th TFC when the frame is compressed. The variable  $A_{C,j}$  is computed as:

$$A_{C,j} = \frac{\beta_{d,j}}{\beta_{c,j}} \cdot \sqrt{\frac{15 \cdot N_{pilot,C}}{N_{slots,C} \cdot N_{pilot,N}}};$$

where  $N_{pilot,C}$  is the number of pilot bits per slot when in compressed mode, and  $N_{pilot,N}$  is the number of pilot bits per slot in normal mode.  $N_{slots,C}$  is the number of slots in the compressed frame used for transmitting the data.

The gain factors for the  $j$ :th TFC in a compressed frame are computed as follows:

If  $A_{C,j} > 1$ , then  $\beta_{d,C,j} = 1.0$  and  $\beta_{c,C,j} = \lfloor 1/A_{C,j} \rfloor$ , where  $\lfloor \bullet \rfloor$  means rounding to closest lower quantized  $\beta$ -value.  $\beta_{c,C,j}$  is the largest quantized  $\beta$ -value, for which the condition  $\beta_{c,C,j} \leq 1/A_{C,j}$  holds. Since  $\beta_{c,C,j}$  may not be set to zero, if the above rounding results in a zero value,  $\beta_{c,C,j}$  shall be set to the lowest quantized amplitude ratio of  $1/15$  ~~0.0667~~ as specified in TS 25.213.

If  $A_{C,j} \leq 1$ , then  $\beta_{d,C,j}$  is the smallest quantized  $\beta$ -value, for which the condition  $\beta_{d,C,j} \geq A_{C,j}$  holds.  $\beta_{d,C,j} = \lceil A_{C,j} \rceil$  and  $\beta_{c,C,j} = 1.0$ , where  $\lceil \bullet \rceil$  means rounding to closest higher quantized  $\beta$ -value.

The quantized  $\beta$ -values are defined in TS 25.213 subclause 4.2.1, table 1

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	096r3	Current Version: 3.2.0
GSM (AA.BB) or 3G (AA.BBB) specification number ↑		↑ CR number as allocated by MCC support team	
For submission to: <b>TSG RAN #8</b> <i>list expected approval meeting # here ↑</i>	for approval for information	<input checked="" type="checkbox"/> <input type="checkbox"/>	strategic <input type="checkbox"/> non-strategic <input type="checkbox"/> <span style="font-size: 0.7em;">(for SMG use only)</span>

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

**Source:**    TSG RAN WG1    **Date:**    2000-05-25

**Subject:**    Correction to RACH subchannel definition

**Work item:**    UTRAN

<b>Category:</b>	F Correction <input checked="" type="checkbox"/> A Corresponds to a correction in an earlier release <input type="checkbox"/> B Addition of feature <input type="checkbox"/> C Functional modification of feature <input type="checkbox"/> D Editorial modification <input type="checkbox"/>	<b>Release:</b>	Phase 2 <input type="checkbox"/> Release 96 <input type="checkbox"/> Release 97 <input type="checkbox"/> Release 98 <input type="checkbox"/> Release 99 <input checked="" type="checkbox"/> Release 00 <input type="checkbox"/>
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(only one category shall be marked with an X)

**Reason for change:**    At the present TS25.211 and TS25.214 are not aligned with respect to RACH subchannel definition. This CR corrects the ambiguity in TS25.214.

**Clauses affected:**    6.1, 6.2

<b>Other specs affected:</b>	Other 3G core specifications <input type="checkbox"/> Other GSM core specifications <input type="checkbox"/> MS test specifications <input type="checkbox"/> BSS test specifications <input type="checkbox"/> O&M specifications <input type="checkbox"/>	→ List of CRs: → List of CRs: → List of CRs: → List of CRs: → List of CRs:	
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**Other comments:**



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## 6 Random access procedure

### 6.1 Physical random access procedure

The physical random access procedure described in this section is initiated upon request of a PHY-Data-REQ primitive from the MAC sublayer (cf. TS 25.321).

Before the physical random-access procedure can be initiated, Layer 1 shall receive the following information from the higher layers (RRC) :

- The preamble scrambling code
- The message length in time, either 10 or 20 ms
- The AICH\_Transmission\_Timing parameter [0 or 1].
- The available signatures and RACH sub-channel groups for each Access Service Class (ASC), where a sub-channel group is defined as a group of some of the sub-channels defined in Section 6.1.1.
- The power-ramping factor Power\_Ramp\_Step [integer > 0].
- The parameter Preamble\_Retrans\_Max [integer > 0].
- The initial preamble power Preamble\_Initial\_Power.
- The power offset  $\Delta P_{p-m} = P_{\text{message-control}} - P_{\text{preamble}}$ , measured in dB, between the power of the last transmitted preamble and the control part of the random-access message
- The set of Transport Format parameters. This includes the power offset between the data part and the control part of the random-access message for each Transport Format.

Note that the above parameters may be updated from higher layers before each physical random access procedure is initiated.

At each initiation of the physical random access procedure, Layer 1 shall receive the following information from the higher layers (MAC):

- The Transport Format to be used for the PRACH message part.
- The ASC of the PRACH transmission.
- The data to be transmitted (Transport Block Set).

The physical random-access procedure shall be performed as follows:

- 1 Randomly select the RACH sub-channel group from the available ones for the given ASC. The random function shall be such that each of the allowed selections is chosen with equal probability.
- 2 Derive the available uplink access slots ~~in the next two frames, defined by SFN and SFN+1~~ in the selected RACH sub-channel group with the help of subclause 6.1.1. and the SFN and table 7 of the first available P-CCPCH frame that is time aligned with the 10 ms long period which contains start boundaries of all the downlink access slots corresponding to the uplink access slots in the selected RACH sub-channel group. Randomly select one uplink access slot from the first available set of uplink access slots corresponding to the selected RACH sub-channel group, in the next frame, defined by SFN, if there is one available. If there is no access slot available ~~in the next frame, defined by SFN~~ then, randomly select one access slot from the next available set of uplink access slots in the selected RACH sub-channel group, following frame, defined by SFN+1. The random function shall be such that each of the allowed selections is chosen with equal probability.
- 3 Randomly select a signature from the available signatures for the given ASC. The random function shall be such that each of the allowed selections is chosen with equal probability.
- 4 Set the Preamble Retransmission Counter to Preamble\_Retrans\_Max.

- 5 Set the preamble transmission power to Preamble\_Initial\_Power.
- 6 Transmit a preamble using the selected uplink access slot, signature, and preamble transmission power.
- 7 If no positive or negative acquisition indicator ( $AI \neq +1$  nor  $-1$ ) corresponding to the selected signature is detected in the downlink access slot corresponding to the selected uplink access slot:
  - 7.1 Select a new uplink access slot as next available access slot, i.e. next access slot in the sub-channel group used, as selected in 1
  - 7.2 Randomly selects a new signature from the available signatures within the given ASC. The random function shall be such that each of the allowed selections is chosen with equal probability.
  - 7.3 Increase the preamble transmission power by  $\Delta P_0 = \text{Power\_Ramp\_Step}$  [dB].
  - 7.4 Decrease the Preamble Retransmission Counter by one.
  - 7.5 If the Preamble Retransmission Counter  $> 0$  then repeat from step 6. Otherwise pass L1 status ("No ack on AICH") to the higher layers (MAC) and exit the physical random access procedure.
- 8 If a negative acquisition indicator corresponding to the selected signature is detected in the downlink access slot corresponding to the selected uplink access slot, pass L1 status ("Nack on AICH received") to the higher layers (MAC) and exit the physical random access procedure.
- 9 Transmit the random access message three or four uplink access slots after the uplink access slot of the last transmitted preamble depending on the AICH transmission timing parameter. Transmission power of the control part of the random access message should be  $\Delta P_{p-m}$  [dB] higher than the power of the last transmitted preamble. Transmission power of the data part of the random access message is set according to Section 5.1.1.2.
- 10 Pass L1 status "RACH message transmitted" to the higher layers and exit the physical random access procedure.

### 6.1.1 RACH sub-channels

A RACH sub-channel defines a sub-set of the total set of [uplink](#) access slots. There are a total of 12 RACH sub-channels. RACH sub-channel #i ( $i = 0, \dots, 11$ ) consists of the following [uplink](#) access slots:

- [Uplink access slot #i transmitted in parallel to lagging by  \$\tau\_{p-a}\$  the downlink access slot #i contained within the 10 ms interval that is time aligned with P-CCPCH frames for which  \$\text{SFN mod } 8 = 0\$  or  \$\text{SFN mod } 8 = 1\$ .](#)
- Every 12<sup>th</sup> access slot relative to this access slot.

The access slots of different RACH sub-channels are also illustrated in Table 7.

Table 7: The available uplink access slots for different RACH sub-channels

SFN modulo 8 of corresponding P- CCPCH frame	Sub-channel number											
	0	1	2	3	4	5	6	7	8	9	10	11
0	0	1	2	3	4	5	6	7				
1	12	13	14						8	9	10	11
2				0	1	2	3	4	5	6	7	
3	9	10	11	12	13	14						8
4	6	7					0	1	2	3	4	5
5			8	9	10	11	12	13	14			
6	3	4	5	6	7					0	1	2
7						8	9	10	11	12	13	14

SFN modulo 8	Sub-channel Number											
	0	1	2	3	4	5	6	7	8	9	10	11
0	0	1	2	3	4	5	6	7				
1	12	13	14						8	9	10	11
2				0	1	2	3	4	5	6	7	
3	9	10	11	12	13	14						8
4	6	7					0	1	2	3	4	5
5			8	9	10	11	12	13	14			
6	3	4	5	6	7					0	1	2
7						8	9	10	11	12	13	14

## 6.2 CPCH Access Procedures

For each CPCH physical channel in a CPCH set allocated to a cell the following physical layer parameters are included in the System Information message: L1 shall receive the following information from the higher layers (RRC).

- UL Access Preamble (AP) scrambling code.
- UL Access Preamble signature set
- The Access preamble slot sub-channels group
- AP- AICH preamble channelization code.
- UL Collision Detection(CD) preamble scrambling code.
- CD Preamble signature set
- CD preamble slot sub-channels group
- CD-AICH preamble channelization code.
- CPCH UL scrambling code.
- DPCCH DL channelization code.([512] chip)

NOTE: There may be some overlap between the AP signature set and CD signature set if they correspond to the same scrambling code.

The following physical layer parameters are received from the RRC layer:

- 1)  $N_{AP\_retrans\_max}$  = Maximum Number of allowed consecutive access attempts (retransmitted preambles) if there is no AICH response. This is a CPCH parameter and is equivalent to Preamble\_Retrans\_Max in RACH.
- 2)  $P_{RACH} = P_{CPCH}$  = Initial open loop power level for the first CPCH access preamble sent by the UE.  
[RACH/CPCH parameter]
- 3)  $\Delta P_0$  = Power step size for each successive CPCH access preamble.



[RACH/CPCH parameter]

- 4)  $\Delta P_1$  = Power step size for each successive RACH/CPCH access preamble in case of negative AICH. A timer is set upon receipt of a negative AICH. This timer is used to determine the period after receipt of a negative AICH when  $\Delta P_1$  is used in place of  $\Delta P_0$ .

[RACH/CPCH parameter]

- 5)  $T_{\text{cpch}}$  = CPCH transmission timing parameter: This parameter is identical to PRACH/AICH transmission timing parameter.

[RACH/CPCH parameter]

- 6)  $L_{\text{pc-preamble}}$  = Length of power control preamble (0 or 8 slots)

[CPCH parameter]

- 7)  $N_{\text{Start\_Message}}$  = Number of frames for the transmission of Start of Message Indicator in DL-DPCCH for CPCH

- 8) The set of Transport Format parameters. This includes a Transport Format to PCPCH mapping table.

L1 shall receive the following information from MAC prior to packet transmission:

- 1) Transport Format of the message part.
- 2) The data to be transmitted is delivered to L1 once every TTI until the data buffer is empty.

The overall CPCH -access procedure consists of two parts:

- 1) Upon receipt of a Status-REQ message from the MAC layer, the UE shall start monitoring the CSICH to determine the availability of the transport formats in the transport format subset included in the Status-REQ message. UTRAN transmits availability of each PCPCH or maximum available data rate with availability of each PCPCH over the CSICH in case CA is active. Upper layers will supply the UE with information to map the transport formats to the PCPCHs. The UE shall send a Status-CNF message to the MAC layer containing the transport format subset listing the transport formats of the requested subset which are currently indicated as 'available'.

The actual access procedure is then:

- 2) Upon receipt of the Access-REQ message from the MAC layer, which contains an identified transport format from the available ones, the following sequence of events occur. The use of step 2a or 2b depends on whether availability of each PCPCH or the Maximum available data rate along with the availability of each PCPCH is transmitted over CSICH. Note that in the first case, each access resource combination (AP signatures and access subchannel group) maps to each PCPCH resource and in the second case each access resource combination maps to each data rate.
  - 2a) (In case CA is not Active) The UE shall test the value(s) of the most recent transmission of the CSICH Status Indicator(s) corresponding to the PCPCH channel(s) for the identified transport format included in the Access-REQ message. If this indicates that no channel is 'available' the UE shall abort the access attempt and send a failure message to the MAC layer. The UE shall also retain the availability status of the each PCPCH for further verification in a later phase.
  - 2b) (In case CA is active) The CSICH Status Indicators indicate the maximum available data rate along with individual PCPCH availability. The UE shall test the value of the most recent transmission of the Status Indicator(s). If this indicates that the maximum available data rate is less than the requested data rate, the UE shall abort the access attempt and send a failure message to the MAC layer. The PHY provides the availability information to the MAC. The UE shall also retain the availability status of the each PCPCH for further channel assignment message verification in a later phase in case of success.
- 3) The UE sets the preamble transmit power to the value  $P_{\text{CPCH}}$  which is supplied by the MAC layer for initial power level for this CPCH access attempt.
- 4) The UE sets the AP Retransmission Counter to  $N_{\text{AP\_Retrans\_Max}}$ .

- 5a) In the case CA is not active, the uplink access slot and signature to be used for the CPCH-AP transmission are selected in the following steps:
- a) The UE selects randomly one PCPCH from the set of available PCPCH channel(s) as indicated on the CSICH and supporting the identified transport format included in the Access-REQ message. The random function shall be such that each of the allowed selections is chosen with equal probability.
  - b) The UE randomly selects a CPCH-AP signature from the set of available signatures in the access resource combination corresponding to the selected PCPCH in step a). The random function shall be such that each of the allowed selections is chosen with equal probability.
  - c) Using the AP access slot sub-channel group of the access resource combination corresponding to selected PCPCH in step a), the UE derives the available CPCH-AP access slots ~~in the next two frames, defined by SFN and SFN+1~~ with the help of ~~subclause 6.1.1. and the SFN of the first available P-CCPCH frame that is time-aligned with the 10 ms long period which contains start boundaries of all the downlink access slots corresponding to the uplink access slots in the selected AP access slot sub-channel group, and table 7 in subclause 6.1.~~ The UE randomly selects one uplink access slot from the first available set of access slots corresponding to the selected AP access slot sub-channel group, in the next frame, defined by SFN, if there is one available. If there is no access slot available ~~in the next frame, defined by SFN~~ then, ~~the UE~~ randomly selects one access slot from the next set of available access slots corresponding to the selected AP access slot sub-channel group, in the following frame, defined by SFN+1. The random function shall be such that each of the allowed selections is chosen with equal probability.
- 5b) In the case CA is active, the uplink access slot and signature to be used for the CPCH-AP transmission are selected in the following steps:
- a) The UE randomly selects a CPCH-AP signature from the set of available signatures in the access resource combination corresponding to the transport format identified in the Access-REQ message. The random function shall be such that each of the allowed selections is chosen with equal probability.
  - b) Using the AP access slot sub-channel group of the access resource combination corresponding to the transport format identified in the Access-REQ message, the UE derives the available CPCH-AP access slots ~~in the next two frames, defined by SFN and SFN+1~~ with the help of ~~subclause 6.1.1 and the SFN of the first available P-CCPCH frame that is time-aligned with the 10 ms long period which contains start boundaries of all the downlink access slots corresponding to the uplink access slots in the selected AP access slot sub-channel group, and table 7 in subclause 6.1.~~ The UE randomly selects one uplink access slot from the first available set of uplink access slots corresponding to the selected AP access slot sub-channel group, in the next frame, defined by SFN, if there is one available. If there is no access slot available ~~in the next frame, defined by SFN~~ then, ~~the UE~~ randomly selects one access slot from the next available set of access slots corresponding to the selected AP access slot sub-channel group, in the following frame, defined by SFN+1. The random function shall be such that each of the allowed selections is chosen with equal probability.
  - 6) The UE transmits the AP using the selected uplink access slot and signature, and MAC supplied initial preamble transmission power. The following sequence of events occur based on whether availability of each PCPCH or the Maximum available data rate along with the availability of each PCPCH is transmitted over CSICH.
  - 6a) (In case CA is not Active) The UE shall test the value of the most recent transmission of the Status Indicator corresponding to the identified CPCH transport channel immediately before AP transmission. If this indicates that the channel is 'not available' the UE shall abort the access attempt and send a failure message to the MAC layer. Otherwise the UE transmits the AP using the UE selected uplink signature and access slot, and the initial preamble transmission power from step 3, above.
  - 6b) (In case CA is active) The Status Indicator indicates the maximum available data rate as well as the availability of each PCPCH. The UE shall test the value of the Status Indicator. If this indicates that the maximum available data rate is less than the requested data rate, the UE shall abort the access attempt and send a failure message to the MAC layer. Otherwise the UE shall transmit the AP using the UE selected uplink access slot, the MAC supplied signature and initial preamble transmission power from step 3, above.
  - 7) If the UE does not detect the positive or negative acquisition indicator corresponding to the selected signature in the downlink access slot corresponding to the selected uplink access slot, the UE shall test the value of the most recent transmission of the Status Indicator corresponding to the selected PCPCH immediately before AP transmission. If this indicates that the PCPCH is 'not available' the UE shall abort the access attempt and send a failure message to the MAC layer. Otherwise the following steps shall be executed:
    - a) Selects the new uplink access slot from the available access slot, i.e. next access slot in the sub-channel

- group used. There must be a minimum distance of three or four (per  $T_{pcch}$  parameter) access slots from the uplink access slot in which the last preamble was transmitted depending on the CPCH/AICH transmission timing parameter.
- b) Increases the preamble transmission power with the specified offset  $\Delta P$ . Power offset  $\Delta P_0$  is used unless the negative AICH timer is running, in which case  $\Delta P_1$  is used instead.
  - c) Decrease the AP Retransmission Counter by one.
  - d) If the AP Retransmission Counter  $< 0$ , the UE aborts the access attempt and sends a failure message to the MAC layer.
- 8) If the UE detects the AP-AICH\_nak (negative acquisition indicator) corresponding to the selected signature in the downlink access slot corresponding to the selected uplink access slot, the UE aborts the access attempt and sends a failure message to the MAC layer. The UE sets the negative AICH timer to indicate use of  $\Delta P_1$  use as the preamble power offset until timer expiry
  - 9) Upon reception of AP-AICH\_ack with matching signature, the access segment ends and the contention resolution segment begins. In this segment, the UE randomly selects a CD signature from the CD signature set and also select one-CD access slot sub-channel from the CD sub-channel group supported in the cell and transmits a CD Preamble, then waits for a CD/CA-ICH and the channel assignment (CA) (in case CA is active) message from the Node B. The slot selection procedure is as follows:
    - a) The next available slot when the PRACH and PCPCH scrambling code are not shared. Furthermore, the PCPCH AP preamble scrambling code and CD Preamble scrambling codes are different.
    - b) When the PRACH and PCPCH AP preamble scrambling code and CD preamble scrambling code are shared, the UE randomly selects one of the available access slots in the next 12 access slots. Number of CD sub-channels will be greater than 2.
  - 10) If the UE does not receive a CD/CA-ICH in the designated slot, the UE aborts the access attempt and sends a failure message to the MAC layer.
  - 11) If the UE receives a CD/CA-ICH in the designated slot with a signature that does not match the signature used in the CD Preamble, the UE aborts the access attempt and sends a failure message to the MAC layer.
  - 12a) (In case CA is not Active) If the UE receives a CDI from the CD/CA-ICH with a matching signature, the UE transmits the power control preamble  $\tau_{cd-pc-p}$  ms later as measured from initiation of the CD Preamble. The transmission of the message portion of the burst starts immediately after the power control preamble.
  - 12b) (In case CA is active) If the UE receives a CDI from the CD/CA-ICH with a matching signature and CA message that points out to one of the PCPCH's (mapping rule is in [5]) that were indicated to be free by the last received CSICH broadcast, the UE transmits the power control preamble  $\tau_{cd-pc-p}$  ms later as measured from initiation of the CD Preamble. The transmission of the message portion of the burst starts immediately after the power control preamble. If the CA message received points out the channel that was indicated to be busy on the last status information transmission received on the CSICH, the UE shall abort the access attempt and send a failure message to the MAC layer.
- NOTE: If the  $L_{pc-preamble}$  parameter indicates a zero length preamble, then there is not power control preamble and the message portion of the burst starts  $\tau_{cd-pc-p}$  ms after the initiation of the CD Preamble
- 13) The UE shall test the value of Start of Message Indicator received from DL-DPCCH for CPCH during the first  $N_{Start\_Message}$  frames after Power Control preamble. Start of Message Indicator is a known sequence repeated on a frame by frame basis. The value of  $N_{Start\_Message}$  shall be provided by the higher layers.
  - 14) If the UE does not detect Start of Message Indicator in the first  $N_{Start\_Message}$  frames of DL-DPCCH for CPCH after Power Control preamble, the UE aborts the access attempt and sends a failure message to the MAC layer. Otherwise, UE continuously transmits the packet data.
  - 15) During CPCH Packet Data transmission, the UE and UTRAN perform inner-loop power control on both the CPCH UL and the DPCCH DL.
  - 16) After the first  $N_{Start\_Message}$  frames after Power Control preamble, upon the detection of an Emergency Stop command sent by UTRAN, the UE halts CPCH UL transmission, aborts the access attempt and sends a failure message to the MAC layer.

- 17) If the UE detects loss of DPCCH DL during transmission of the power control preamble or the packet data, the UE halts CPCH UL transmission, aborts the access attempt and sends a failure message to the MAC layer.
- 18) If the UE completes the transmission of the packet data, the UE sends a success message to the MAC layer



---

## 3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ASC	Access Service Class
AP	Access Preamble
BCH	Broadcast Channel
<u>CCC</u>	<u>CPCH Control Command</u>
CCPCH	Common Control Physical Channel
CD	Collision Detection
CPCCH	Common Packet Channel
DCH	Dedicated Channel
DPCCH	Dedicated Physical Control Channel
DPCH	Dedicated Physical Channel
DTX	Discontinuous Transmission
DPDCH	Dedicated Physical Data Channel
FACH	Forward Access Channel
MUI	Mobile User Identifier
PCH	Paging Channel
PCPCH	Physical Common Packet Channel
PI	Paging Indication
PRACH	Physical Random Access Channel
RACH	Random Access Channel
SCH	Synchronisation Channel
SIR	Signal-to-Interference Ratio
SSDT	Site Selection Diversity TPC
TPC	Transmit Power Control
UE	User Equipment

## 5.2 Downlink power control

The transmit power of the downlink channels is determined by the network. In general the ratio of the transmit power between different downlink channels is not specified and may change with time. However, regulations exist as described in the following sub-clauses.

### 5.2.1 DPCCH/DPDCH

#### 5.2.1.1 General

The downlink transmit power control procedure controls simultaneously the power of a DPCCH and its corresponding DPDCHs. The power control loop adjusts the power of the DPCCH and DPDCHs with the same amount, i.e. the relative power difference between the DPCCH and DPDCHs is not changed.

The relative transmit power offset between DPCCH fields and DPDCHs is determined by the network. The TFCI, TPC and pilot fields of the DPCCH are offset relative to the DPDCHs power by PO1, PO2 and PO3 dB respectively. The power offsets may vary in time.

The power of CCC field in DL DPCCH for CPCH is the same as the power of the pilot field.

## CHANGE REQUEST

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**25.214** CR **098r4** Current Version: **3.2.0**

GSM (AA.BB) or 3G (AA.BBB) specification number ↑

↑ CR number as allocated by MCC support team

For submission to: **TSG-RAN #8**

list expected approval meeting # here ↑

for approval   
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strategic   
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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:** (U)SIM  ME  UTRAN / Radio  Core Network   
 (at least one should be marked with an X)

**Source:** TSG RAN WG1 **Date:** 2000-05-25

**Subject:** Procedure for end of transmission indicator in CPCH

**Work item:**

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

**Reason for change:** For improving the channel throughput, the EOT indicator is necessary. A release procedure by using EOT is needed in 25.214.

**Clauses affected:** 6.2 of 25.214

**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:**



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

## 6.1.1 RACH sub-channels

A RACH sub-channel defines a sub-set of the total set of access slots. There are a total of 12 RACH sub-channels. RACH sub-channel # $i$  ( $i = 0, \dots, 11$ ) consists of the following access slots:

- Access slot # $i$  transmitted in parallel to P-CCPCH frames for which  $SNF \bmod 8 = 0$  or  $SNF \bmod 8 = 1$ .
- Every 12<sup>th</sup> access slot relative to this access slot.

The access slots of different RACH sub-channels are also illustrated in Table 7.

**Table 7: The available access slots for different RACH sub-channels**

SFN modulo 8	Sub-channel Number											
	0	1	2	3	4	5	6	7	8	9	10	11
0	0	1	2	3	4	5	6	7				
1	12	13	14						8	9	10	11
2				0	1	2	3	4	5	6	7	
3	9	10	11	12	13	14						8
4	6	7					0	1	2	3	4	5
5			8	9	10	11	12	13	14			
6	3	4	5	6	7					0	1	2
7						8	9	10	11	12	13	14

## 6.2 CPCH Access Procedures

For each CPCH physical channel in a CPCH set allocated to a cell the following physical layer parameters are included in the System Information message: L1 shall receive the following information from the higher layers (RRC).

- UL Access Preamble (AP) scrambling code.
- UL Access Preamble signature set.
- The Access preamble slot sub-channels group.
- AP- AICH preamble channelization code.
- UL Collision Detection(CD) preamble scrambling code.
- CD Preamble signature set.
- CD preamble slot sub-channels group.
- CD-AICH preamble channelization code.
- CPCH UL scrambling code.
- DPCCH DL channelization code.([512] chip).

NOTE: There may be some overlap between the AP signature set and CD signature set if they correspond to the same scrambling code.

The following physical layer parameters are received from the RRC layer:

- 1)  $N_{AP\_retrans\_max}$  = Maximum Number of allowed consecutive access attempts (retransmitted preambles) if there is no AICH response. This is a CPCH parameter and is equivalent to Preamble\_Retrans\_Max in RACH.
- 2)  $P_{RACH} = P_{CPCH}$  = Initial open loop power level for the first CPCH access preamble sent by the UE.
  - [RACH/CPCH parameter].
- 3)  $\Delta P_0$  = Power step size for each successive CPCH access preamble.
  - [RACH/CPCH parameter].



- 4)  $\Delta P_1$  = Power step size for each successive RACH/CPCH access preamble in case of negative AICH. A timer is set upon receipt of a negative AICH. This timer is used to determine the period after receipt of a negative AICH when  $\Delta P_1$  is used in place of  $\Delta P_0$ .
  - [RACH/CPCH parameter].
- 5)  $T_{\text{cpch}}$  = CPCH transmission timing parameter: This parameter is identical to PRACH/AICH transmission timing parameter.
  - [RACH/CPCH parameter].
- 6)  $L_{\text{pc-preamble}}$  = Length of power control preamble (0 or 8 slots).
  - [CPCH parameter].
- 7)  $N_{\text{Start\_Message}}$  = Number of frames for the transmission of Start of Message Indicator in DL-DPCCH for CPCH.
- 8) The set of Transport Format parameters. This includes a Transport Format to PCPCH mapping table.

L1 shall receive the following information from MAC prior to packet transmission:

- 1) Transport Format of the message part.
- 2) The data to be transmitted is delivered to L1 once every TTI until the data buffer is empty.

The overall CPCH -access procedure consists of two parts:

- 1) Upon receipt of a Status-REQ message from the MAC layer, the UE shall start monitoring the CSICH to determine the availability of the transport formats in the transport format subset included in the Status-REQ message. UTRAN transmits availability of each PCPCH or maximum available data rate with availability of each PCPCH over the CSICH in case CA is active. Upper layers will supply the UE with information to map the transport formats to the PCPCHs. The UE shall send a Status-CNF message to the MAC layer containing the transport format subset listing the transport formats of the requested subset which are currently indicated as "available".

The actual access procedure is then:

- 2) Upon receipt of the Access-REQ message from the MAC layer, which contains an identified transport format from the available ones, the following sequence of events occur. The use of step 2a or 2b depends on whether availability of each PCPCH or the Maximum available data rate along with the availability of each PCPCH is transmitted over CSICH. Note that in the first case, each access resource combination (AP signatures and access subchannel group) maps to each PCPCH resource and in the second case each access resource combination maps to each data rate.
  - 2a) (In case CA is not Active) The UE shall test the value(s) of the most recent transmission of the CSICH Status Indicator(s) corresponding to the PCPCH channel(s) for the identified transport format included in the Access-REQ message. If this indicates that no channel is 'available' the UE shall abort the access attempt and send a failure message to the MAC layer. The UE shall also retain the availability status of the each PCPCH for further verification in a later phase.
  - 2b) (In case CA is active) The CSICH Status Indicators indicate the maximum available data rate along with individual PCPCH availability. The UE shall test the value of the most recent transmission of the Status Indicator(s). If this indicates that the maximum available data rate is less than the requested data rate, the UE shall abort the access attempt and send a failure message to the MAC layer. The PHY provides the availability information to the MAC. The UE shall also retain the availability status of the each PCPCH for further channel assignment message verification in a later phase in case of success.
- 3) The UE sets the preamble transmit power to the value  $P_{\text{CPCH}}$  which is supplied by the MAC layer for initial power level for this CPCH access attempt.
- 4) The UE sets the AP Retransmission Counter to  $N_{\text{AP\_Retrans\_Max}}$ .
- 5a) In the case CA is not active, the uplink access slot and signature to be used for the CPCH-AP transmission are selected in the following steps:

- a) The UE selects randomly one PCPCH from the set of available PCPCH channel(s) as indicated on the CSICH and supporting the identified transport format included in the Access-REQ message. The random function shall be such that each of the allowed selections is chosen with equal probability.
  - b) The UE randomly selects a CPCH-AP signature from the set of available signatures in the access resource combination corresponding to the selected PCPCH in step a). The random function shall be such that each of the allowed selections is chosen with equal probability.
  - c) Using the AP access slot sub-channel group of the access resource combination corresponding to selected PCPCH in step a), the UE derives the available CPCH-AP access slots in the next two frames, defined by SFN and SFN+1 with the help of SFN and table 7 in subclause 6.1. The UE randomly selects one access slot from the available access slots in the next frame, defined by SFN, if there is one available. If there is no access slot available in the next frame, defined by SFN then, randomly selects one access slot from the available access slots in the following frame, defined by SFN+1. The random function shall be such that each of the allowed selections is chosen with equal probability.
- 5b) In the case CA is active, the uplink access slot and signature to be used for the CPCH-AP transmission are selected in the following steps:
- a) The UE randomly selects a CPCH-AP signature from the set of available signatures in the access resource combination corresponding to the transport format identified in the Access-REQ message. The random function shall be such that each of the allowed selections is chosen with equal probability.
  - b) Using the AP access slot sub-channel group of the access resource combination corresponding to the transport format identified in the Access-REQ message, the UE derives the available CPCH-AP access slots in the next two frames, defined by SFN and SFN+1 with the help of SFN and table 7 in subclause 6.1. The UE randomly selects one access slot from the available access slots in the next frame, defined by SFN, if there is one available. If there is no access slot available in the next frame, defined by SFN then, randomly selects one access slot from the available access slots in the following frame, defined by SFN+1. The random function shall be such that each of the allowed selections is chosen with equal probability.
- 6) The UE transmits the AP using the selected uplink access slot and signature, and MAC supplied initial preamble transmission power. The following sequence of events occur based on whether availability of each PCPCH or the Maximum available data rate along with the availability of each PCPCH is transmitted over CSICH.
- 6a) (In case CA is not Active) The UE shall test the value of the most recent transmission of the Status Indicator corresponding to the identified CPCH transport channel immediately before AP transmission. If this indicates that the channel is 'not available' the UE shall abort the access attempt and send a failure message to the MAC layer. Otherwise the UE transmits the AP using the UE selected uplink signature and access slot, and the initial preamble transmission power from step 3, above.
- 6b) (In case CA is active) The Status Indicator indicates the maximum available data rate as well as the availability of each PCPCH. The UE shall test the value of the Status Indicator. If this indicates that the maximum available data rate is less than the requested data rate, the UE shall abort the access attempt and send a failure message to the MAC layer. Otherwise the UE shall transmit the AP using the UE selected uplink access slot, the MAC supplied signature and initial preamble transmission power from step 3, above.
- 7) If the UE does not detect the positive or negative acquisition indicator corresponding to the selected signature in the downlink access slot corresponding to the selected uplink access slot, the UE shall test the value of the most recent transmission of the Status Indicator corresponding to the selected PCPCH immediately before AP transmission. If this indicates that the PCPCH is 'not available' the UE shall abort the access attempt and send a failure message to the MAC layer. Otherwise the following steps shall be executed:
- a) Selects the new uplink access slot from the available access slot, i.e. next access slot in the sub-channel group used. There must be a minimum distance of three or four (per T<sub>cpch</sub> parameter) access slots from the uplink access slot in which the last preamble was transmitted depending on the CPCH/AICH transmission timing parameter.
  - b) Increases the preamble transmission power with the specified offset  $\Delta P$ . Power offset  $\Delta P_0$  is used unless the negative AICH timer is running, in which case  $\Delta P_1$  is used instead.
  - c) Decrease the AP Retransmission Counter by one.

- d) If the AP Retransmission Counter  $< 0$ , the UE aborts the access attempt and sends a failure message to the MAC layer.
- 8) If the UE detects the AP-AICH\_nak (negative acquisition indicator) corresponding to the selected signature in the downlink access slot corresponding to the selected uplink access slot, the UE aborts the access attempt and sends a failure message to the MAC layer. The UE sets the negative AICH timer to indicate use of  $\Delta P_1$  use as the preamble power offset until timer expiry.
- 9) Upon reception of AP-AICH\_ack with matching signature, the access segment ends and the contention resolution segment begins. In this segment, the UE randomly selects a CD signature from the CD signature set and also select one-CD access slot sub-channel from the CD sub-channel group supported in the cell and transmits a CD Preamble, then waits for a CD/CA-ICH and the channel assignment (CA) (in case CA is active) message from the Node B. The slot selection procedure is as follows:
- The next available slot when the PRACH and PCPCH scrambling code are not shared. Furthermore, the PCPCH AP preamble scrambling code and CD Preamble scrambling codes are different.
  - When the PRACH and PCPCH AP preamble scrambling code and CD preamble scrambling code are shared, the UE randomly selects one of the available access slots in the next 12 access slots. Number of CD sub-channels will be greater than 2.
- 10) If the UE does not receive a CD/CA-ICH in the designated slot, the UE aborts the access attempt and sends a failure message to the MAC layer.
- 11) If the UE receives a CD/CA-ICH in the designated slot with a signature that does not match the signature used in the CD Preamble, the UE aborts the access attempt and sends a failure message to the MAC layer.
- 12a) (In case CA is not Active) If the UE receives a CDI from the CD/CA-ICH with a matching signature, the UE transmits the power control preamble  $\tau_{cd-p-pc-p}$  ms later as measured from initiation of the CD Preamble. The transmission of the message portion of the burst starts immediately after the power control preamble.
- 12b) (In case CA is active) If the UE receives a CDI from the CD/CA-ICH with a matching signature and CA message that points out to one of the PCPCH's (mapping rule is in [5]) that were indicated to be free by the last received CSICH broadcast, the UE transmits the power control preamble  $\tau_{cd-p-pc-p}$  ms later as measured from initiation of the CD Preamble. The transmission of the message portion of the burst starts immediately after the power control preamble. If the CA message received points out the channel that was indicated to be busy on the last status information transmission received on the CSICH, the UE shall abort the access attempt and send a failure message to the MAC layer.
- NOTE: If the  $L_{pc-preamble}$  parameter indicates a zero length preamble, then there is not power control preamble and the message portion of the burst starts  $\tau_{cd-p-pc-p}$  ms after the initiation of the CD Preamble.
- 13) The UE shall test the value of Start of Message Indicator received from DL-DPCCH for CPCH during the first  $N_{Start\_Message}$  frames after Power Control preamble. Start of Message Indicator is a known sequence repeated on a frame by frame basis. The value of  $N_{Start\_Message}$  shall be provided by the higher layers.
- 14) If the UE does not detect Start of Message Indicator in the first  $N_{Start\_Message}$  frames of DL-DPCCH for CPCH after Power Control preamble, the UE aborts the access attempt and sends a failure message to the MAC layer. Otherwise, UE continuously transmits the packet data.
- 15) During CPCH Packet Data transmission, the UE and UTRAN perform inner-loop power control on both the CPCH UL and the DPCCH DL.
- 16) After the first  $N_{Start\_Message}$  frames after Power Control preamble, upon the detection of an Emergency Stop command sent by UTRAN, the UE halts CPCH UL transmission, aborts the access attempt and sends a failure message to the MAC layer.
- 17) If the UE detects loss of DPCCH DL during transmission of the power control preamble or the packet data, the UE halts CPCH UL transmission, aborts the access attempt and sends a failure message to the MAC layer.
- ~~18) If the UE completes the transmission of the packet data, the UE sends a success message to the MAC layer.~~
- 18) The UE may send empty frames after the end of the packet to indicate the end of transmission. The number of the empty frames is set by higher layers.

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# 7 Closed loop mode transmit diversity

<h2 style="margin: 0;">CHANGE REQUEST</h2>		<i>Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.</i>
<b>25.214</b>	<b>CR</b>	<b>099</b>
GSM (AA.BB) or 3G (AA.BBB) specification number ↑		↑ CR number as allocated by MCC support team
For submission to: <span style="background-color: yellow;">TSG-RAN #8</span>		Current Version: <span style="background-color: yellow;">3.2.0</span>
List expected approval meeting # here ↑	for approval <input checked="" type="checkbox"/>	strategic <input type="checkbox"/>
	for information <input type="checkbox"/>	non-strategic <input type="checkbox"/>
		(for SMG use only)

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

**Source:**    TSG RAN WG1    **Date:**    2000-04-14

**Subject:**    Downlink inner-loop power control in compressed mode

**Work item:**    Outer-loop power control

<b>Category:</b>	F Correction <input type="checkbox"/> A Corresponds to a correction in an earlier release <input type="checkbox"/> B Addition of feature <input type="checkbox"/> C Functional modification of feature <input checked="" type="checkbox"/> D Editorial modification <input type="checkbox"/>	<b>Release:</b>	Phase 2 <input type="checkbox"/> Release 96 <input type="checkbox"/> Release 97 <input type="checkbox"/> Release 98 <input type="checkbox"/> Release 99 <input checked="" type="checkbox"/> Release 00 <input type="checkbox"/>
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(only one category shall be marked With an X)

**Reason for change:**    Downlink inner-loop power control was not specified up to now.

**Clauses affected:**    5.2.1.3

<b>Other specs affected:</b>	Other 3G core specifications <input type="checkbox"/> Other GSM core specifications <input type="checkbox"/> MS test specifications <input type="checkbox"/> BSS test specifications <input type="checkbox"/> O&M specifications <input type="checkbox"/>	→ List of CRs: → List of CRs: → List of CRs: → List of CRs: → List of CRs:	
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**Other comments:**   



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

### 5.2.1.3 Power control in compressed mode

The aim of downlink power control in uplink or/and downlink compressed mode is to recover as fast as possible a signal-to-interference ratio (SIR) close to the target SIR after each transmission gap.

The UE behaviour is the same in compressed mode as in normal mode, described in subclause 5.2.1.2.

~~The UTRAN behaviour during compressed mode is not specified. As an example, the algorithm can be similar to uplink power control in downlink compressed mode as described in subclause 5.1.2.3.~~

~~In downlink compressed mode or in simultaneous downlink and uplink compressed mode, the transmission of downlink DPCCH and DPDCH(s) is stopped.~~

In compressed mode, compressed frames may occur in either the uplink or the downlink or both. In compressed frames, the transmission of downlink DPDCH(s) and DPCCH shall be stopped during transmission gaps.

The power of the DPCCH in the first slot after the transmission gap should be set to the same value as in the slot just before the transmission gap.

During RPL slots after each transmission gap, ordinary transmit power control algorithm is applied with a step size  $\Delta_{RP-TPC}$  instead of  $\Delta_{TPC}$ , where:

- $\Delta_{RP-TPC}$  is called the recovery power control step size and is expressed in dB.  $\Delta_{RP-TPC}$  is equal to the minimum value of 3 dB and  $2\Delta_{TPC}$ .
- RPL is called recovery period length and is equal to the minimum value out of the transmission gap length and 7 slots.

After the recovery period, ordinary transmit power control resumes with step size  $\Delta_{TPC}$ .

<b>CHANGE REQUEST</b>		Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.
<b>25.214</b>	<b>CR</b>	<b>100</b>
GSM (AA.BB) or 3G (AA.BBB) specification number ↑		↑ CR number as allocated by MCC support team
For submission to: <b>TSG RAN#8</b> <small>list expected approval meeting # here ↑</small>		Current Version: <b>3.2.0</b>
for approval <input checked="" type="checkbox"/> for information <input type="checkbox"/>		strategic <input type="checkbox"/> non-strategic <input type="checkbox"/> <small>(for SMG use only)</small>

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

**Source:**    TSG RAN WG1    **Date:**    25-April-2000

**Subject:**    Definition of vector transmission weight entity

**Work item:**    \_\_\_\_\_

<b>Category:</b>	F Correction <input checked="" type="checkbox"/> A Corresponds to a correction in an earlier release <input type="checkbox"/> B Addition of feature <input type="checkbox"/> C Functional modification of feature <input type="checkbox"/> D Editorial modification <input type="checkbox"/>	<b>Release:</b>	Phase 2 <input type="checkbox"/> Release 96 <input type="checkbox"/> Release 97 <input type="checkbox"/> Release 98 <input type="checkbox"/> Release 99 <input checked="" type="checkbox"/> Release 00 <input type="checkbox"/>
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(only one category shall be marked with an X)

**Reason for change:**    Current text has no mathematical definition of w. Text description ambiguous.

**Clauses affected:**    7.1

<b>Other specs affected:</b>	Other 3G core specifications <input type="checkbox"/> Other GSM core specifications <input type="checkbox"/> MS test specifications <input type="checkbox"/> BSS test specifications <input type="checkbox"/> O&M specifications <input type="checkbox"/>	→ List of CRs: → List of CRs: → List of CRs: → List of CRs: → List of CRs:	
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**Other comments:**    Release 99 scheme has two antennas, remove "...".

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

## 7.1 Determination of feedback information

The UE uses the Common Pilot Channel (CPICH) to separately estimate the channels seen from each antenna.

Once every slot, the UE computes the phase adjustment,  $\phi$ , and for mode 2 the amplitude adjustment that should be applied at the UTRAN access point to maximise the UE received power. In non-soft handover case, that can be accomplished by e.g. solving for weight vector,  $\underline{w}$ , that maximises

$$P = \underline{w}^H H^H H \underline{w} \quad (1)$$

where

$$H = [\underline{h}_1 \ \underline{h}_2 \ \dots] \text{ and } \underline{w} = [w_1, w_2]^T$$

and where the column vectors  $\underline{h}_i$  and  $\underline{h}_2$  represent the estimated channel impulse responses for the transmission antennas 1 and 2, of length equal to the length of the channel impulse response. The elements of  $\underline{w}$  correspond to the ~~phase and amplitude~~ adjustments computed by the UE.

During soft handover or SSDT power control, the antenna weight vector,  $\underline{w}$  can be, for example, determined so as to maximise the criteria function,

$$P = \underline{w}^H (H_1^H H_1 + H_2^H H_2 + \dots) \underline{w} \quad (2)$$

where  $H_i$  is an estimated channel impulse response for BS#i. In regular SHO, the set of BS#i corresponds to the active set. With SSDT, the set of BS#i corresponds to the primary base station(s).



## 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 101r1**      Current Version: **3.2.0**

GSM (AA.BB) or 3G (AA.BBB) specification number ↑

↑ CR number as allocated by MCC support team

For submission to: **TSG-RAN #8**  
list expected approval meeting # here  
↑

for approval   
for information

strategic  (for SMG use only)  
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:**      (U)SIM       ME       UTRAN / Radio       Core Network   
(at least one should be marked with an X)

**Source:**      TSG RAN WG1      **Date:**      2000-04-27

**Subject:**      Number of slots for DPCCH power control preamble

**Work item:**      \_\_\_\_\_

<b>Category:</b>	F Correction <input type="checkbox"/> A Corresponds to a correction in an earlier release <input type="checkbox"/> B Addition of feature <input type="checkbox"/> C Functional modification of feature <input checked="" type="checkbox"/> D Editorial modification <input type="checkbox"/>	<b>Release:</b>	Phase 2 <input type="checkbox"/> Release 96 <input type="checkbox"/> Release 97 <input type="checkbox"/> Release 98 <input type="checkbox"/> Release 99 <input checked="" type="checkbox"/> Release 00 <input type="checkbox"/>
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(only one category shall be marked with an X)

**Reason for change:**      This CR will increase the probability of success for uplink DCH setup by allowing the UE to transmit the preamble for up to 15 slots and the UTRAN to use the search time accordingly. Also the power control step size is being changed correspondingly.

**Clauses affected:**      5.1.2.4

<b>Other specs affected:</b>	Other 3G core specifications <input checked="" type="checkbox"/> Other GSM core specifications <input type="checkbox"/> MS test specifications <input type="checkbox"/> BSS test specifications <input type="checkbox"/> O&M specifications <input type="checkbox"/>	→ List of CRs:	XX     
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**Other comments:**      25.331 3.2.0



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

#### 5.1.2.4 Transmit power control in DPCCH power control preamble

A power control preamble may be used for initialisation of a DCH. Both the UL and DL DPCCHs shall be transmitted during the uplink power control preamble. The UL DPDCH shall not commence before the end of the power control preamble.

The length of the power control preamble is a UE-specific parameter signalled by the network, and can take the values 0 slots or 15.8 slots.

If the length of the power control preamble is greater than zero, the details of power control used during the power control preamble differ from the ordinary power control which is used afterwards. After the first slot of the power control preamble the change in uplink DPCCH transmit power shall initially be given by:

$$\Delta_{\text{DPCCH}} = \Delta_{\text{TPC-init}} \times \text{TPC\_cmd}.$$

~~If the value of PCA is 1 then  $\Delta_{\text{TPC-init}}$  is equal to the minimum value out of 3 dB and  $2\Delta_{\text{TPC}}$ .~~

~~If the value of PCA is 2 then  $\Delta_{\text{TPC-init}}$  is equal to 2dB.~~

For PCA equal to 1 and 2, the value of  $\Delta_{\text{TPC-init}}$  is set to  $\Delta_{\text{TPC}}$ .

TPC\_cmd is derived according to algorithm 1 as described in sub clause 5.1.2.2.1, regardless of the value of PCA.

Ordinary power control (see subclause 5.1.2.2), with the power control algorithm determined by the value of PCA and step size  $\Delta_{\text{TPC}}$ , shall be used as soon as the sign of TPC\_cmd reverses for the first time, or at the end of the power control preamble if the power control preamble ends first.

## CHANGE REQUEST

**25.214 CR 102**

Current Version: 3.2.0

For submission to: TSG RAN #8 for approval  for information  strategic  non-strategic

**Proposed change affects:** (U)SIM  ME  UTRAN / Radio  Core Network

**Source:** TSG RAN WG1 **Date:** 11.5.2000

**Subject:** Clarification of UTRAN Tx diversity reponse timing description in 25.214

**Work item:**

<b>Category:</b>	F Correction	<input type="checkbox"/>	<b>Release:</b>	Phase 2	<input type="checkbox"/>
	A Corresponds to a correction in an earlier release	<input type="checkbox"/>		Release 96	<input type="checkbox"/>
	B Addition of feature	<input type="checkbox"/>		Release 97	<input type="checkbox"/>
	C Functional modification of feature	<input type="checkbox"/>		Release 98	<input type="checkbox"/>
	D Editorial modification	<input checked="" type="checkbox"/>		Release 99	<input checked="" type="checkbox"/>
				Release 00	<input type="checkbox"/>

**Reason for change:** Clarification of description of the UTRAN Tx diversity reponse timing

**Clauses affected:** 7.1

<b>Other specs affected:</b>	Other 3G core specifications	<input type="checkbox"/>	→ List of CRs:	
	Other GSM core specifications	<input type="checkbox"/>	→ List of CRs:	
	MS test specifications	<input type="checkbox"/>	→ List of CRs:	
	BSS test specifications	<input type="checkbox"/>	→ List of CRs:	
	O&M specifications	<input type="checkbox"/>	→ List of CRs:	

**Other comments:**

## 7.1 Determination of feedback information

The UE uses the Common Pilot Channel (CPICH) to separately estimate the channels seen from each antenna.

Once every slot, the UE computes the phase adjustment,  $\phi$ , and for mode 2 the amplitude adjustment that should be applied at the UTRAN access point to maximise the UE received power. In non-soft handover case, that can be accomplished by e.g. solving for weight vector,  $\underline{w}$ , that maximises.

$$P = \underline{w}^H H^H H \underline{w} \quad (1)$$

where

$$H = [\underline{h}_1 \ \underline{h}_2 \ \dots]$$

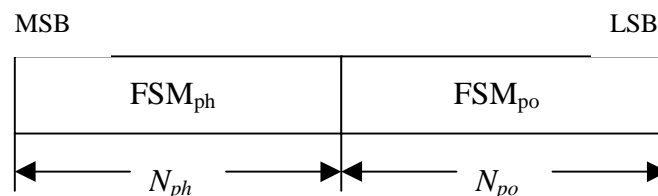
and where the column vectors  $\underline{h}_1$  and  $\underline{h}_2$  represent the estimated channel impulse responses for the transmission antennas 1 and 2, of length equal to the length of the channel impulse response. The elements of  $\underline{w}$  correspond to the phase and amplitude adjustments computed by the UE.

During soft handover or SSdT power control, the antenna weight vector,  $\underline{w}$  can be, for example, determined so as to maximise the criteria function:

$$P = \underline{w}^H (H_1^H H_1 + H_2^H H_2 + \dots) \underline{w} \quad (2)$$

where  $H_i$  is an estimated channel impulse response for BS#i. In regular SHO, the set of BS#i corresponds to the active set. With SSdT, the set of BS#i corresponds to the primary base station(s).

The UE feeds back to the UTRAN access point the information on which phase/power settings to use. Feedback Signalling Message (FSM) bits are transmitted in the portion of FBI field of uplink DPCCCH slot(s) assigned to Closed Loop Mode Transmit Diversity, the FBI D field (see 25.211). Each message is of length  $N_w = N_{po} + N_{ph}$  bits and its format is shown in the figure 3. The transmission order of bits is from MSB to LSB, i.e. MSB is transmitted first. FSM<sub>po</sub> and FSM<sub>ph</sub> subfields are used to transmit the power and phase settings, respectively.



**Figure 3: Format of feedback signalling message. FSM<sub>po</sub> transmits the power setting and FSM<sub>ph</sub> the phase setting**

The adjustments are made by the UTRAN Access Point at the beginning of the downlink DPCCCH pilot field. The downlink slot in which the adjustment is done is signaled to L1 of UE by higher layers. Two possibilities exist:

- 1) When feedback command is transmitted in uplink slot  $i$ , which is transmitted in a chip offset limited to  $1024 \pm 148$  chips when compared to received downlink slot  $j$ , the adjustment is done at the beginning of the pilot field of the downlink slot  $(j+1) \bmod 15$ .
- 2) When feedback command is transmitted in uplink slot  $i$ , which is transmitted in a chip offset limited to  $1024 \pm 148$  chips when compared to received downlink slot  $j$ , the adjustment is done at the beginning of the pilot field of the downlink slot  $(j+2) \bmod 15$ .

Thus, adjustment timing at UTRAN Access Point is either according to 1) or 2) as controlled by the higher layers.

In case a PDSCH is associated with a DPCH for which closed-loop transmit diversity is applied, the antenna weights applied to the PDSCH are the same as the antenna weights applied to the associated DPCH. The timing of the weight adjustment of the PDSCH is such that the PDSCH weight adjustment is done at the PDSCH slot border,  $N$  chips after the adjustment of the associated DPCH, where  $0 \leq N < 2560$ .

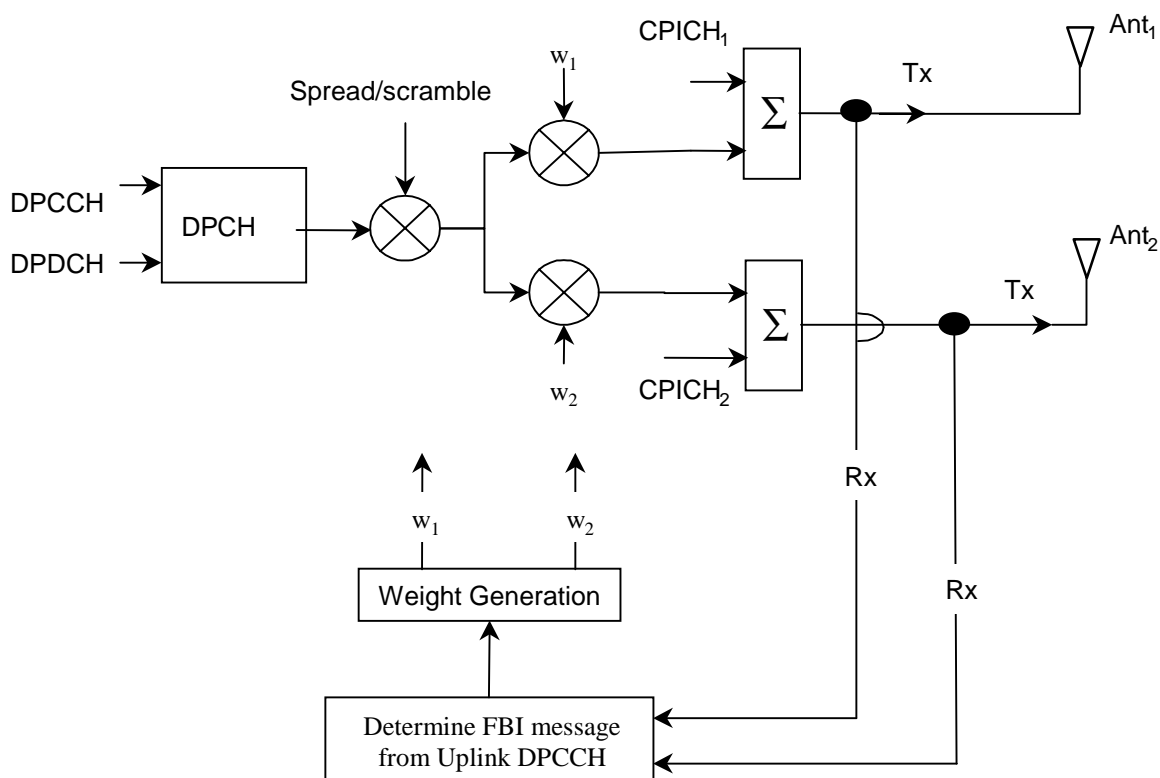


## 7 Closed loop mode transmit diversity

The general transmitter structure to support closed loop mode transmit diversity for DPCH transmission is shown in figure 2. Channel coding, interleaving and spreading are done as in non-diversity mode. The spread complex valued signal is fed to both TX antenna branches, and weighted with antenna specific weight factors  $w_1$  and  $w_2$ . The weight factors are complex valued signals (i.e.,  $w_i = a_i + jb_i$ ), in general.

The weight factors (actually the corresponding phase adjustments in closed loop mode 1 and phase/amplitude adjustments in closed loop mode 2) are determined by the UE, and signalled to the UTRAN access point (=cell transceiver) using the D-bits of the FBI field of uplink DPCCCH.

For the closed loop mode 1 different (orthogonal) dedicated pilots symbols in the DPCCCH are sent on the 2 different antennas. For closed loop mode 2 the same dedicated pilot symbols in the DPCCCH are sent on both antennas.



**Figure 2: The generic downlink transmitter structure to support closed loop mode transmit diversity for DPCH transmission**

There are two closed loop modes whose characteristics are summarized in the table 8. The use of the modes is controlled via higher layer signalling.

**Table 8: Summary of number of feedback information bits per slot,  $N_{FBD}$ , feedback command length in slots,  $N_w$ , feedback command rate, feedback bit rate, number of phase bits,  $N_{ph}$ , per signalling word, number of amplitude bits,  $N_{po}$ , per signalling word and amount of constellation rotation at UE for the two closed loop modes**

Closed loop mode	$N_{FBD}$	$N_w$	Update rate	Feedback bit rate	$N_{po}$	$N_{ph}$	Constellation rotation
1	1	1	1500 Hz	1500 bps	0	1	$\pi/2$
2	1	4	1500 Hz	1500 bps	1	3	N/A

## 7.1 Determination of feedback information

The UE uses the Common Pilot Channel (CPICH) to separately estimate the channels seen from each antenna.

Once every slot, the UE computes the phase adjustment,  $\phi$ , and for mode 2 the amplitude adjustment that should be applied at the UTRAN access point to maximise the UE received power. In non-soft handover case, that can be accomplished by e.g. solving for weight vector,  $\underline{w}$ , that maximises.

$$P = \underline{w}^H H^H H \underline{w} \quad (1)$$

where

$$H = [\underline{h}_1/\underline{h}_1 \quad \underline{h}_2/\underline{h}_2 \dots]$$

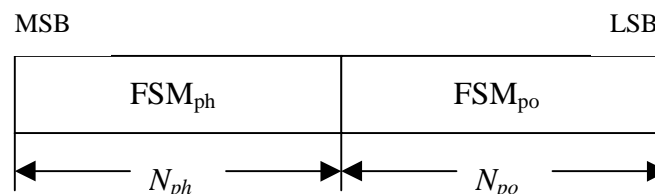
and where the column vectors  $\underline{h}_1/\underline{h}_1$  and  $\underline{h}_2/\underline{h}_2$  represent the estimated channel impulse responses for the transmission antennas 1 and 2, of length equal to the length of the channel impulse response. The elements of  $\underline{w}$  correspond to the phase and amplitude adjustments computed by the UE.

During soft handover or SSdT power control, the antenna weight vector,  $\underline{w}$  can be, for example, determined so as to maximise the criteria function:

$$P = \underline{w}^H (H_1^H H_1 + H_2^H H_2 + \dots) \underline{w} \quad (2)$$

where  $H_i$  is an estimated channel impulse response for BS#i. In regular SHO, the set of BS#i corresponds to the active set. With SSdT, the set of BS#i corresponds to the primary base station(s).

The UE feeds back to the UTRAN access point the information on which phase/power settings to use. Feedback Signalling Message (FSM) bits are transmitted in the portion of FBI field of uplink DPCH slot(s) assigned to Closed Loop Mode 1 transmit Diversity, the FBI D field (see 25.211). Each message is of length  $N_w = N_{po} + N_{ph}$  bits and its format is shown in the figure 3. The transmission order of bits is from MSB to LSB, i.e. MSB is transmitted first.  $FSM_{po}$  and  $FSM_{ph}$  subfields are used to transmit the power and phase settings, respectively.



**Figure 3: Format of feedback signalling message.  $FSM_{po}$  transmits the power setting and  $FSM_{ph}$  the phase setting**

The adjustments are made by the UTRAN Access Point at the beginning of the downlink DPCH pilot field. The downlink slot in which the adjustment is done is signalled to L1 of UE by higher layers. Two possibilities exist:

- 1) When feedback command is transmitted in uplink slot  $i$ , which is transmitted in a chip offset limited to  $1024 \pm 148$  chips when compared to received downlink slot  $j$ , the adjustment is done at the beginning of the pilot field of the downlink slot  $(j+1) \bmod 15$ , or
- 2) When feedback command is transmitted in uplink slot  $i$ , which is transmitted in a chip offset limited to  $1024 \pm 148$  chips when compared to received downlink slot  $j$ , the adjustment is done at the beginning of the pilot field of the downlink slot  $(j+2) \bmod 15$ .

In case a PDSCH is associated with a DPCH for which closed-loop transmit diversity is applied, the antenna weights applied to the PDSCH are the same as the antenna weights applied to the associated DPCH. The timing of the weight adjustment of the PDSCH is such that the PDSCH weight adjustment is done at the PDSCH slot border,  $N$  chips after the adjustment of the associated DPCH, where  $0 \leq N < 2560$ .

## 7.2 Closed loop mode 1

UE uses the CPICH transmitted both from antenna 1 and antenna 2 to calculate the phase adjustment to be applied at UTRAN access point to maximise the UE received power. The received CPICH can be denoted as:

$$S_{CPICH}^1(t) = a_1(t)e^{j\phi_1(t)} \quad (2)$$

$$S_{CPICH}^2(t) = a_2(t)e^{j\phi_2(t)} \quad (3)$$

where:

$S_{CPICH}^1(t)$  = common pilot signal from antenna 1.

$a_1(t)$  = time varying amplitude of the  $S_{CPICH}^1(t)$ .

$\phi_1(t)$  = time varying phase of the  $S_{CPICH}^1(t)$ .

$S_{CPICH}^2(t)$  = common pilot signal from antenna 2 (diversity antenna).

$a_2(t)$  = time varying amplitude of the  $S_{CPICH}^2(t)$ .

$\phi_2(t)$  = time varying phase of the  $S_{CPICH}^2(t)$ .

Before solving for the optimum phase adjustment, the  $S_{CPICH}^2$  is rotated as follows:

$$S_{CPICH}^2(t) = a_2(t)e^{j\phi_2(t)}e^{j\phi_r(t)} \quad (4)$$

The rotation angle,  $\phi_r(t)$ , which is applied before solving for phase adjustment to be signaled in uplink slot  $i$ , is defined as:

$$\phi_r(t) = \begin{cases} 0, & i = 0,2,4,6,8,10,12,14 \\ \frac{\pi}{2}, & i = 1,3,5,7,9,11,13 \end{cases} \quad (5)$$

After rotation of the  $S_{CPICH}^2$  by  $\phi_r(t)$ , In each slot, UE calculates the optimum phase adjustment,  $\phi$ , for antenna 2, which is then quantized into  $\phi_Q$  having two possible values as follows:

$$\begin{aligned} \frac{-\pi}{2} < \phi \leq \frac{\pi}{2} &\Rightarrow \phi_Q = 0 \\ \frac{\pi}{2} < \phi \leq \frac{3\pi}{2} &\Rightarrow \phi_Q = \pi \end{aligned} \quad \phi_Q = \begin{cases} \pi, & \text{if } \pi/2 < \phi - \phi_r(i) \leq 3\pi/2 \\ 0, & \text{otherwise} \end{cases} \quad (6)$$

where:

$$\phi_r(i) = \begin{cases} 0, & i = 0,2,4,6,8,10,12,14 \\ \pi/2, & i = 1,3,5,7,9,11,13 \end{cases} \quad (3)$$

If  $\phi_Q = 0$ , a command '0' is send to UTRAN using the FSM<sub>ph</sub> field. Correspondingly, if  $\phi_Q = \pi$ , command '1' is send to UTRAN using the FSM<sub>ph</sub> field.

Due to rotation of the constellation at UE the UTRAN interprets the received commands according to table 9 which shows the mapping between phase adjustment,  $\phi_i$ , and received feedback command for each UL slot.



**Table 9: Feedback commands and corresponding phase adjustments,  $\phi_i$ , corresponding to feedback commands for the slots  $i$  of the UL radio frame**

FSM <sub>ph</sub>	$\phi_i$														
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0	0	$\pi/2$	0	$\pi/2$	0	$\pi/2$	0	$\pi/2$	0	$\pi/2$	0	$\pi/2$	0	$\pi/2$	0
1	$\pi$	$-\pi/2$	$\pi$	$-\pi/2$	$\pi$	$-\pi/2$	$\pi$	$-\pi/2$	$\pi$	$-\pi/2$	$\pi$	$-\pi/2$	$\pi$	$-\pi/2$	$\pi$

Slot #	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
FSM	0	0	$\pi/2$	0	$\pi/2$	0	$\pi/2$	0	$\pi/2$	0	$\pi/2$	0	$\pi/2$	0	$\pi/2$
	1	$\pi$	$-\pi/2$	$\pi$	$-\pi/2$	$\pi$	$-\pi/2$	$\pi$	$-\pi/2$	$\pi$	$-\pi/2$	$\pi$	$-\pi/2$	$\pi$	$-\pi/2$

The weight vector,  $w_2$ , is then calculated by sliding window averaging the received phases over 2 consecutive slots. Algorithmically,  $w_2$  is calculated as follows:

$$w_2 = \frac{\sum_{i=n-1}^n \cos(\phi_i)}{\sqrt{2}} + j \frac{\sum_{i=n-1}^n \sin(\phi_i)}{\sqrt{2}} \quad (74)$$

where:

$$\phi_i \in \{0, \pi, \pi/2, -\pi/2\} \quad (85)$$

For antenna 1, the weight vector,  $w_1$ , is always:

$$w_1 = 1 \quad (96)$$

### 7.2.1 Mode 1 end of frame adjustment

In closed loop mode 1 at frame borders the sliding window averaging operation is slightly modified. Upon reception of the FB command for slot 0 of the next frame, the average is calculated based on the command for slot 13 of the previous frame and the command for slot 0 of the next frame, i.e.  $\phi_i$  from slot 14 is not used:

$$w_2 = \frac{\cos(\phi_{13}^{j-1}) + \cos(\phi_0^j)}{\sqrt{2}} + j \frac{\sin(\phi_{13}^{j-1}) + \sin(\phi_0^j)}{\sqrt{2}} \quad (107)$$

where:

- $\phi_{13}^{j-1}$  = phase adjustment from frame j-1, slot 13.
- $\phi_0^j$  = phase adjustment from frame j, slot 0.

### 7.2.2 Mode 1 normal initialization

For the first frame of transmission UE determines the feedback commands in a normal way and sends them to UTRAN.

Having received the first FB command the UTRAN calculates the  $w_2$  as follows:

$$w_2 = \frac{\cos(\pi/2) + \cos(\phi_0)}{\sqrt{2}} + j \frac{\sin(\pi/2) + \sin(\phi_0)}{\sqrt{2}} \quad (118)$$

where:

$\phi_0$  = phase adjustment from slot 0 of the first frame.

## 7.2.3 Mode 1 operation during compressed mode

### 7.2.3.1 Downlink in compressed mode and uplink in normal mode

When downlink is in compressed mode but uplink is operating normally (i.e. not compressed) the UTRAN continues its Tx diversity related functions in the same way as in non-compressed downlink mode.

If UE continues to calculate the phase adjustments based on the received CPICH from antennas 1 and 2 during the idle downlink slots there is no difference in UE operation when compared to non-compressed downlink operation.

If during the compressed downlink transmission there are uplink slots for which no new estimate of the phase adjustment has been calculated the following rules are applied in UE when determining the feedback command:

- 1) If no new estimate of phase adjustment,  $\phi_i$ , exist corresponding to the feedback command to be send in uplink slot  $i$ :
  - If  $1 < i < 15$ :
    - the feedback command sent in uplink slot  $i-2$  is used;
  - else if  $i = 0$ :
    - the feedback command sent in uplink slot 14 of previous frame is used;
  - else if  $i = 1$ :
    - the feedback command sent in uplink slot 13 of previous frame is used;
  - end if.
- 2) When transmission in downlink is started again in downlink slot  $N_{\text{last}+1}$  (if  $N_{\text{last}+1} = 15$ , then slot 0 in the next frame) the UE must resume calculating new estimates of the phase adjustment. The feedback command corresponding to the first new estimate of  $\phi_i$  must be send in the uplink slot which is transmitted 1024 chips in offset from the downlink slot  $N_{\text{last}+1}$ .

### 7.2.3.2 Both downlink and uplink in compressed mode

During the uplink idle slots no FB commands are sent from UE to UTRAN. When transmission in downlink is started again in downlink slot  $N_{\text{last}+1}$  (if  $N_{\text{last}+1} = 15$ , then slot 0 in the next frame) the UE must resume calculating new estimates of the phase adjustment. The feedback command corresponding to the first new estimate of  $\phi_i$  must be send in the uplink slot which is transmitted 1024 chips in offset from the downlink slot  $N_{\text{last}+1}$ .

The UTRAN continues to update the weight vector,  $w_2$ , until the uplink enters the compressed mode and no more FB commands are received. When the transmission in downlink resumes in slot  $N_{\text{last}+1}$ , the value of  $w_2$  calculated after receiving the last FB command before uplink entered the compressed mode is applied to antenna 2 signal.

After UE resumes transmission in uplink and sends the first FB command the new value of  $w_2$  is calculated as follows:

- $S_1 = \{0, 2, 4, 6, 8, 10, 12, 14\}$ .
- $S_2 = \{1, 3, 5, 7, 9, 11, 13\}$ .
- $i$  = number of uplink slot at which the transmission resumes.
- $j$  = number of uplink slot at which the last FB command was send before uplink entered compressed mode.
- Do while ( $i \in S_1$  and  $j \in S_1$ ) or ( $i \in S_2$  and  $j \in S_2$ ):
  - $j = j-1$ ;
  - if  $j < 0$ ;
  - $j = 14$ ;
- end if;

- end do;
- calculate  $w_2$  based on FB commands received in uplink slots i and j.

### 7.3 Closed loop mode 2

In closed loop mode 2 there are 16 possible combinations of phase and amplitude adjustment from which the UE selects and transmits the FSM according to table 10 and table 11. As opposed to closed loop Mode 1, no constellation rotation is done at UE and no filtering of the received weights is performed at the UTRAN.

**Table 10: FSM<sub>po</sub> subfield of closed loop mode 2 signalling message**

FSM <sub>po</sub>	Power_ant1	Power_ant2
0	0.2	0.8
1	0.8	0.2

**Table 11: FSM<sub>ph</sub> subfield of closed loop mode 2 signalling message**

FSM <sub>ph</sub>	Phase difference between antennas ( <u>degree</u> <u>radians</u> )
000	$\pi/80$
001	$-3\pi/4135$
011	$-\pi/290$
010	$-\pi/445$
110	0
111	$\pi/445$
101	$\pi/290$
100	$3\pi/4135$

To obtain the best performance, progressive updating is performed at both the UE and the UTRAN Access point. [The UE procedure shown below is an example of how to determine FSM at UE. Different implementation is allowed.](#) Every slot time, the UE may refine its choice of FSM, from the set of weights allowed given the previously transmitted bits of the FSM. This is shown in figure 4, where, in this figure  $b_i$  ( $0 \leq i \leq 3$ ) are the bits of the FSM (from table 10 and table 11) from the MSB to the LSB and  $m=0, 1, 2, 3$  (the end of frame adjustment given subclause 7.3.1 is not shown here).

At the beginning of a FSM to be transmitted, the UE chooses the best FSM out of the 16 possibilities. Then the UE starts sending the FSM bits from the MSB to the LSB in the portion of FBI field of the uplink DPCCCH during 4 (FSM message length) slots. Within the transmission of the FSM the UE refines its choice of FSM. This is defined in the following:

- define the 4 bits of FSM, which are transmitted from slot number  $k$  to  $k+3$ , as  $\{b_3(k) b_2(k+1) b_1(k+2) b_0(k+3)\}$ , where  $k=0, 4, 8, 12$ . Define also the estimated received power criteria defined in Equation 1 for a given FSM as  $\underline{pP}(\{x_3, x_2, x_1, x_0\})$ , where  $\{x_3, x_2, x_1, x_0\}$  is one of the 16 possible FSMs which defines an applied phase and amplitude offset according to table 10 and table 11. The  $b_i()$  and  $x_i$  are 0 or 1.

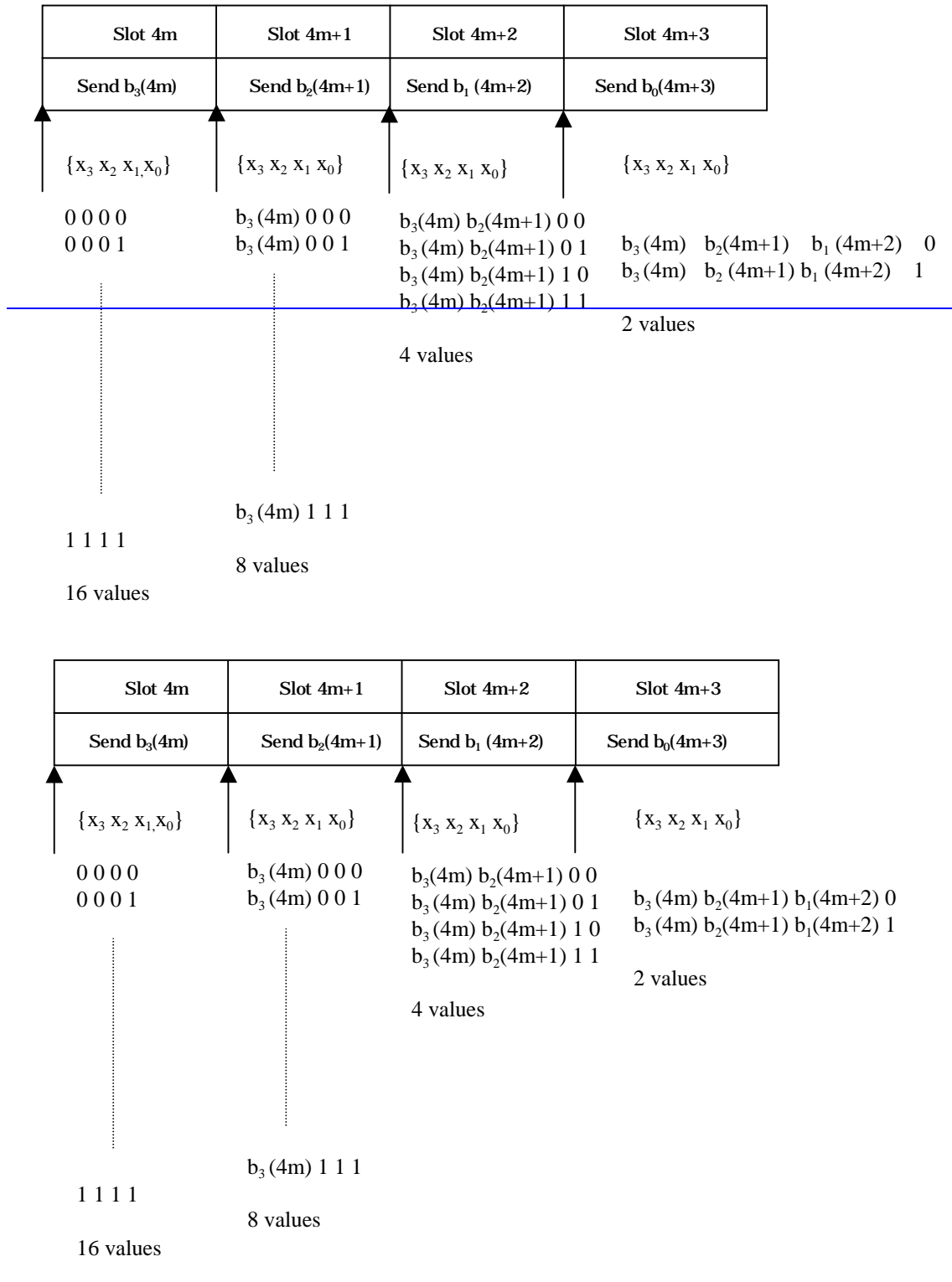
The bits transmitted during the  $m$ 'th FSM of the frame, where  $m=0,1,2,3$ , are then given by:

$b_3(4m)=X_3$  from the  $\{X_3, X_2, X_1, X_0\}$  which maximises  $\underline{pP}(\{x_3, x_2, x_1, x_0\})$  over all  $x_3, x_2, x_1, x_0$  (16 possible combinations);

$b_2(4m+1)=X_2$  from the  $\{b_3(4m), X_2, X_1, X_0\}$  which maximises  $\underline{pP}(\{b_3(4m), x_2, x_1, x_0\})$  over all  $x_2, x_1, x_0$  (8 possible combinations);

$b_1(4m+2)=X_1$  from the  $\{b_3(4m), b_2(4m+1), X_1, X_0\}$  which maximises  $\underline{pP}(\{b_3(4m), b_2(4m+1), x_1, x_0\})$  over all  $x_1, x_0$  (4 possible combinations);

$b_0(4m+3)=X_0$  from the  $\{b_3(4m), b_2(4m+1), b_1(4m+2), X_0\}$  which maximises  $\underline{pP}(\{b_3(4m), b_2(4m+1), b_1(4m+2), x_0\})$  over  $x_0$  (2 possible combinations).



**Figure 4: Progressive Refinement at the UE for closed loop mode 2**

Every slot time the UTRAN constructs the FSM from the most recently received bits for each position in the word and applies the phase and amplitude as defined by table 10 and table 11. More precisely, the UTRAN operation can be explained as follows. The UTRAN maintains a register  $\mathbf{z} = \{z_3 z_2 z_1 z_0\}$ , which is updated every slot time according to  $z_i = b_i(ns)$  ( $i=0:3, ns=0:14$ ). Every slot time the contents of register  $\mathbf{z}$  are used to determine the phase and amplitude adjustments as defined by table 10 and table 11, with  $FSM_{ph} = \{z_3 z_2 z_1\}$  and  $FSM_{p0} = z_0$ .

Special procedures for initialisation and end of frame processing are described below.

The weight vector,  $\mathbf{w}$ , is then calculated as:

$$w = \left[ \frac{\sqrt{\text{power\_ant1}}}{\sqrt{\text{power\_ant2} \cdot \exp(j\pi \cdot \text{phase\_diff} / 180)}} \right] w = \left[ \frac{\sqrt{\text{power\_ant1}}}{\sqrt{\text{power\_ant2} \exp(j \text{ phase\_diff})}} \right] \quad (69)$$

### 7.3.1 Mode 2 end of frame adjustment

The FSM must be wholly contained within a frame. To achieve this an adjustment is made to the last FSM in the frame where the UE only sends the FSM<sub>ph</sub> subfield, and the ~~Node-B~~UTRAN takes the amplitude bit FSM<sub>po</sub> of the previous FSM.

### 7.3.2 Mode 2 normal initialisation

For the first frame of transmission using closed loop mode 2, the operation is as follows.

The UE starts sending the FSM message ~~in~~from slot 0 in the normal way. ~~The UE may refine, refining~~ its choice of FSM in slots 1 to 3 from the set of weights allowed given the previously transmitted bits of the FSM.

During the reception of the first three FSM bits (that is before the full four bits are received), the UTRAN Access Point initialises its transmissions as follows. The power in both antennas is set to 0.5. The phase offset applied between the antennas is updated according to the number and value of FSM<sub>ph</sub> bits received as given in table 12.

**Table 12: FSM<sub>ph</sub> normal initialisation for closed loop mode 2**

FSM <sub>ph</sub>	Phase difference between antennas ( <del>degree</del> radians)
---	<del>π/180</del> (normal initialisation) or held from previous setting ( <del>slot</del> compressed mode recovery)
0--	<del>π/180</del>
1--	0
00-	<del>π/180</del>
01-	<del>-π/290</del>
11-	0
10-	<del>π/290</del>
000	<del>π/180</del>
001	<del>-3π/4135</del>
011	<del>-π/290</del>
010	<del>-π/445</del>
110	0
111	<del>π/445</del>
101	<del>π/290</del>
100	<del>3π/4135</del>

This operation applies in both the soft handover and non soft handover cases.

### 7.3.3 Mode 2 operation during compressed mode

#### 7.3.3.1 Downlink in compressed mode and uplink in normal mode

When the downlink is in compressed mode and the uplink is in normal mode, the closed loop mode 2 functions are described below.

If UE continues to calculate the phase adjustments based on the received CPICH from antennas 1 and 2 during the idle downlink slots there is no difference in UE operation when compared to non-compressed downlink operation.

When the UE is not listening to the CPICH from antennas 1 and 2 during the idle downlink slots, the UE sends the last FSM bits calculated before entering in the compressed mode.

- For recovery after compressed mode, UTRAN Access Point sets the power in both antennas to 0.5 until a FSM<sub>po</sub> bit is received. Until the first FSM<sub>ph</sub> bit is received and acted upon, UTRAN uses the phase offset, which was applied before the transmission interruption (table 12).

- Normal initialisation of  $FSM_{ph}$  (table 12) occurs if the uplink signalling information resumes at the beginning of a FSM period (that is if signalling resumes in slots 0,4,8,12).
- If the uplink signalling does not resume at the beginning of a FSM period, the following operation is performed. In each of the remaining slots of the partial FSM period, and for the first slot of the next full FSM period, the UE sends the first (i.e. MSB) bit of the  $FSM_{ph}$  message, and at the UTRAN access point the phase offset applied between the antennas is updated according to the number and value of  $FSM_{ph}$  bits received as given in table 13. Initialisation then continues with the transmission by the UE of the remaining  $FSM_{ph}$  bits and the UTRAN operation according to table 12.

**Table 13:  $FSM_{ph}$  subfield of closed loop mode 2 in compressed mode recovery period**

$FSM_{ph}$	Phase difference between antennas ( <u>degree</u> <u>radians</u> )
-	held from previous setting
0	$\pi/80$
1	0

### 7.3.3.2 Both downlink and uplink in compressed mode

During both downlink and uplink compressed mode, the UTRAN and the UE performs the functions of recovery after compressed mode as described in the previous subclause 7.3.3.1.

<h2 style="margin: 0;">CHANGE REQUEST</h2>		<i>Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.</i>
<b>25.214</b>	<b>CR</b>	<b>104r1</b>
GSM (AA.BB) or 3G (AA.BBB) specification number ↑		↑ CR number as allocated by MCC support team
For submission to: <b>TSG-RAN #8</b> <small>list expected approval meeting # here ↑</small>	for approval <input checked="" type="checkbox"/> for information <input type="checkbox"/>	Current Version: <b>3.2.0</b>  strategic <input type="checkbox"/> non-strategic <input type="checkbox"/> <small>(for SMG use only)</small>

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

**Source:**    TSG RAN WG1    **Date:**    2000-05-24

**Subject:**    Corrections to uplink power control in compressed mode

**Work item:**    \_\_\_\_\_

<b>Category:</b>	F Correction <input checked="" type="checkbox"/> A Corresponds to a correction in an earlier release <input type="checkbox"/> B Addition of feature <input type="checkbox"/> C Functional modification of feature <input type="checkbox"/> D Editorial modification <input type="checkbox"/>	<b>Release:</b>	Phase 2 <input type="checkbox"/> Release 96 <input type="checkbox"/> Release 97 <input type="checkbox"/> Release 98 <input type="checkbox"/> Release 99 <input checked="" type="checkbox"/> Release 00 <input type="checkbox"/>
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(only one category shall be marked with an X)

**Reason for change:**    Corrections to take all permitted cases of compressed mode parameters into account.

**Clauses affected:**    5.1.2.3 Transmit power control in compressed mode

<b>Other specs affected:</b>	Other 3G core specifications <input type="checkbox"/> → List of CRs: Other GSM core specifications <input type="checkbox"/> → List of CRs: MS test specifications <input type="checkbox"/> → List of CRs: BSS test specifications <input type="checkbox"/> → List of CRs: O&M specifications <input type="checkbox"/> → List of CRs:	
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**Other comments:**    \_\_\_\_\_



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

### 5.1.2.3 Transmit power control in compressed mode

In compressed mode, some frames are compressed and contain transmission gaps. The uplink power control procedure is as specified in clause 5.1.2.2, using the same UTRAN supplied parameters for Power Control Algorithm and step size ( $\Delta_{\text{TPC}}$ ), but with additional features which aim to recover as rapidly as possible a signal-to-interference ratio (SIR) close to the target SIR after each transmission gap.

In compressed mode, compressed frames may occur in either the uplink or the downlink or both. In uplink compressed frames, the transmission of uplink DPDCH(s) and DPCCH shall both be stopped during transmission gaps.

Due to the transmission gaps in compressed frames, there may be missing TPC commands in the downlink. If no downlink TPC command is transmitted, the corresponding TPC\_cmd derived by the UE shall be set to zero.

Compressed and non-compressed frames in the uplink DPCCH may have a different number of pilot bits per slot. A change in the transmit power of the uplink DPCCH would be needed in order to compensate for the change in the total pilot energy. Therefore at the start of each slot the UE shall derive the value of a power offset  $\Delta_{\text{PILOT}}$ . If the number of pilot bits per slot in the uplink DPCCH is different from its value in the most recently transmitted slot,  $\Delta_{\text{PILOT}}$  (in dB) shall be given by:

$$\Delta_{\text{PILOT}} = 10\text{Log}_{10} (N_{\text{pilot,prev}}/N_{\text{pilot,curr}});$$

where  $N_{\text{pilot,prev}}$  is the number of pilot bits in the most recently transmitted slot, and  $N_{\text{pilot,curr}}$  is the number of pilot bits in the current slot. Otherwise, including during transmission gaps in the downlink,  $\Delta_{\text{PILOT}}$  shall be zero.

Unless otherwise specified, in every slot during compressed mode the UE shall adjust the transmit power of the uplink DPCCH with a step of  $\Delta_{\text{DPCCH}}$  (in dB) which is given by:

$$\Delta_{\text{DPCCH}} = \Delta_{\text{TPC}} \times \text{TPC\_cmd} + \Delta_{\text{PILOT}}.$$

At the start of the first slot after an uplink or downlink transmission gap the UE shall apply a change in the transmit power of the uplink DPCCH by an amount  $\Delta_{\text{DPCCH}}$  (in dB), with respect to the uplink DPCCH power in the most recently transmitted uplink slot, where:

$$\Delta_{\text{DPCCH}} = \Delta_{\text{RESUME}} + \Delta_{\text{PILOT}}.$$

The value of  $\Delta_{\text{RESUME}}$  (in dB) shall be determined by the UE according to the Initial Transmit Power mode (ITP). The ITP is a UE specific parameter, which is signalled by the network with the other compressed mode parameters (see TS 25.215). The different modes are summarised in table 1.

**Table 1: Initial Transmit Power modes during compressed mode**

Initial Transmit Power mode	Description
0	$\Delta_{\text{RESUME}} = \Delta_{\text{TPC}} \times \text{TPC\_cmd}_{\text{gap}}$
1	$\Delta_{\text{RESUME}} = \delta_{\text{last}}$

In the case of a transmission gap in the uplink,  $\text{TPC\_cmd}_{\text{gap}}$  shall be the value of TPC\_cmd derived in the first slot of the uplink transmission gap, if a downlink TPC command is transmitted in that slot. Otherwise  $\text{TPC\_cmd}_{\text{gap}}$  shall be zero.

~~If a downlink TPC command is transmitted in the first slot of a downlink transmission gap, then  $\delta_{\text{last}}$  shall be equal to the most recently computed value of  $\delta_i$  computed in the first slot of the downlink transmission gap. Otherwise  $\delta_{\text{last}}$  shall be equal to the value of  $\delta_i$  computed in the last slot before the downlink transmission gap.  $\delta_i$  shall be updated according to the following recursive relations, which shall be executed in all slots with-in which both the simultaneous uplink DPCCH and a downlink TPC command are transmitted, DPCCH transmission and in the first slot of an uplink downlink transmission gap if a downlink TPC command is transmitted in that slot:~~

$$\begin{aligned} \delta_i &= 0.9375\delta_{i-1} - 0.96875\text{TPC\_cmd}_i\Delta_{\text{TPC}} \\ \delta_{i-1} &= \delta_i \end{aligned}$$



$TPC\_cmd_i$  is the ~~most recent~~ power control command derived by the UE in that slot.

$\delta_{i-1}$  is the value of  $\delta_i$  computed for the previous slot. The value of  $\delta_{i-1}$  shall be initialised to zero when the uplink DPCCH is activated, and also at the end of the first slot after each uplink transmission gap, and also at the end of the first slot after each downlink transmission gap. The value of  $\delta_i$  shall be set to zero at the end of the first slot after each uplink transmission gap. After a transmission gap in either the uplink or the downlink, the period following resumption of simultaneous uplink and downlink DPCCH transmission is called a recovery period. RPL is the recovery period length and is expressed as a number of slots. RPL is equal to the minimum value out of the transmission gap length and 7 slots.

During the recovery period, 2 modes are possible for the power control algorithm. The Recovery Period Power control mode (RPP) is signalled with the other compressed mode parameters (see TS 25.215). The different modes are summarised in the table 2:

**Table 2: Recovery Period Power control modes during compressed mode**

Recovery Period power control mode	Description
0	Transmit power control is applied using the algorithm determined by the value of PCA, as in subclause 5.1.2.2 with step size $\Delta_{TPC}$ .
1	Transmit power control is applied using algorithm 1 (see subclause 5.1.2.2.2) with step size $\Delta_{RP-TPC}$ during RPL slots after each transmission gap.

For RPP mode 0, the step size is not changed during the recovery period and ordinary transmit power control is applied (see subclause 5.1.2.2), using the algorithm for processing TPC commands determined by the value of PCA (see subclauses 5.1.2.2.2 and 5.1.2.2.3).

For RPP mode 1, during RPL slots after each transmission gap, power control algorithm 1 is applied with a step size  $\Delta_{RP-TPC}$  instead of  $\Delta_{TPC}$ , regardless of the value of PCA. The change in uplink DPCCH transmit power (except for the first slot after the transmission gap) is given by:

$$\Delta_{DPCCH} = \Delta_{RP-TPC} \times TPC\_cmd + \Delta_{PILOT}$$

$\Delta_{RP-TPC}$  is called the recovery power control step size and is expressed in dB. If PCA has the value 1,  $\Delta_{RP-TPC}$  is equal to the minimum value of 3 dB and  $2\Delta_{TPC}$ . If PCA has the value 2,  $\Delta_{RP-TPC}$  is equal to 1 dB.

After the recovery period, ordinary transmit power control resumes using the algorithm specified by the value of PCA and with step size  $\Delta_{TPC}$ .

If PCA has the value 2, the sets of slots over which the TPC commands are processed shall remain aligned to the frame boundaries in the compressed frame. For both RPP mode 0 and RPP mode 1, if the transmission gap or the recovery period results in any incomplete sets of TPC commands,  $TPC\_cmd$  shall be zero for those sets of slots which are incomplete.



## 5.2 Downlink power control

The transmit power of the downlink channels is determined by the network. In general the ratio of the transmit power between different downlink channels is not specified and may change with time. However, regulations exist as described in the following subclauses.

### 5.2.1 DPCCH/DPDCH

#### 5.2.1.1 General

The downlink transmit power control procedure controls simultaneously the power of a DPCCH and its corresponding DPDCHs. The power control loop adjusts the power of the DPCCH and DPDCHs with the same amount, i.e. the relative power difference between the DPCCH and DPDCHs is not changed.

The relative transmit power offset between DPCCH fields and DPDCHs is determined by the network. The TFCI, TPC and pilot fields of the DPCCH are offset relative to the DPDCHs power by PO1, PO2 and PO3 dB respectively. The power offsets may vary in time.

#### 5.2.1.2 Ordinary transmit power control

The UE shall generate TPC commands to control the network transmit power and send them in the TPC field of the uplink DPCCH. An example on how to derive the TPC commands is given in Annex B.2.

~~When the UE is not in soft handover the TPC command generated is transmitted in the first available TPC field in the uplink DPCCH.~~

~~When the UE is in soft handover it should~~ shall check the downlink power control mode (DPC\_MODE) before generating the TPC command:

- if DPC\_MODE = 0 : the UE sends a unique TPC command in each slot and the TPC command generated is transmitted in the first available TPC field in the uplink DPCCH;
- if DPC\_MODE = 1 : the UE repeats the same TPC command over 3 slots and the new TPC command is transmitted such that there is a new command at the beginning of the frame.

The DPC\_MODE parameter is a UE specific parameter controlled by the UTRAN.

As a response to the received TPC commands, UTRAN may adjust the downlink DPCCH/DPDCH power. The average power of transmitted DPDCH symbols over one timeslot shall not exceed Maximum\_DL\_Power(dBm), nor shall it be below Minimum\_DL\_Power (dBm). Transmitted DPDCH symbol means here a complex QPSK symbol before spreading which does not contain DTX. Maximum\_DL\_Power and Minimum\_DL\_Power are power limits for one spreading code.

Changes of power shall be a multiple of the minimum step size  $\Delta_{\text{TPC,min}}$  dB. It is mandatory for UTRAN to support  $\Delta_{\text{TPC,min}}$  of 1 dB, while support of 0.5 dB is optional.

UTRAN may further employ following method. If the value of *Limited Power Raise Used* parameter is 'Used', UTRAN shall not increase the DL power of the RL if it would exceed by more than *Power\_Raise\_Limit* dB the averaged DL power used in the last *DL\_Power\_Averaging\_Window\_Size* timeslots of the same RL. This shall only be applied after the first *DL\_Power\_Averaging\_Window\_Size* timeslots after the activation of this method.

*Power\_Raise\_Limit* and *DL\_Power\_Averaging\_Window\_Size* are parameters configured in the UTRAN.

When TPC commands cannot be generated in the UE due to downlink out-of-synchronisation, the TPC command transmitted shall be set as "1" during the period of out-of-synchronisation.

#### 5.2.1.3 Power control in compressed mode

The aim of downlink power control in uplink or/and downlink compressed mode is to recover as fast as possible a signal-to-interference ratio (SIR) close to the target SIR after each transmission gap.

The UE behaviour is the same in compressed mode as in normal mode, described in subclause 5.2.1.2.

The UTRAN behaviour during compressed mode is not specified. As an example, the algorithm can be similar to uplink power control in downlink compressed mode as described in subclause 5.1.2.3.

In downlink compressed mode or in simultaneous downlink and uplink compressed mode, the transmission of downlink DPCCH and DPDCH(s) is stopped.



5.1.2.2.2.2 Combining of TPC commands from radio links of the same radio link set~~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~~when the radio links are in the same radio link set. For these cases, the TPC commands from the same radio link set~~known to be the same~~ shall be 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 from radio links of different radio link sets~~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 from radio links of different radio link sets~~not known to be the same~~.

First, the UE shall conduct a soft symbol decision  $W_i$  on each of the power control commands  $TPC_i$ , where  $i = 1, 2, \dots, N$ , where  $N$  is greater than 1 and is the number of TPC commands from radio links of different radio link sets~~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.

Finally, the UE derives a combined TPC command,  $TPC\_cmd$ , as a function  $\gamma$  of all the  $N$  soft symbol decisions  $W_i$ :

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

The function  $\gamma$  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  $\gamma$  is equal to 1 shall be greater than or equal to  $1/(2^N)$ , and the probability that the output of  $\gamma$  is equal to -1 shall be greater than or equal to 0.5.

5.1.2.2.3.2 Combining of TPC commands ~~from radio links of the same radio link set 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 ~~when the radio links are in the same radio link set, 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 ~~from radio links of the same radio link set 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 ~~from radio links of different radio link sets 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 ~~from radio links of different radio link sets not known to be the same.~~

The UE shall make a hard decision on the value of each  $TPC_i$ , where  $i = 1, 2, \dots, N$  and  $N$  is the number of TPC commands ~~from radio links of different radio link sets 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  $\gamma$  of all the  $N$  temporary power control commands  $TPC\_temp_i$ :

$TPC\_cmd(3^{rd} \text{ slot}) = \gamma(TPC\_temp_1, TPC\_temp_2, \dots, TPC\_temp_N)$ , where  $TPC\_cmd(3^{rd} \text{ slot})$  can take the values 1, 0 or -1, and  $\gamma$  is given by the following definition:

- $TPC\_cmd$  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.





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## 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)".

[2] TS 25.212: "Multiplexing and channel coding (FDD)".

[3] TS 25.213: "Spreading and modulation (FDD)".

[4] TS 25.215: "Physical layer – Measurements (FDD)".

[5] TS 25.331: "RRC Protocol Specification".

[6] [TS 25.433: "UTRAN Iub Interface NBAP Signalling"](#).

[7] [TS 25.101: "UE Radio transmission and Reception \(FDD\)"](#).

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## 4 Synchronisation procedures

### 4.1 Cell search

During the cell search, the UE searches for a cell and determines the downlink scrambling code and common channel frame synchronisation of that cell. How cell search is typically done is described in Annex C.

### 4.2 Common physical channel synchronisation

The radio frame timing of all common physical channels can be determined after cell search. The P-CCPCH radio frame timing is found during cell search and the radio frame timing of all common physical channel are related to that timing as described in [25.214\[1\]](#).

### 4.3 DPCCH/DPDCH synchronisation

#### 4.3.1 Synchronisation primitives

##### 4.3.1.1 General

For the dedicated channels, synchronisation primitives are used to indicate the synchronisation status of radio links, both in uplink and downlink. The definition of the primitives is given in the following sub-clauses.

##### 4.3.1.2 Downlink synchronisation primitives

Layer 1 in the UE shall every radio frame check synchronisation status of the downlink dedicated channels. Synchronisation status is indicated to higher layers using the CPHY-Sync-IND and CPHY-Out-of-Sync-IND primitives.

Out-of-sync shall be reported using the CPHY-Out-of-Sync-IND primitive if either of the following criteria is fulfilled:

- The UE estimates the DPCCH quality over the last 200 ms period to be worse than a threshold  $Q_{out}$ . This criterion shall never be fulfilled during the first 200 ms of the dedicated channel's existence.  $Q_{out}$  is defined implicitly by the relevant tests in [TS 25.104\[7\]](#).
- The last 20 transport blocks, as observed on all TrCHs using CRC, are received with incorrect CRC. In addition, over the last 200 ms, no transport block has been received with correct CRC.

In-sync shall be reported using the CPHY-Sync-IND primitive if both of the following criteria are fulfilled:

- The UE estimates the DPCCH quality over the last 200 ms period to be better than a threshold  $Q_{in}$ . This criterion shall always be fulfilled during the first 200 ms of the dedicated channel's existence.  $Q_{in}$  is defined implicitly by the relevant tests in [TS 25.104\[7\]](#).
- At least one transport block, as observed on all TrCHs using CRC, is received with correct CRC. If there is no TrCH using CRC, this criterion is always fulfilled.

How the primitives are used by higher layers is described in [TS 25.334\[5\]](#).

##### 4.3.1.3 Uplink synchronisation primitives

Layer 1 in the Node B shall every radio frame check synchronisation status of all radio link sets. Synchronisation status is indicated to the RL Failure/Restored triggering function using either the CPHY-Sync-IND or CPHY-Out-of-Sync-IND primitive. Hence, only one synchronisation status indication shall be given per radio link set.

The exact criteria for indicating in-sync/out-of-sync is not subject to specification, but could e.g. be based on received DPCCH quality or CRC checks. One example would be to have the same criteria as for the downlink synchronisation status primitives.

## 4.3.2 Radio link establishment

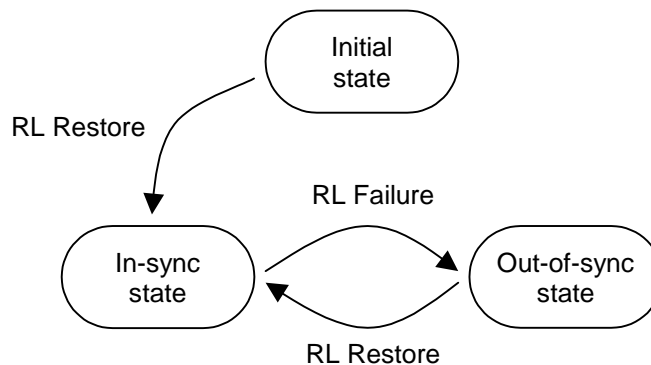
### 4.3.2.1 General

The establishment of a radio link can be divided into two cases:

- when there is no existing radio link, i.e. when at least one downlink dedicated physical channel and one uplink dedicated physical channel are to be set up;
- or when one or several radio links already exist, i.e. when at least one downlink dedicated physical channel is to be set up and ~~there~~ an uplink dedicated physical channel already exists.

The two cases are described in sub-clauses 4.3.2.2 and 4.3.2.3 respectively.

In Node B, each radio link set can be in three different states: initial state, out-of-sync state and in-sync state. Transitions between the different states is shown in figure 1 below. The state of the Node B at the start of radio link establishment is described in the following sub-clauses. Transitions between initial state and in-sync state are described in sub-clauses 4.3.2.2 and 4.3.2.3 and transitions between the in-sync and out-of-sync states are described in sub-clause 4.3.3.2.



**Figure 1: Node B radio link set states and transitions.**

### 4.3.2.2 No existing radio link

When one or several radio links are to be established and there is no existing radio link for the UE already, a dedicated physical channel is to be set up in uplink and at least one dedicated physical channel is to be set up in downlink. This corresponds to the case when a dedicated physical channel is initially set up on a frequency.

The radio link establishment is as follows:

- a) Node B considers the radio link sets which are to be set up to be in the initial state. UTRAN starts the transmission of downlink DPCCH/DPDCHs.
- b) The UE establishes downlink chip and frame synchronisation of DPCCH/DPDCHs, using based on the P-CCPCH timing and timing offset information notified from UTRAN. Frame synchronisation can be confirmed using the frame synchronisation word. Downlink synchronisation status is reported to higher layers every radio frame according to sub-clause 4.3.1.2.
- c) If no activation time for uplink DPCCH/DPDCH has been signalled to the UE, uplink DPCCH/DPDCH transmission is started when higher layers consider the downlink physical channel established. If an activation time has been given, uplink DPCCH/DPDCH transmission is started at the activation time or later, as soon as higher layers consider the downlink physical channel established. Physical channel establishment and activation time are defined in [5]. When higher layers consider the downlink physical channel established, uplink DPCCH/DPDCH transmission is started. The timing of the start of the uplink channels is as defined in sub-clause 7.7 in [1].
- d) UTRAN establishes uplink chip and frame synchronisation. Frame synchronisation can be confirmed using the frame synchronisation word. Radio link sets remain in the initial state until N\_INSYNC\_IND successive in-sync indications are received from layer 1, when Node B shall trigger the RL Restore procedure indicating which radio link set has obtained synchronisation. When RL Restore has been triggered the radio link set shall be

considered to be in the in-sync state. The parameter value of N\_INSYNC\_IND is configurable, see [TS 25.433\[6\]](#). The RL Restore procedure may be triggered several times, indicating when synchronisation is obtained for different radio link sets.

#### 4.3.2.3 One or several existing radio links

When one or several radio links are to be established and one or several radio links already exist, there is an existing DPCCH/DPDCH in the uplink, and at least one corresponding dedicated physical channel shall be set up in the downlink. This corresponds to the case when new radio links are added to the active set and downlink transmission starts for those radio links.

The radio link establishment is as follows:

- a) Node B considers new radio link sets to be set up to be in initial state. If a radio link is to be added to an existing radio link set this radio link set shall be considered to be in the state the radio link set was prior to the addition of the radio link, i.e. if the radio link set was in the in-sync state before the addition of the radio link it shall remain in that state.
- b) UTRAN starts the transmission of the downlink DPCCH/DPDCH at a frame timing such that the frame timing received at the UE will be within  $T_0 \pm 148$  chips prior to the frame timing of the uplink DPCCH/DPDCH at the UE. Simultaneously, UTRAN establishes uplink chip and frame synchronisation of the new radio link. Frame synchronisation can be confirmed using the frame synchronization word. Radio link sets considered to be in the initial state shall remain in the initial state until N\_INSYNC\_IND successive in-sync indications are received from layer 1, when Node B shall trigger the RL Restore procedure indicating which radio link set has obtained synchronisation. When RL Restore is triggered the radio link set shall be considered to be in the in-sync state. The parameter value of N\_INSYNC\_IND is configurable, see [TS 25.433\[6\]](#). The RL Restore procedure may be triggered several times, indicating when synchronisation is obtained for different radio link sets.
- c) The UE establishes chip and frame synchronisation of the new radio link. Frame synchronisation can be confirmed using the frame synchronization word. Downlink synchronisation status shall be reported to higher layers every radio frame according to sub-clause 4.3.1.2.

### 4.3.3 Radio link monitoring

#### 4.3.3.1 Downlink radio link failure

The downlink radio links shall be monitored by the UE, to trigger radio link failure procedures. The downlink radio link failure criteria is specified in [TS 25.331\[5\]](#), and is based on the synchronisation status primitives CPHY-Sync-IND and CPHY-Out-of-Sync-IND, indicating in-sync and out-of-sync respectively.

#### 4.3.3.2 Uplink radio link failure/restore

The uplink radio link sets are monitored by the Node B, to trigger radio link failure/restore procedures. Once the radio link sets have been established, they will be in the in-sync or out-of-sync states as shown in figure 1 in sub-clause 4.3.2.1. Transitions between those two states are described below.

The uplink radio link failure/restore criteria is based on the synchronisation status primitives CPHY-Sync-IND and CPHY-Out-of-Sync-IND, indicating in-sync and out-of-sync respectively. Note that only one synchronisation status indication shall be given per radio link set.

When the radio link set is in the in-sync state, Node B shall start timer T\_RLFAILURE after receiving N\_OUTSYNC\_IND consecutive out-of-sync indications. Node B shall stop and reset timer T\_RLFAILURE upon receiving successive N\_INSYNC\_IND in-sync indications. If T\_RLFAILURE expires, Node B shall trigger the RL Failure procedure and indicate which radio link set is out-of-sync. When the RL Failure procedure is triggered, the state of the radio link set change to the out-of-sync state.

When the radio link set is in the out-of-sync state, after receiving N\_INSYNC\_IND successive in-sync indications Node B shall trigger the RL Restore procedure and indicate which radio link set has re-established synchronisation. When the RL Restore procedure is triggered, the state of the radio link set change to the in-sync state.

The specific parameter settings (values of T\_RLFAILURE, N\_OUTSYNC\_IND, and N\_INSYNC\_IND) are configurable, see [TS-25.433\[6\]](#).

#### 4.3.4 Transmission timing adjustments

During a connection the UE may adjust its DPDCH/DPCCH transmission time instant.

If the receive timing for any downlink DPCCH/DPDCH in the current active set has drifted, so the time between reception of the downlink DPCCH/DPDCH in question and transmission of uplink DPCCH/DPDCH lies outside the valid range, L1 shall inform higher layers of this, so that the network can be informed of this and downlink timing can be adjusted by the network.

NOTE: The maximum rate of uplink TX time adjustment, and the valid range for the time between downlink DPCCH/DPDCH reception and uplink DPCCH/DPDCH transmission in the UE is to be specified by RAN WG4.