

TSG-RAN Meeting #13
Beijing, China, 18 - 21, September, 2001

RP-010520

Title: Agreed CRs (R99 and Rel-4 Category A) to TS 25.214

Source: TSG-RAN WG1

Agenda item: 8.1.3

No.	Spec	CR	Rev	R1 T-doc	Subject	Release	Cat	W/I Code	V_old	V_new
1	25.214	191	-	R1-01-0814	Corrections and Clarifications for calculation of idle period position in subclause 8.3 in 25.214	R99	F	TEI	3.7.0	3.8.0
2	25.214	192	-	R1-01-0814	Corrections and Clarifications for calculation of idle period position in subclause 8.3 in 25.214	REL-4	A	TEI	4.1.0	4.2.0
3	25.214	193	1	R1-01-0931	Minor modifications to the CPCH access procedure	R99	F	TEI	3.7.0	3.8.0
4	25.214	194	1	R1-01-0931	Minor modifications to the CPCH access procedure	REL-4	A	TEI	4.1.0	4.2.0
5	25.214	196	-	R1-01-0836	Downlink power control in compressed mode	R99	F	TEI	3.7.0	3.8.0
6	25.214	197	-	R1-01-0836	Downlink power control in compressed mode	REL-4	A	TEI	4.1.0	4.2.0
7	25.214	198	1	R1-01-0927	Improvements of closed loop TX diversity description	R99	F	TEI	3.7.0	3.8.0
8	25.214	199	1	R1-01-0927	Improvements of closed loop TX diversity description	REL-4	A	TEI	4.1.0	4.2.0
9	25.214	200	1	R1-01-0926	Correction to Random access procedure (Primitive from MAC)	R99	F	TEI	3.7.0	3.8.0
10	25.214	201	1	R1-01-0926	Correction to Random access procedure (Primitive from MAC)	REL-4	A	TEI	4.1.0	4.2.0

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R1-01-0814

CR-Form-v4

CHANGE REQUEST

⌘ **25.214 CR 191** ⌘ rev **-** ⌘ Current version: **3.7.0** ⌘

For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.

Proposed change affects: ⌘ (U)SIM ME/UE Radio Access Network Core Network

Title:	⌘ Corrections and Clarifications for calculation of idle period position in subclause 8.3 in 25.214
Source:	⌘ TSG RAN WG1
Work item code:	⌘ TEI
Date:	⌘ Aug.20 th , 2001
Category:	⌘ F
	Use <u>one</u> of the following categories:
	F (correction)
	A (corresponds to a correction in an earlier release)
	B (addition of feature),
	C (functional modification of feature)
	D (editorial modification)
	Detailed explanations of the above categories can be found in 3GPP <u>TR 21.900</u> .
Release:	⌘ R99
	Use <u>one</u> of the following releases:
	2 (GSM Phase 2)
	R96 (Release 1996)
	R97 (Release 1997)
	R98 (Release 1998)
	R99 (Release 1999)
	REL-4 (Release 4)
	REL-5 (Release 5)

Reason for change:	⌘ There is inconsistency between the text and the example figure Figure6 in calculation of idle period position in subclause 8.3.
Summary of change:	⌘ Corrections and clarifications are made in subclause 8.3.
Consequences if not approved:	⌘ Inconsistency will cause confusion.

Clauses affected:	⌘ 8.3
Other specs affected:	⌘ <input type="checkbox"/> Other core specifications ⌘ <input type="checkbox"/>
	<input type="checkbox"/> Test specifications
	<input type="checkbox"/> O&M Specifications
Other comments:	⌘

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

- 1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.
- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under <ftp://ftp.3gpp.org/specs/> For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

8.3 Calculation of idle period position

In burst mode, the first burst #0 starts in the radio frame with SFN = 256×Burst_Start. The *n*-th burst #*k* starts in the radio frame with SFN = 256×Burst_Start + *n*×256×Burst_Freq (*k* = 0,1,2 ...). The sequence of bursts according to this formula continues up to and including the radio frame with SFN = 4095. At the start of the radio frame with SFN = 0, the burst sequence is terminated (no idle periods are generated) and at SFN = 256×Burst_Start the burst sequence is restarted with the first burst #0 followed by the second burst #1 etc., as described above.

Continuous mode is equivalent to burst mode, with only one burst spanning the whole SFN cycle of 4096 radio frames, this burst starting in the radio frame with SFN = 0.

Assume that IP_Position(*x*) is the position of idle period number *x* within a burst, where *x* = 1, 2, ..., and IP_Position(*x*) is measured in number of CPICH symbols from the start of the first radio frame of the burst.

The positions of the idle periods within each burst are then given by the following equation:

$$IP_Position(x) = (x \times IP_Spacing \times 150) + (\text{rand}(x \text{ modulo } 64) \text{ modulo } (150 - IP_Length)) + IP_Offset;$$

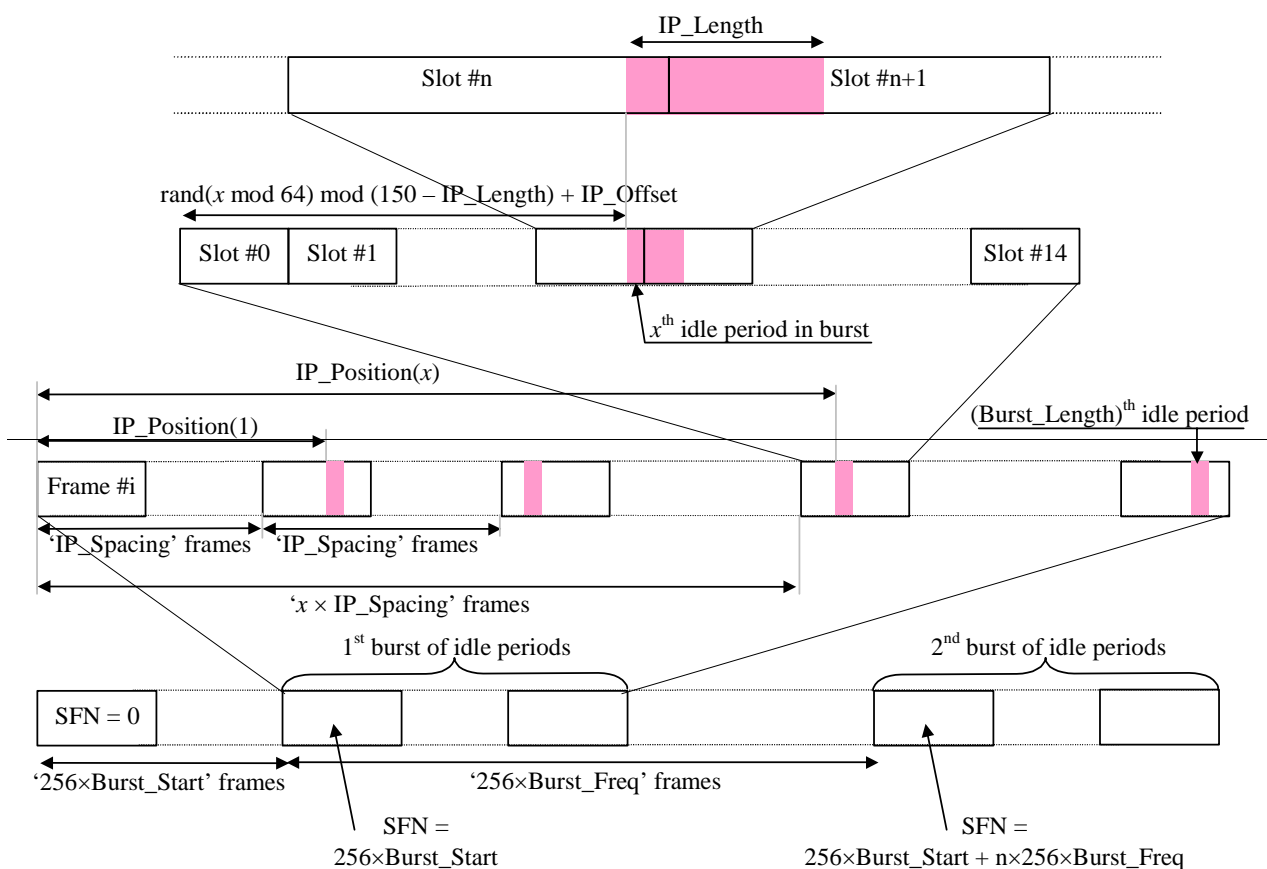
where rand(*m*) is a pseudo random generator defined as follows:

$$\text{rand}(0) = \text{Seed};$$

$$\text{rand}(m) = (106 \times \text{rand}(m - 1) + 1283) \text{ modulo } 6075, m = 1, 2, 3, \dots$$

Note that *x* is reset to *x* = 1 for the first idle period in every burst.

Figure 6 below illustrates the idle periods for the burst mode case.



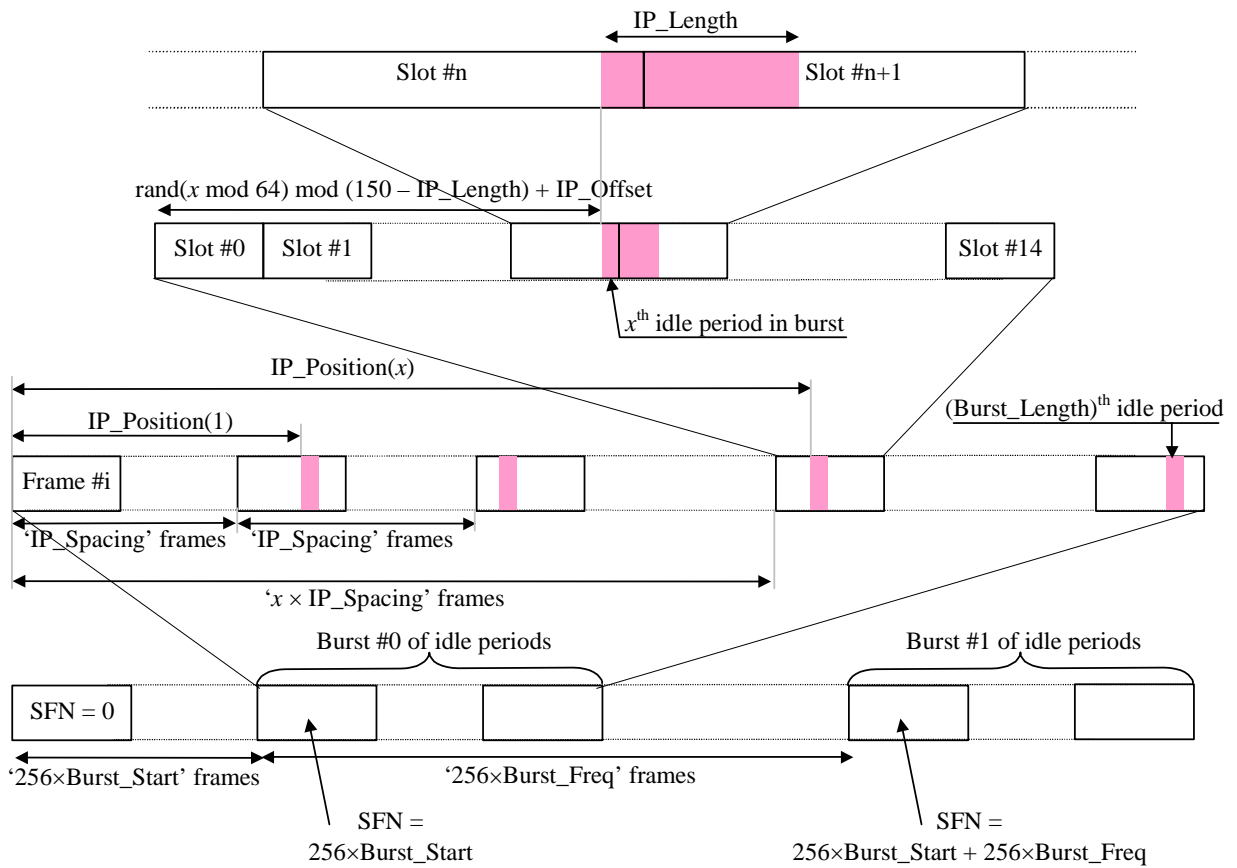


Figure 6: Idle Period placement in the case of burst mode operation

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Beijing, China, 18th – 21st, September, 2001

R1-01-0814

CR-Form-v4

CHANGE REQUEST

⌘ **25.214 CR 192** ⌘ rev **-** ⌘ Current version: **4.1.0** ⌘

For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.

Proposed change affects: ⌘ (U)SIM ME/UE Radio Access Network Core Network

Title:	⌘ Corrections and Clarifications for calculation of idle period position in subclause 8.3 in 25.214														
Source:	⌘ TSG RAN WG1														
Work item code:	⌘ TEI Date: ⌘ Aug. 20th, 2001														
Category:	⌘ A Release: ⌘ REL-4														
Use <u>one</u> of the following categories:															
<table border="0"> <tr> <td>F (correction)</td> <td>2 (GSM Phase 2)</td> </tr> <tr> <td>A (corresponds to a correction in an earlier release)</td> <td>R96 (Release 1996)</td> </tr> <tr> <td>B (addition of feature),</td> <td>R97 (Release 1997)</td> </tr> <tr> <td>C (functional modification of feature)</td> <td>R98 (Release 1998)</td> </tr> <tr> <td>D (editorial modification)</td> <td>R99 (Release 1999)</td> </tr> <tr> <td></td> <td>REL-4 (Release 4)</td> </tr> <tr> <td></td> <td>REL-5 (Release 5)</td> </tr> </table>		F (correction)	2 (GSM Phase 2)	A (corresponds to a correction in an earlier release)	R96 (Release 1996)	B (addition of feature),	R97 (Release 1997)	C (functional modification of feature)	R98 (Release 1998)	D (editorial modification)	R99 (Release 1999)		REL-4 (Release 4)		REL-5 (Release 5)
F (correction)	2 (GSM Phase 2)														
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	<input type="checkbox"/> Test specifications
	<input type="checkbox"/> O&M Specifications
Other comments:	⌘

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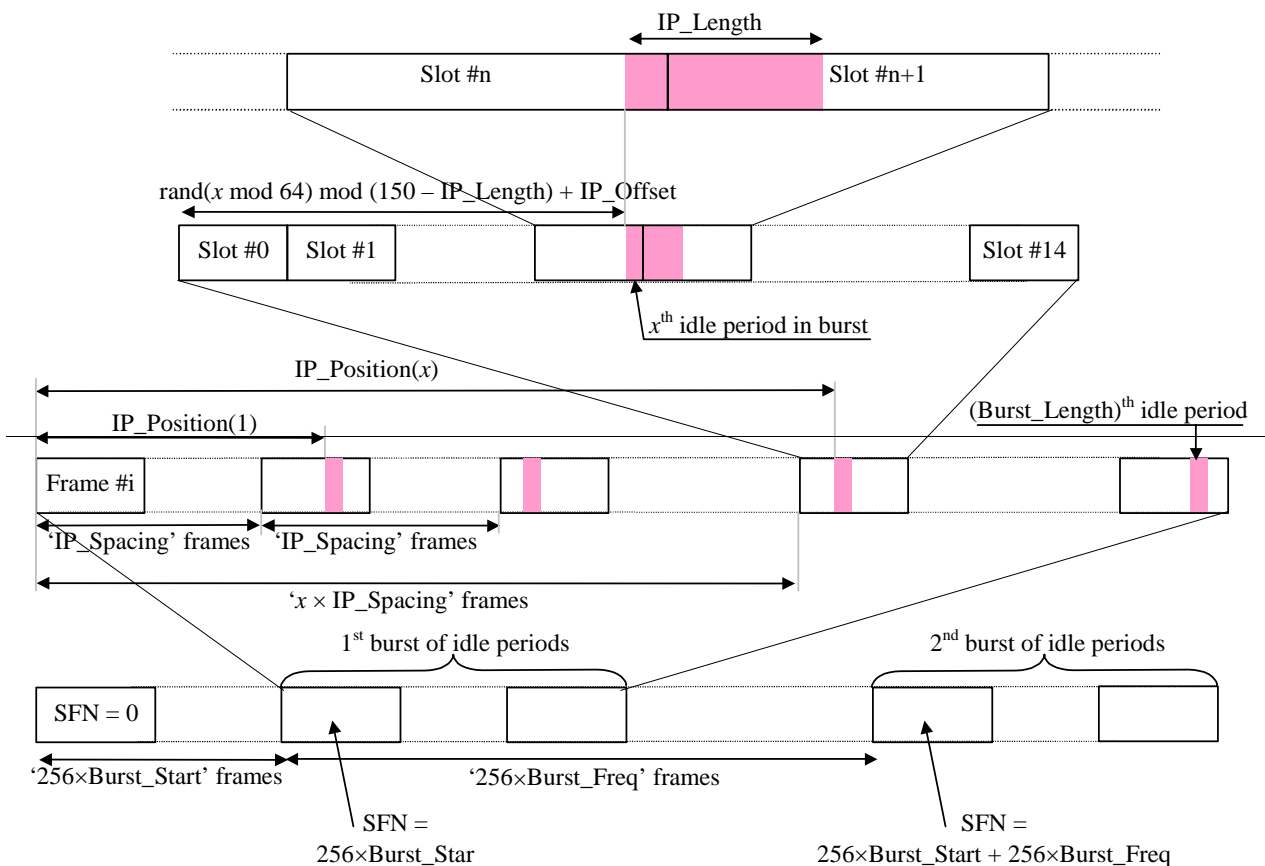
where rand(m) is a pseudo random generator defined as follows:

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Note that x is reset to $x = 1$ for the first idle period in every burst.

Figure 6 below illustrates the idle periods for the burst mode case.



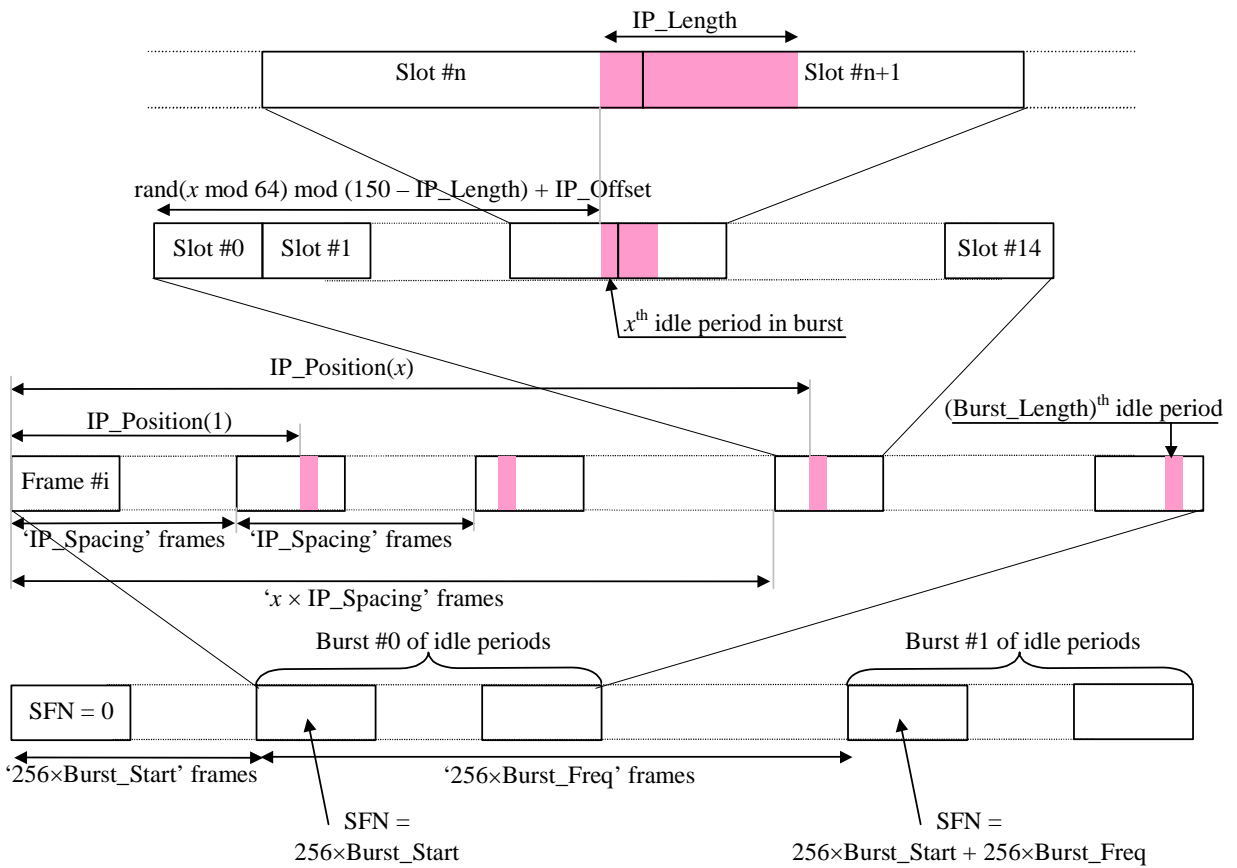


Figure 6: Idle Period placement in the case of burst mode operation

3GPP TSG RAN Meeting #13
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R1-01-0931

CR-Form-v4	
CHANGE REQUEST	
⌘	⌘
25.214 CR 193	rev 1
⌘	⌘
Current version:	3.7.0
⌘	⌘

For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.

Proposed change affects: ⌘ (U)SIM ME/UE Radio Access Network Core Network

Title:	⌘ Minor modifications to the CPCH access procedure		
Source:	⌘ TSG RAN WG1		
Work item code:	⌘ TEI	Date:	⌘ August 19, 2001
Category:	⌘ F	Release:	⌘ R99
	Use <u>one</u> of the following categories:		Use <u>one</u> of the following releases:
	F (correction)		2 (GSM Phase 2)
	A (corresponds to a correction in an earlier release)		R96 (Release 1996)
	B (addition of feature),		R97 (Release 1997)
	C (functional modification of feature)		R98 (Release 1998)
	D (editorial modification)		R99 (Release 1999)
	Detailed explanations of the above categories can be found in 3GPP TR 21.900 .		REL-4 (Release 4)
			REL-5 (Release 5)

Reason for change:	⌘ The parameter Delta P1 has been deleted from higher layer specifications TS25.331 and TS25.302. CPCH ramp-up procedure was decided to be the same as that of RACH. The Delta P1 parameter has been deleted from the RACH access procedure, but has not been deleted from the CPCH access procedure.
Summary of change:	⌘ The delta P1 parameter is deleted from the CPCH access procedure.
Consequences if not approved:	⌘ Inconsistency between the parameters defined in Layer 1 and Layer2 specifications.

Clauses affected:	⌘	
Other specs affected:	⌘ <input type="checkbox"/> Other core specifications	⌘
	<input type="checkbox"/> Test specifications	
	<input type="checkbox"/> O&M Specifications	
Other comments:	⌘	

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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) ΔP_0 = Power step size for each successive CPCH access preamble.
 - [RACH/CPCH parameter].

~~4) ΔP_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 ΔP_1 is used in place of ΔP_0 .~~

~~— [RACH/CPCH parameter].~~

~~45) $\Delta P_{p-m} = P_{message-control} - P_{cd}$, 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_{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 with the help of subclauses 6.1.1. and 6.1.2. The UE randomly selects one uplink access slot from the derived available CPCH-AP access slots. If there is no access slot available in the selected set, the UE randomly selects one uplink access slot corresponding to the selected CPCH sub-channel group from the next access slot set. 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 with the help of subclauses 6.1.1 and 6.1.2. The UE randomly selects one uplink access slot from the derived available CPCH-AP access slots. If there is no access slot available in the selected set, the UE randomly selects one uplink access slot corresponding to the selected CPCH sub-channel group from the next access slot set. 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) Select the next available access slot in the sub-channel group used. There must be a minimum distance of three or four (per T_{cpch} 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 ΔP . Power offset ΔP_0 is used, ~~unless the negative AICH timer is running, in which case ΔP_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 ΔP_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 $\tau_{\text{cd-p-pc-p}}$ ms later as measured from initiation of the CD Preamble. The initial transmission power of the power control preamble shall be $\Delta P_{\text{p-m}}$ [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 $\tau_{\text{cd-p-pc-p}}$ ms later as measured from initiation of the CD Preamble. The initial transmission power of the power control preamble shall be $\Delta P_{\text{p-m}}$ [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 $L_{\text{pc-preamble}}$ parameter indicates a zero length preamble, then there is no power control preamble and the message portion of the burst starts $\tau_{\text{cd-p-pc-p}}$ 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 $\Delta P_{\text{p-m}}$ [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 $N_{\text{Start_Message}}$ frames after Power Control preamble. Start of Message Indicator is a known sequence repeated on a frame by frame basis. The value of $N_{\text{Start_Message}}$ shall be provided by the higher layers.
- 14) If the UE does not detect Start of Message Indicator in the first $N_{\text{Start_Message}}$ 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 $N_{\text{Start_Message}}$ 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) 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.

3GPP TSG RAN Meeting #13
Beijing, China, 18th – 21st, September, 2001

R1-01-0931

CR-Form-v4

CHANGE REQUEST

⌘ **25.214 CR 194** ⌘ rev **1** ⌘ Current version: **4.1.0** ⌘

For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.

Proposed change affects: ⌘ (U)SIM ME/UE Radio Access Network Core Network

Title:	⌘ Minor modifications to the CPCH access procedure		
Source:	⌘ TSG RAN WG1		
Work item code:	⌘ TEI Date: ⌘ August 19, 2001		
Category:	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> ⌘ A Use <u>one</u> of the following categories: F (correction) A (corresponds to a correction in an earlier release) B (addition of feature), C (functional modification of feature) D (editorial modification) Detailed explanations of the above categories can be found in 3GPP TR 21.900. </td> <td style="width: 50%; vertical-align: top;"> Release: ⌘ REL-4 Use <u>one</u> of the following releases: 2 (GSM Phase 2) R96 (Release 1996) R97 (Release 1997) R98 (Release 1998) R99 (Release 1999) REL-4 (Release 4) REL-5 (Release 5) </td> </tr> </table>	⌘ A Use <u>one</u> of the following categories: F (correction) A (corresponds to a correction in an earlier release) B (addition of feature), C (functional modification of feature) D (editorial modification) Detailed explanations of the above categories can be found in 3GPP TR 21.900 .	Release: ⌘ REL-4 Use <u>one</u> of the following releases: 2 (GSM Phase 2) R96 (Release 1996) R97 (Release 1997) R98 (Release 1998) R99 (Release 1999) REL-4 (Release 4) REL-5 (Release 5)
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Reason for change:	⌘ The parameter Delta P1 has been deleted from higher layer specifications TS25.331 and TS25.302. CPCH ramp-up procedure was decided to be the same as that of RACH. The Delta P1 parameter has been deleted from the RACH access procedure, but has not been deleted from the CPCH access procedure.
Summary of change:	⌘ The delta P1 parameter is deleted from the CPCH access procedure.
Consequences if not approved:	⌘ Inconsistency between the parameters defined in Layer 1 and Layer2 specifications.

Clauses affected:	⌘									
Other specs affected:	<table style="width: 100%; border: none;"> <tr> <td style="width: 30%;"><input type="checkbox"/></td> <td>Other core specifications</td> <td style="width: 30%;">⌘</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Test specifications</td> <td></td> </tr> <tr> <td><input type="checkbox"/></td> <td>O&M Specifications</td> <td></td> </tr> </table>	<input type="checkbox"/>	Other core specifications	⌘	<input type="checkbox"/>	Test specifications		<input type="checkbox"/>	O&M Specifications	
<input type="checkbox"/>	Other core specifications	⌘								
<input type="checkbox"/>	Test specifications									
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Other comments:	⌘									

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- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

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) ΔP_0 = Power step size for each successive CPCH access preamble.
 - [RACH/CPCH parameter].

~~4) ΔP_i = 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 ΔP_i is used in place of ΔP_0 .~~

~~— [RACH/CPCH parameter].~~

~~45) $\Delta P_{p-m} = P_{message-control} - P_{cd}$, 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_{cph} = 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_{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 with the help of subclauses 6.1.1. and 6.1.2. The UE randomly selects one uplink access slot from the derived available CPCH-AP access slots. If there is no access slot available in the selected set, the UE randomly selects one uplink access slot corresponding to the selected CPCH sub-channel group from the next access slot set. 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 with the help of subclauses 6.1.1 and 6.1.2. The UE randomly selects one uplink access slot from the derived available CPCH-AP access slots. If there is no access slot available in the selected set, the UE randomly selects one uplink access slot corresponding to the selected CPCH sub-channel group from the next access slot set. 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) Select the next available access slot in the sub-channel group used. There must be a minimum distance of three or four (per T_{cpch} 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 ΔP . Power offset ΔP_0 is used, ~~unless the negative AICH timer is running, in which case ΔP_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 ΔP_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 $\tau_{\text{cd-p-pc-p}}$ ms later as measured from initiation of the CD Preamble. The initial transmission power of the power control preamble shall be $\Delta P_{\text{p-m}}$ [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 $\tau_{\text{cd-p-pc-p}}$ ms later as measured from initiation of the CD Preamble. The initial transmission power of the power control preamble shall be $\Delta P_{\text{p-m}}$ [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 $L_{\text{pc-preamble}}$ parameter indicates a zero length preamble, then there is no power control preamble and the message portion of the burst starts $\tau_{\text{cd-p-pc-p}}$ 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 $\Delta P_{\text{p-m}}$ [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 $N_{\text{Start_Message}}$ frames after Power Control preamble. Start of Message Indicator is a known sequence repeated on a frame by frame basis. The value of $N_{\text{Start_Message}}$ shall be provided by the higher layers.
- 14) If the UE does not detect Start of Message Indicator in the first $N_{\text{Start_Message}}$ 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 $N_{\text{Start_Message}}$ 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) 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.

CR-Form-v4			
CHANGE REQUEST			
⌘	25.214 CR 196	⌘ rev	- ⌘ Current version: 3.7.0 ⌘

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Proposed change affects: ⌘ (U)SIM ME/UE Radio Access Network Core Network

Title:	⌘ Downlink power control in compressed mode		
Source:	⌘ TSG RAN WG1		
Work item code:	⌘ TEI	Date:	⌘ 2001-07-10
Category:	⌘ F Use <u>one</u> of the following categories: F (correction) A (corresponds to a correction in an earlier release) B (addition of feature), C (functional modification of feature) D (editorial modification) Detailed explanations of the above categories can be found in 3GPP TR 21.900 .	Release:	⌘ R99 Use <u>one</u> of the following releases: 2 (GSM Phase 2) R96 (Release 1996) R97 (Release 1997) R98 (Release 1998) R99 (Release 1999) REL-4 (Release 4) REL-5 (Release 5)

Reason for change:	⌘ From the current text in section 5.2.1.3 one could get the impression that the UE power control behaviour during DL compressed mode is exactly the same as in normal mode. This is not totally correct, as the SIR target is offset for certain frames during DL compressed mode.
Summary of change:	⌘ Clarify that the UE power control behaviour during DL compressed mode includes SIR target offsets.
Consequences if not approved:	⌘ Ambiguity for the UE implementation of power control during DL compressed mode.

Clauses affected:	⌘ 5.2.1.3
Other specs affected:	⌘ <input type="checkbox"/> Other core specifications ⌘ <input type="checkbox"/> <input type="checkbox"/> Test specifications <input type="checkbox"/> O&M Specifications
Other comments:	⌘ No backward compatibility issues were identified with this CR.

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- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request

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. The method for controlling the power offsets within UTRAN is specified in [6].

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

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.

The UE 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.

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.

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 [6].

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

If the value of *Limited Power Increase 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 Increase 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

$$\Delta_{sum}(k) = \sum_{i=k-DL_Power_Averaging_Window_Size}^{k-1} P_{TPC}(i)$$

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 of the limited power increase 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 Δ_{TPC} can take four values: 0.5, 1, 1.5 or 2 dB. It is mandatory for UTRAN to support Δ_{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.

The average power of transmitted DPDCH symbols over one timeslot shall not exceed *Maximum_DL_Power* (dB), nor shall it be below *Minimum_DL_Power* (dB). Transmitted DPDCH symbol means here a complex QPSK symbol before spreading which does not contain DTX. *Maximum_DL_Power* (dB) and *Minimum_DL_Power* (dB) are power limits for one channelisation code, relative to the primary CPICH power [6].

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, except that the target SIR is offset by higher layer signaling.

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 and DPDCH in the first slot after the transmission gap should be set to the same value as in the slot just before the transmission gap.

In every slot during compressed mode except during downlink transmission gaps, UTRAN shall estimate the k :th TPC command and adjust the current downlink power $P(k-1)$ [dB] to a new power $P(k)$ [dB] according to the following formula:

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

where $P_{TPC}(k)$ is the k :th power adjustment due to the inner loop power control, $P_{SIR}(k)$ is the k -th power adjustment due to the downlink target SIR variation, 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 [6].

Due to transmission gaps in uplink compressed frames, there may be missing TPC commands in the uplink. If no uplink TPC command is received, $P_{TPC}(k)$ derived by the Node B shall be set to zero. Otherwise, $P_{TPC}(k)$ is calculated the same way as in normal mode (see sub-clause 5.2.1.2.2) but with a step size Δ_{STEP} instead of Δ_{TPC} .

The power control step size $\Delta_{STEP} = \Delta_{RP-TPC}$ during RPL slots after each transmission gap and $\Delta_{STEP} = \Delta_{TPC}$ otherwise, where:

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

The power offset $P_{SIR}(k) = \delta P_{curr} - \delta P_{prev}$, where δP_{curr} and δP_{prev} are respectively the value of δP in the current slot and the most recently transmitted slot and δP is computed as follows:

$$\delta P = \max(\Delta P1_compression, \dots, \Delta Pn_compression) + \Delta P1_coding + \Delta P2_coding$$

where n is the number of different TTI lengths amongst TTIs of all TrChs of the CCTrCh, where $\Delta P1_coding$ and $\Delta P2_coding$ are computed from uplink parameters DeltaSIR1, DeltaSIR2, DeltaSIRafter1, DeltaSIRafter2 signaled by higher layers as:

- $\Delta P1_coding = \text{DeltaSIR1}$ if the start of the first transmission gap in the transmission gap pattern is within the current frame.
- $\Delta P1_coding = \text{DeltaSIRafter1}$ if the current frame just follows a frame containing the start of the first transmission gap in the transmission gap pattern.
- $\Delta P2_coding = \text{DeltaSIR2}$ if the start of the second transmission gap in the transmission gap pattern is within the current frame.
- $\Delta P2_coding = \text{DeltaSIRafter2}$ if the current frame just follows a frame containing the start of the second transmission gap in the transmission gap pattern.
- $\Delta P1_coding = 0$ dB and $\Delta P2_coding = 0$ dB in all other cases.

and $\Delta P_i_compression$ is defined by :

- $\Delta P_i_compression = 3$ dB for downlink frames compressed by reducing the spreading factor by 2.
- $\Delta P_i_compression = 10 \log(15 * F_i / (15 * F_i - TGL_i))$ if there is a transmission gap created by puncturing method within the current TTI of length F_i frames, where TGL_i is the gap length in number of slots (either from one gap or a sum of gaps) in the current TTI of length F_i frames.
- $\Delta P_i_compression = 0$ dB in all other cases.

In case several compressed mode patterns are used simultaneously, a δP offset is computed for each compressed mode pattern and the sum of all δP offsets is applied to the frame.

For all time slots except those in transmissions gaps, the average power of transmitted DPDCH symbols over one timeslot shall not exceed Maximum_DL_Power (dB) by more than P_{SIR} , nor shall it be below Minimum_DL_Power (dB). Transmitted DPDCH symbol means here a complex QPSK symbol before spreading which does not contain DTX. Maximum_DL_Power (dB) and Minimum_DL_Power (dB) are power limits for one channelisation code, relative to the primary CPICH power [6].

CHANGE REQUEST

⌘ **25.214 CR 197** ⌘ rev **-** ⌘ Current version: **4.1.0** ⌘

For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.

Proposed change affects: ⌘ (U)SIM ME/UE Radio Access Network Core Network

Title:	⌘	Downlink power control in compressed mode
Source:	⌘	TSG RAN WG1
Work item code:	⌘	TEI
		Date: ⌘ 2001-07-10
Category:	⌘	A
		Use <u>one</u> of the following categories:
		F (correction)
		A (corresponds to a correction in an earlier release)
		B (addition of feature),
		C (functional modification of feature)
		D (editorial modification)
		Detailed explanations of the above categories can be found in 3GPP TR 21.900 .
		Release: ⌘ REL-4
		Use <u>one</u> of the following releases:
		2 (GSM Phase 2)
		R96 (Release 1996)
		R97 (Release 1997)
		R98 (Release 1998)
		R99 (Release 1999)
		REL-4 (Release 4)
		REL-5 (Release 5)

Reason for change:	⌘	From the current text in section 5.2.1.3 one could get the impression that the UE power control behaviour during DL compressed mode is exactly the same as in normal mode. This is not totally correct, as the SIR target is offset for certain frames during DL compressed mode.
Summary of change:	⌘	Clarify that the UE power control behaviour during DL compressed mode includes SIR target offsets.
Consequences if not approved:	⌘	Ambiguity for the UE implementation of power control during DL compressed mode.

Clauses affected:	⌘	5.2.1.3
Other specs affected:	⌘	<input type="checkbox"/> Other core specifications ⌘ <input type="checkbox"/> Test specifications <input type="checkbox"/> O&M Specifications
Other comments:	⌘	No backward compatibility issues were identified with this CR.

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- 1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.
- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under [ftp://ftp.3gpp.org/specs/](http://ftp.3gpp.org/specs/). For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change requests

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. The method for controlling the power offsets within UTRAN is specified in [6].

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

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.

The UE 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.

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.

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 [6].

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

If the value of *Limited Power Increase 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 Increase 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

$$\Delta_{sum}(k) = \sum_{i=k-DL_Power_Averaging_Window_Size}^{k-1} P_{TPC}(i)$$

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 of the limited power increase 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 Δ_{TPC} can take four values: 0.5, 1, 1.5 or 2 dB. It is mandatory for UTRAN to support Δ_{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.

The average power of transmitted DPDCH symbols over one timeslot shall not exceed *Maximum_DL_Power* (dB), nor shall it be below *Minimum_DL_Power* (dB). Transmitted DPDCH symbol means here a complex QPSK symbol before spreading which does not contain DTX. *Maximum_DL_Power* (dB) and *Minimum_DL_Power* (dB) are power limits for one channelisation code, relative to the primary CPICH power [6].

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, except that the target SIR is offset by higher layer signaling.

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 and DPDCH in the first slot after the transmission gap should be set to the same value as in the slot just before the transmission gap.

In every slot during compressed mode except during downlink transmission gaps, UTRAN shall estimate the k :th TPC command and adjust the current downlink power $P(k-1)$ [dB] to a new power $P(k)$ [dB] according to the following formula:

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

where $P_{TPC}(k)$ is the k :th power adjustment due to the inner loop power control, $P_{SIR}(k)$ is the k -th power adjustment due to the downlink target SIR variation, 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 [6].

Due to transmission gaps in uplink compressed frames, there may be missing TPC commands in the uplink. If no uplink TPC command is received, $P_{TPC}(k)$ derived by the Node B shall be set to zero. Otherwise, $P_{TPC}(k)$ is calculated the same way as in normal mode (see sub-clause 5.2.1.2.2) but with a step size Δ_{STEP} instead of Δ_{TPC} .

The power control step size $\Delta_{STEP} = \Delta_{RP-TPC}$ during RPL slots after each transmission gap and $\Delta_{STEP} = \Delta_{TPC}$ otherwise, where:

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

The power offset $P_{SIR}(k) = \delta P_{curr} - \delta P_{prev}$, where δP_{curr} and δP_{prev} are respectively the value of δP in the current slot and the most recently transmitted slot and δP is computed as follows:

$$\delta P = \max(\Delta P1_compression, \dots, \Delta Pn_compression) + \Delta P1_coding + \Delta P2_coding$$

where n is the number of different TTI lengths amongst TTIs of all TrChs of the CCTrCh, where $\Delta P1_coding$ and $\Delta P2_coding$ are computed from uplink parameters DeltaSIR1, DeltaSIR2, DeltaSIRafter1, DeltaSIRafter2 signaled by higher layers as:

- $\Delta P1_coding = \text{DeltaSIR1}$ if the start of the first transmission gap in the transmission gap pattern is within the current frame.
- $\Delta P1_coding = \text{DeltaSIRafter1}$ if the current frame just follows a frame containing the start of the first transmission gap in the transmission gap pattern.
- $\Delta P2_coding = \text{DeltaSIR2}$ if the start of the second transmission gap in the transmission gap pattern is within the current frame.
- $\Delta P2_coding = \text{DeltaSIRafter2}$ if the current frame just follows a frame containing the start of the second transmission gap in the transmission gap pattern.
- $\Delta P1_coding = 0$ dB and $\Delta P2_coding = 0$ dB in all other cases.

and $\Delta P_i_compression$ is defined by :

- $\Delta P_i_compression = 3$ dB for downlink frames compressed by reducing the spreading factor by 2.
- $\Delta P_i_compression = 10 \log(15 * F_i / (15 * F_i - TGL_i))$ if there is a transmission gap created by puncturing method within the current TTI of length F_i frames, where TGL_i is the gap length in number of slots (either from one gap or a sum of gaps) in the current TTI of length F_i frames.
- $\Delta P_i_compression = 0$ dB in all other cases.

In case several compressed mode patterns are used simultaneously, a δP offset is computed for each compressed mode pattern and the sum of all δP offsets is applied to the frame.

For all time slots except those in transmissions gaps, the average power of transmitted DPDCH symbols over one timeslot shall not exceed Maximum_DL_Power (dB) by more than P_{SIR} , nor shall it be below Minimum_DL_Power (dB). Transmitted DPDCH symbol means here a complex QPSK symbol before spreading which does not contain DTX. Maximum_DL_Power (dB) and Minimum_DL_Power (dB) are power limits for one channelisation code, relative to the primary CPICH power [6].

CR-Form-v4		
CHANGE REQUEST		
⌘	25.214 CR 198	⌘ rev 1 ⌘ Current version: 3.7.0 ⌘

For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.

Proposed change affects: ⌘ (U)SIM ME/UE Radio Access Network Core Network

Title:	⌘ Improvements of closed loop TX diversity description	
Source:	⌘ TSG RAN WG1	
Work item code:	⌘ TEI	Date: ⌘ 2001-08-27
Category:	⌘ F Use <u>one</u> of the following categories: F (correction) A (corresponds to a correction in an earlier release) B (addition of feature), C (functional modification of feature) D (editorial modification) Detailed explanations of the above categories can be found in 3GPP TR 21.900 .	Release: ⌘ R99 Use <u>one</u> of the following releases: 2 (GSM Phase 2) R96 (Release 1996) R97 (Release 1997) R98 (Release 1998) R99 (Release 1999) REL-4 (Release 4) REL-5 (Release 5)

Reason for change:	⌘ Improve the description of closed loop TX diversity.
Summary of change:	⌘ A number of small text improvements is made, inconsistencies are removed.
Consequences if not approved:	⌘ Remaining ambiguities in the description of closed loop TX diversity. Higher risk of misinterpretation of the specification.

Clauses affected:	⌘ 7
Other specs affected:	⌘ <input type="checkbox"/> Other core specifications ⌘ <input type="checkbox"/> Test specifications <input type="checkbox"/> O&M Specifications
Other comments:	⌘ No backward compatibility issues were identified with this CR.

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- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request

7 Closed loop mode transmit diversity

The general transmitter structure to support closed loop mode transmit diversity for DPCH transmission is shown in figure 3. 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 sub-bits-field of the FBI field of uplink DPCCCH.

For the closed loop mode 1 different (orthogonal) dedicated pilot 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.

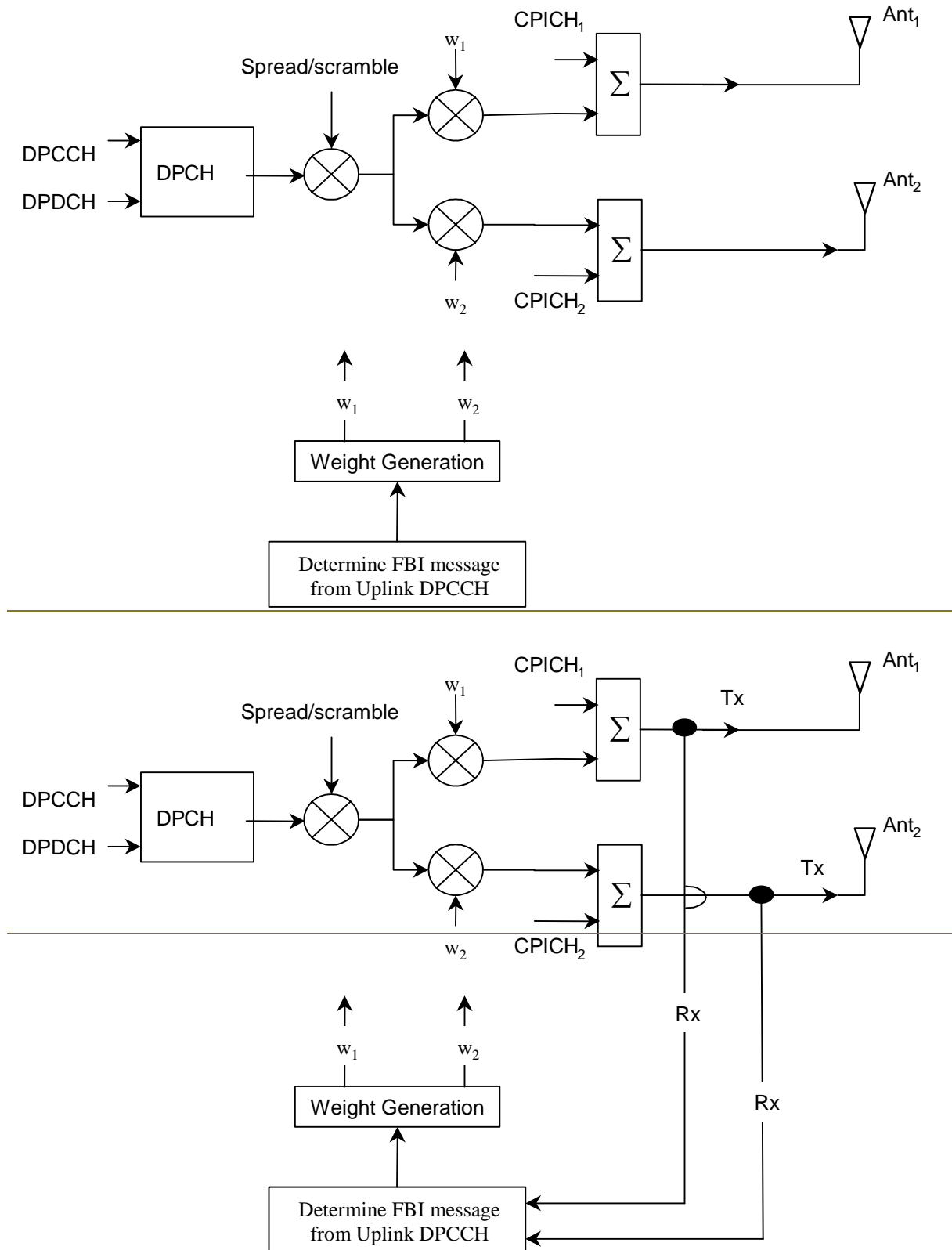


Figure 3: The generic downlink transmitter structure to support closed loop mode transmit diversity for DPCH transmission

There are two closed loop modes whose characteristics are summarised 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, ϕ , and for mode 2 the amplitude adjustment that should be applied at the UTRAN access point to maximise the UE received power. An example of how the computations can be accomplished is given in Annex A.2. In non-soft handover case, that can be accomplished by e.g. solving for weight vector, \underline{w} , that maximises.

$$P = \underline{w}^H H^H H \underline{w} \tag{1}$$

where

$$H = [h_1 \ h_2] \text{ and } \underline{w} = [w_1 \ w_2]^T$$

and where the column vectors h_1 and 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 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:

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

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 DPCCH slot(s) assigned to closed loop mode transmit diversity, the FBI D field (see [1]). Each message is of length $N_W = N_{po} + N_{ph}$ bits and its format is shown in the figure 4. 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.

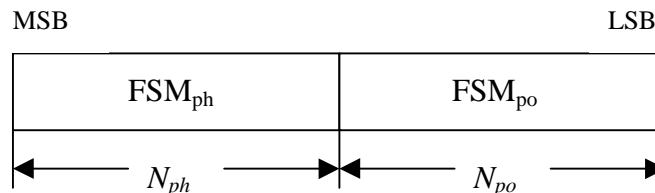


Figure 4: Format of feedback signalling message. FSM_{po} transmits the power setting and FSM_{ph} the phase setting

The adjustments are made by the UTRAN Access Point at the beginning of the downlink DPCCH 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 approximately 1024 ± 148 chips when compared to in offset from the 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 approximately 1024 \pm 148 chips when compared to in offset from the~~ 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 $0 \leq N < 2560$.

7.2 Closed loop mode 1

The 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. In each slot, UE calculates the optimum phase adjustment, ϕ , for antenna 2, which is then quantized into ϕ_Q having two possible values as follows:

$$\phi_Q = \begin{cases} \pi, & \text{if } \pi/2 < \phi - \phi_r(i) \leq 3\pi/2 \\ 0, & \text{otherwise} \end{cases} \quad (21)$$

where:

$$\phi_r(i) = \begin{cases} 0, & i = 0,2,4,6,8,10,12,14 \\ \pi/2, & i = 1,3,5,7,9,11,13 \end{cases} \quad (32)$$

If $\phi_Q = 0$, a command '0' is send to UTRAN using the FSM_{ph} field. Correspondingly, if $\phi_Q = \pi$, command '1' is send to UTRAN using the FSM_{ph} 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, ϕ_i , and received feedback command for each UL-uplink slot.

Table 9: Phase adjustments, ϕ_i corresponding to feedback commands for the slots i of the UL radio frame

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

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:

$$w_2 = \frac{\sum_{i=n-1}^n \cos(\phi_i)}{2} + j \frac{\sum_{i=n-1}^n \sin(\phi_i)}{2} \quad (43)$$

where:

$$\phi_i \in \{0, \pi, \pi/2, -\pi/2\} \quad (54)$$

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

$$w_1 = 1/\sqrt{2} \quad (65)$$

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-a** 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-current** frame, i.e. ϕ_i from slot 14 is not used:

$$w_2 = \frac{\cos(\phi_{13}^{j-1}) + \cos(\phi_0^j)}{2} + j \frac{\sin(\phi_{13}^{j-1}) + \sin(\phi_0^j)}{2} \quad (76)$$

where:

- ϕ_{13}^{j-1} = phase adjustment from frame j-1, slot 13.
- ϕ_0^j = phase adjustment from frame j, slot 0.

7.2.2 Mode 1 normal initialisation

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

Before the first FB command is received, the UTRAN shall use the initial weight $w_2 = \frac{1}{2}(1 + j)$.

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

$$w_2 = \frac{\cos(\pi / 2) + \cos(\phi_0)}{2} + j \frac{\sin(\pi / 2) + \sin(\phi_0)}{2} \quad (87)$$

where:

ϕ_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.

In **compressed** downlink transmission **gaps** there are uplink slots for which no new estimate of the phase adjustment is calculated. During these slots the following rules are applied in UE when determining the feedback command:

- 1) If no new estimate of phase adjustment, ϕ_i , exists corresponding to the feedback command to be sent 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 ϕ_i must be sent in the uplink slot which is transmitted approximately 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 slot~~transmission gaps 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 ϕ_i must be sent in the uplink slot which is transmitted approximately 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 transmission gap starts~~ 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 the start of the uplink entered the compressed mode transmission gap, is applied to antenna 2 signal.

After the 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 sent before the start of the uplink entered compressed mode transmission gap.
- 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 .

7.2.4 Mode 1 initialisation during compressed mode

When closed loop mode 1 is initialised during the downlink transmission gap of compressed mode there are slots for which no estimate of the phase adjustment is calculated and no previous feedback command is available.

In this case, if the UE is required to send feedback in the uplink, the FB command to the UTRAN shall be '0'.

When transmission in downlink is started again in slot $N_{\text{last}+1}$ (if $N_{\text{last}+1} = 15$, then slot 0 in the next frame), the UTRAN shall use the initial weight $w_2 = \frac{1}{2}(1 + j)$. The UE must start calculating estimates of the phase adjustment.

The feedback command corresponding to the first estimate of ϕ_i must be ~~sent~~ in the uplink slot which is transmitted approximately 1024 chips in offset from the downlink slot $N_{\text{last}+1}$. Having received this feedback command the UTRAN calculates w_2 as follows:

$$w_2 = \frac{\cos(\phi_i) + \cos(\phi_j)}{2} + j \frac{\sin(\phi_i) + \sin(\phi_j)}{2} \quad (98)$$

where:

ϕ_i = phase adjustment in uplink slot i , which is transmitted approximately 1024 chips in offset from the downlink slot $N_{last}+1$.

$$\phi_j = \frac{\pi}{2}, \text{ if slot } i \text{ is even } (i \in \{0, 2, 4, 6, 8, 10, 12, 14\}) \text{ and}$$

$$\phi_j = 0, \text{ if slot } i \text{ is odd } (i \in \{1, 3, 5, 7, 9, 11, 13\})$$

7.3 Closed loop mode 2

In closed loop mode 2 there are 16 possible combinations of phase and power 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_{po} subfield of closed loop mode 2 signalling message

FSM _{po}	Power_ant1	Power_ant2
0	0.2	0.8
1	0.8	0.2

Table 11: FSM_{ph} subfield of closed loop mode 2 signalling message

FSM _{ph}	Phase difference between antennas (radians)
000	π
001	$-3\pi/4$
011	$-\pi/2$
010	$-\pi/4$
110	0
111	$\pi/4$
101	$\pi/2$
100	$3\pi/4$

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 5, 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 in 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 DPCCH 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 $P(\{x_3, x_2, x_1, x_0\})$, where $\{x_3, x_2, x_1, x_0\}$ is one of the 16 possible FSMs which defines an applied phase and power 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:

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

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

$b_1(4m+2)=X_1$ from the $\{b_3(4m) b_2(4m+1) X_1 X_0\}$ which maximises $P(\{b_3(4m) b_2(4m+1) x_1 x_0\})$ 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 $P(\{b_3(4m) b_2(4m+1) b_1(4m+2) x_0\})$ over x_0 (2 possible combinations).

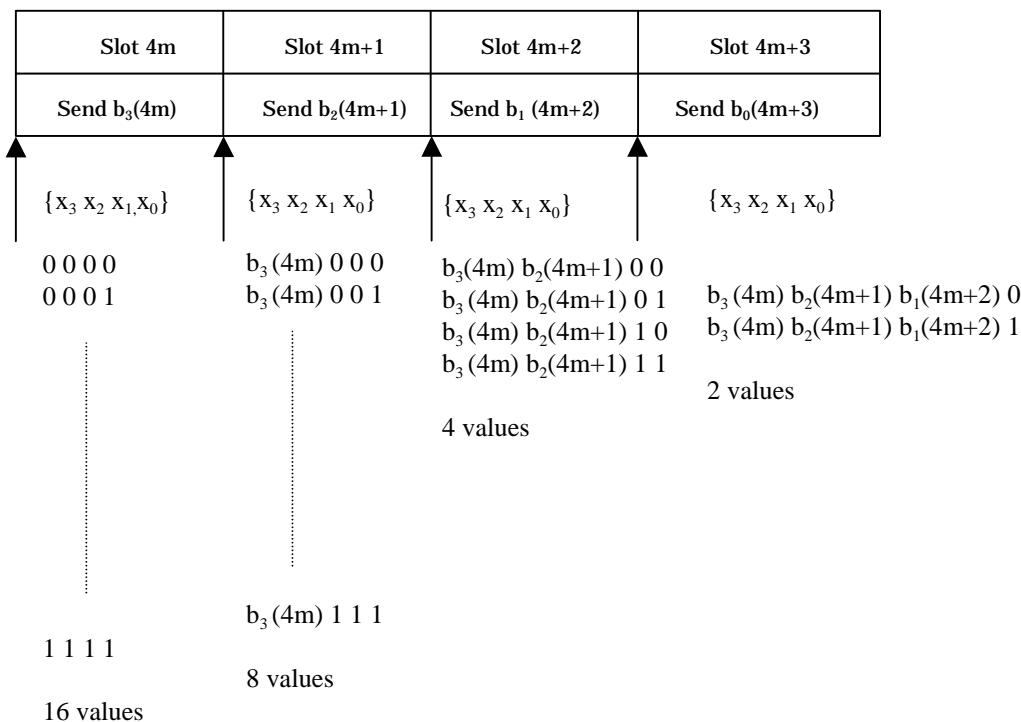


Figure 5: Progressive Refinement at the UE for closed loop mode 2

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 (derived from power) 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 power adjustments as defined by table 10 and table 11, with $FSM_{ph}=\{z_3 z_2 z_1\}$ and $FSM_{po}=z_0$.

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

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

$$\mathbf{w} = \begin{bmatrix} \sqrt{power_ant1} \\ \sqrt{power_ant2} \exp(j \text{ phase_diff}) \end{bmatrix} \tag{910}$$

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_{ph} subfield, and the UTRAN takes the power bit FSM_{po} 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 from slot 0 in the normal way. The UE may refine its choice of FSM in slots 1 to 3 from the set of weights allowed given the previously transmitted bits of the FSM.

The UTRAN Access Point operation is as follows. Until the first FSM_{po} bit is received and acted upon (depending on the timing control specified via the higher layer parameter described in section 7.1) the power in both antennas shall be set to 0.5. Until the first FSM_{ph} bit is received and acted upon the phase difference between antennas shall be π radians.

Before the first FSM message is received and during the reception of the first three FSM bits, the UTRAN Access Point shall initialise 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_{ph} bits received as given in table 12.

Table 12: FSM_{ph} normal initialisation for closed loop mode 2

FSM _{ph}	Phase difference between antennas (radians)
- - -	π (normal initialisation) or held from previous setting (compressed mode recovery)
0 - -	π
1 - -	0
0 0 -	π
0 1 -	$-\pi/2$
1 1 -	0
1 0 -	$\pi/2$
0 0 0	π
0 0 1	$-3\pi/4$
0 1 1	$-\pi/2$
0 1 0	$-\pi/4$
1 1 0	0
1 1 1	$\pi/4$
1 0 1	$\pi/2$
1 0 0	$3\pi/4$

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.

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

Recovery from compressed mode is described in the following. Downlink transmissions commence at the pilot field of slot N_{last} as described in [2].

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

If the uplink slot N_{last}+1 (modulo 15) occurs at the beginning of a FSM period (that is at slot 0,4,8, or 12), the UE sends the FSM message in the normal way, with 3 FSM_{ph} bits and with the FSM_{po} bit on slot 3, 7 or 11, and the UTRAN Access Point acts on the FSM_{ph} bits according to 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 slot N_{last}+1 (modulo 15) does not occur 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, that is from slot N_{last}+1 (modulo 15) until the final slot (slot 3, 7, 11 or 14), 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. During the following full FSM period, which starts on slot 0, 4, 8, or 12, the UE sends the FSM message in the normal way, with 3 FSM_{ph} bits and with the FSM_{po} bit on slot 3, 7 or 11, and the UTRAN Access Point acts on the FSM_{ph} bits according to table 12. 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 (radians)
-	held from previous setting
0	π
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 transmission gaps~~ as described in the previous subclause 7.3.3.1.

7.3.4 Mode 2 initialisation during compressed mode

When closed loop mode 2 is initialised during the downlink transmission gap of compressed mode there are slots for which no FSM bit is calculated and no previous sent FSM bit is available.

In this case, if the UE is required to send feedback in the uplink, the FB command to the UTRAN shall be '0'.

The UTRAN and the UE perform the functions of recovery after the downlink transmission gap as described in the previous subclause 7.3.3.1. If no previous phase setting is available, UTRAN shall use the phase offset π , until the first FSM_{ph} bit is received and acted upon.

Annex A (informative):

A.1 Antenna verification

In closed loop mode 1, if channel estimates are taken from the Primary CPICH, the performance will also suffer if the UE can not detect errors since the channel estimates will be taken for the incorrect phase settings. To mitigate this problem, antenna verification can be done, which can make use of antenna specific pilot patterns of the dedicated physical channel. The antenna verification can be implemented with several different algorithms. A straightforward algorithm can use a 4-hypothesis test per slot. Alternatively, a simplified beam former verification (SBV) requiring only a 2-hypothesis test per slot can be used. If we have orthogonal pilot patterns on the downlink DPCCCH we can apply the SBV as follows:

Consider:

$$2 \sum_{i=1}^{N_{path}} \frac{1}{\sigma_i^2} \left\{ \sqrt{2} \operatorname{Re}(\gamma h_{2,i}^{(d)} h_{2,i}^{(p)*}) \right\} > \ln \left(\frac{\bar{p}(\phi_{Rx} = \pi)}{\bar{p}(\phi_{Rx} = 0)} \right)$$

then define the variable x_0 as, $x_0 = 0$ if the above inequality holds good and $x_0 = \pi$ otherwise.

Similarly consider:

$$-2 \sum_{i=1}^{N_{path}} \frac{1}{\sigma_i^2} \left\{ \sqrt{2} \operatorname{Im}(\gamma h_{2,i}^{(d)} h_{2,i}^{(p)*}) \right\} > \ln \left(\frac{\bar{p}(\phi_{Rx} = -\pi/2)}{\bar{p}(\phi_{Rx} = \pi/2)} \right)$$

then define the variable x_1 as, $x_1 = -\pi/2$ if the above inequality holds good and $x_1 = \pi/2$ otherwise.

Whether x_0 or x_1 is to be calculated for each slot is given by the following table:

Slot	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	x_0	x_1	x_0	x_1	x_0	x_1	x_0	x_1	x_0	x_1	x_0	x_1	x_0	x_1	x_0

The estimate for the transmitted phase is now obtained as:

$$\sin(\phi_{Tx}) + j \cos(\phi_{Tx}) = \frac{\sum_{i=0}^1 \sin(x_i)}{\sqrt{2}} + j \frac{\sum_{i=0}^1 \cos(x_i)}{\sqrt{2}}$$

where:

- the x_i values are used corresponding to the current slot and the next slot, except in the case of slot 14 wherein the slot 14 and slot 1 of the next frame values are used;
- $h_{2,i}^{(p)}$ is the i 'th estimated channel tap of antenna 2 using the CPICH;
- $h_{2,i}^{(d)}$ is the i 'th estimated channel tap of antenna 2 using the DPCCCH;
- γ^2 is the DPCH Pilot SNIR/ CPICH SNIR;
- σ_i^2 is the noise plus interference power on the i 'th path.

In normal operation the *a priori* probability for selected pilot pattern is assumed to be 96% (assuming there are 4% of errors in the feedback channel for power control and antenna selection).

A.2 Computation of feedback information for closed loop transmit diversity

In non-soft handover case, the computation of feedback information can be accomplished by e.g. solving for weight vector, w , that maximises.

$$P = w^H H^H H w \quad (1)$$

where

$$H = [h_1 \ h_2] \text{ and } w = [w_1, w_2]^T$$

and where the column vectors h_1 and 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 w correspond to the adjustments computed by the UE.

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

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

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).

CR-Form-v4

CHANGE REQUEST

⌘ **25.214 CR 199** ⌘ rev **1** ⌘ Current version: **4.1.0** ⌘

For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.

Proposed change affects: ⌘ (U)SIM ME/UE Radio Access Network Core Network

Title:	⌘ Improvements of closed loop TX diversity description		
Source:	⌘ TSG RAN WG1		
Work item code:	⌘ TEI	Date:	⌘ 2001-08-27
Category:	⌘ A	Release:	⌘ REL-4
	Use <u>one</u> of the following categories:		Use <u>one</u> of the following releases:
	F (correction)		2 (GSM Phase 2)
	A (corresponds to a correction in an earlier release)		R96 (Release 1996)
	B (addition of feature),		R97 (Release 1997)
	C (functional modification of feature)		R98 (Release 1998)
	D (editorial modification)		R99 (Release 1999)
	Detailed explanations of the above categories can be found in 3GPP TR 21.900 .		REL-4 (Release 4)
			REL-5 (Release 5)

Reason for change:	⌘ Improve the description of closed loop TX diversity.
Summary of change:	⌘ A number of small text improvements is made, inconsistencies are removed.
Consequences if not approved:	⌘ Remaining ambiguities in the description of closed loop TX diversity. Higher risk of misinterpretation of the specification.

Clauses affected:	⌘ 7
Other specs affected:	⌘ <input type="checkbox"/> Other core specifications ⌘ <input type="checkbox"/>
	<input type="checkbox"/> Test specifications
	<input type="checkbox"/> O&M Specifications
Other comments:	⌘ No backward compatibility issues were identified with this CR.

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

- 1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.
- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under <ftp://ftp.3gpp.org/specs/> For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request

7 Closed loop mode transmit diversity

The general transmitter structure to support closed loop mode transmit diversity for DPCH transmission is shown in figure 3. 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 sub-bits-field of the FBI field of uplink DPCCCH.

For the closed loop mode 1 different (orthogonal) dedicated pilot 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.

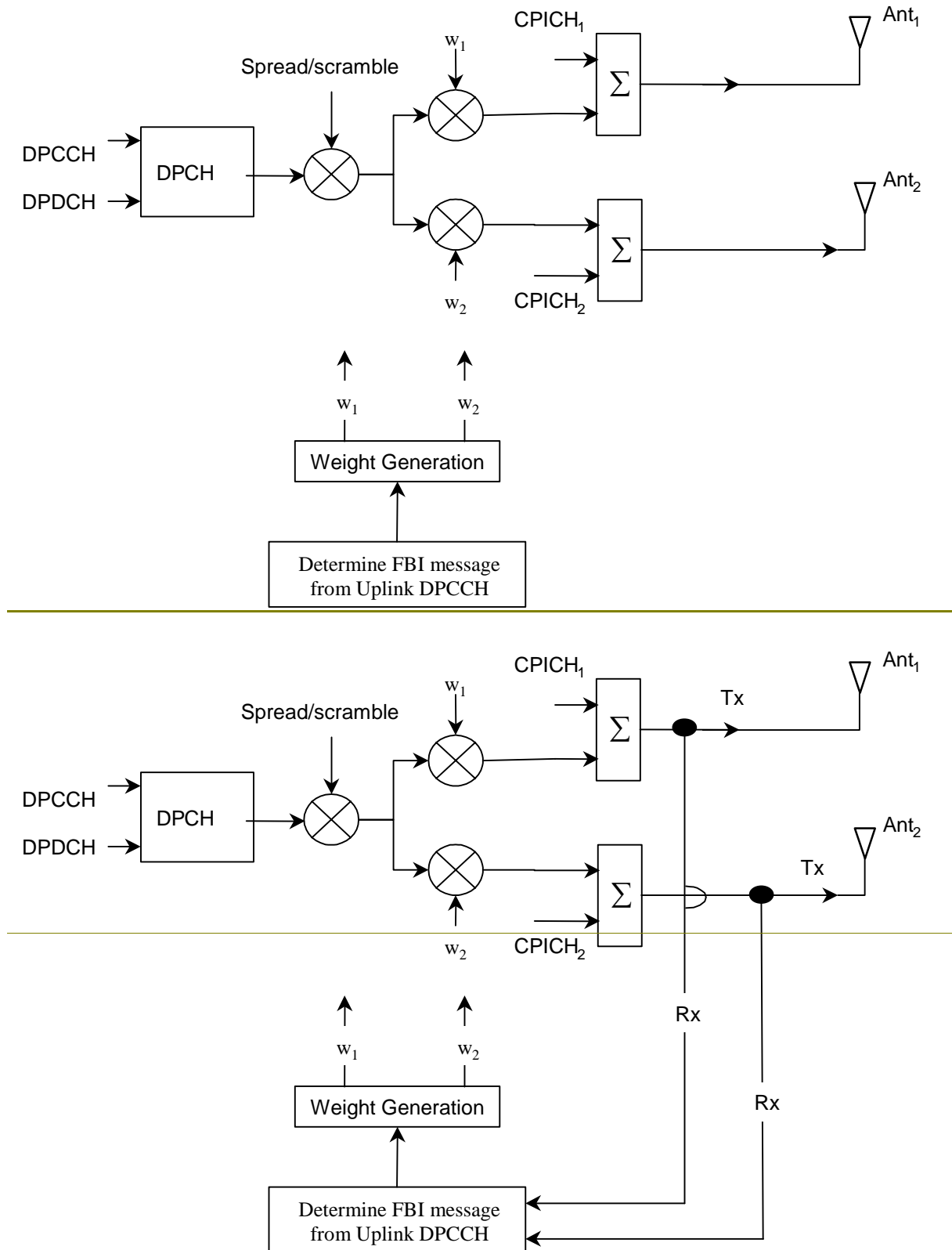


Figure 3: The generic downlink transmitter structure to support closed loop mode transmit diversity for DPCH transmission

There are two closed loop modes whose characteristics are summarised 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, ϕ , and for mode 2 the amplitude adjustment that should be applied at the UTRAN access point to maximise the UE received power. An example of how the computations can be accomplished is given in Annex A.2. In non-soft handover case, that can be accomplished by e.g. solving for weight vector, \underline{w} , that maximises:

$$P = \underline{w}^H H^H H \underline{w} \tag{1}$$

where

$$H = [h_1 \ h_2] \text{ and } \underline{w} = [w_1 \ w_2]^T$$

and where the column vectors h_1 and 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 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:

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

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 DPCCH slot(s) assigned to closed loop mode transmit diversity, the FBI D field (see [1]). Each message is of length $N_W = N_{po} + N_{ph}$ bits and its format is shown in the figure 4. 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.

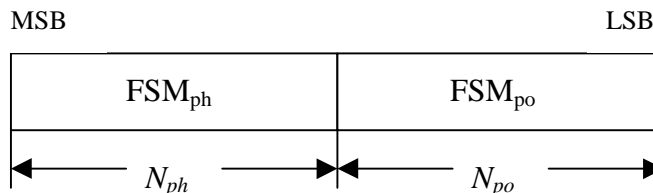


Figure 4: Format of feedback signalling message. FSM_{po} transmits the power setting and FSM_{ph} the phase setting

The adjustments are made by the UTRAN Access Point at the beginning of the downlink DPCCH 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 approximately 1024 ± 148 chips when compared to in offset from the 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 approximately 1024 \pm 148 chips when compared to in offset from the~~ 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 $0 \leq N < 2560$.

7.2 Closed loop mode 1

The 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. In each slot, UE calculates the optimum phase adjustment, ϕ , for antenna 2, which is then quantized into ϕ_Q having two possible values as follows:

$$\phi_Q = \begin{cases} \pi, & \text{if } \pi/2 < \phi - \phi_r(i) \leq 3\pi/2 \\ 0, & \text{otherwise} \end{cases} \quad (21)$$

where:

$$\phi_r(i) = \begin{cases} 0, & i = 0,2,4,6,8,10,12,14 \\ \pi/2, & i = 1,3,5,7,9,11,13 \end{cases} \quad (32)$$

If $\phi_Q = 0$, a command '0' is send to UTRAN using the FSM_{ph} field. Correspondingly, if $\phi_Q = \pi$, command '1' is send to UTRAN using the FSM_{ph} 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, ϕ_i , and received feedback command for each UL-uplink slot.

Table 9: Phase adjustments, ϕ_i corresponding to feedback commands for the slots i of the UL radio frame

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	π	$-\pi/2$	π	$-\pi/2$	π	$-\pi/2$	π	$-\pi/2$	π	$-\pi/2$	π	$-\pi/2$	π	$-\pi/2$

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:

$$w_2 = \frac{\sum_{i=n-1}^n \cos(\phi_i)}{2} + j \frac{\sum_{i=n-1}^n \sin(\phi_i)}{2} \quad (43)$$

where:

$$\phi_i \in \{0, \pi, \pi/2, -\pi/2\} \quad (54)$$

For antenna 1, ~~the weight vector~~, w_1 , is ~~constant always~~:

$$w_1 = 1/\sqrt{2} \quad (65)$$

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-a** 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-current** frame, i.e. ϕ_i from slot 14 is not used:

$$w_2 = \frac{\cos(\phi_{13}^{j-1}) + \cos(\phi_0^j)}{2} + j \frac{\sin(\phi_{13}^{j-1}) + \sin(\phi_0^j)}{2} \quad (76)$$

where:

- ϕ_{13}^{j-1} = phase adjustment from frame j-1, slot 13.
- ϕ_0^j = phase adjustment from frame j, slot 0.

7.2.2 Mode 1 normal initialisation

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

Before the first FB command is received, the UTRAN shall use the initial weight $w_2 = \frac{1}{2}(1 + j)$.

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

$$w_2 = \frac{\cos(\pi / 2) + \cos(\phi_0)}{2} + j \frac{\sin(\pi / 2) + \sin(\phi_0)}{2} \quad (87)$$

where:

ϕ_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.

In **compressed** downlink transmission **gaps** there are uplink slots for which no new estimate of the phase adjustment is calculated. During these slots the following rules are applied in UE when determining the feedback command:

- 1) If no new estimate of phase adjustment, ϕ_i , exists corresponding to the feedback command to be sent 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 ϕ_i must be sent in the uplink slot which is transmitted approximately 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 slot~~transmission gaps 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 ϕ_i must be sent in the uplink slot which is transmitted approximately 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 transmission gap starts~~ 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 the start of the uplink entered the compressed mode transmission gap, is applied to antenna 2 signal.

After the 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 sent before the start of the uplink entered compressed mode transmission gap.
- 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 .

7.2.4 Mode 1 initialisation during compressed mode

When closed loop mode 1 is initialised during the downlink transmission gap of compressed mode there are slots for which no estimate of the phase adjustment is calculated and no previous feedback command is available.

In this case, if the UE is required to send feedback in the uplink, the FB command to the UTRAN shall be '0'.

When transmission in downlink is started again in slot $N_{\text{last}+1}$ (if $N_{\text{last}+1} = 15$, then slot 0 in the next frame), the UTRAN shall use the initial weight $w_2 = \frac{1}{2}(1 + j)$. The UE must start calculating estimates of the phase adjustment.

The feedback command corresponding to the first estimate of ϕ_i must be ~~sent~~ in the uplink slot which is transmitted approximately 1024 chips in offset from the downlink slot $N_{\text{last}+1}$. Having received this feedback command the UTRAN calculates w_2 as follows:

$$w_2 = \frac{\cos(\phi_i) + \cos(\phi_j)}{2} + j \frac{\sin(\phi_i) + \sin(\phi_j)}{2} \quad (98)$$

where:

ϕ_i = phase adjustment in uplink slot i , which is transmitted approximately 1024 chips in offset from the downlink slot $N_{last}+1$.

$$\phi_j = \frac{\pi}{2}, \text{ if slot } i \text{ is even } (i \in \{0, 2, 4, 6, 8, 10, 12, 14\}) \text{ and}$$

$$\phi_j = 0, \text{ if slot } i \text{ is odd } (i \in \{1, 3, 5, 7, 9, 11, 13\})$$

7.3 Closed loop mode 2

In closed loop mode 2 there are 16 possible combinations of phase and power 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_{po} subfield of closed loop mode 2 signalling message

FSM _{po}	Power_ant1	Power_ant2
0	0.2	0.8
1	0.8	0.2

Table 11: FSM_{ph} subfield of closed loop mode 2 signalling message

FSM _{ph}	Phase difference between antennas (radians)
000	π
001	$-3\pi/4$
011	$-\pi/2$
010	$-\pi/4$
110	0
111	$\pi/4$
101	$\pi/2$
100	$3\pi/4$

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 5, 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 in 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 DPCCH 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 $P(\{x_3, x_2, x_1, x_0\})$, where $\{x_3, x_2, x_1, x_0\}$ is one of the 16 possible FSMs which defines an applied phase and power 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:

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

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

$b_1(4m+2)=X_1$ from the $\{b_3(4m) b_2(4m+1) X_1 X_0\}$ which maximises $P(\{b_3(4m) b_2(4m+1) x_1 x_0\})$ 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 $P(\{b_3(4m) b_2(4m+1) b_1(4m+2) x_0\})$ over x_0 (2 possible combinations).

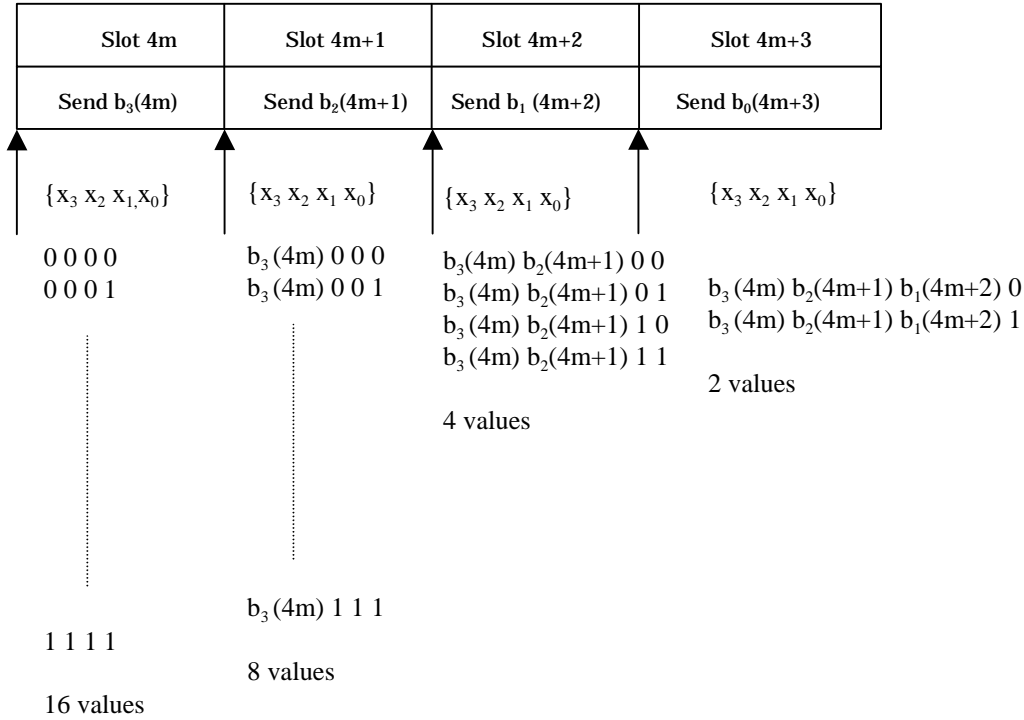


Figure 5: Progressive Refinement at the UE for closed loop mode 2

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 (derived from power) as defined by table 10 and table 11. More precisely, the UTRAN operation can be explained as follows. The UTRAN maintains a register $z=\{z_3 z_2 z_1 z_0\}$, 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 z are used to determine the phase and power adjustments as defined by table 10 and table 11, with $FSM_{ph}=\{z_3 z_2 z_1\}$ and $FSM_{po}=z_0$.

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

The weight vector, w , is then calculated as:

$$w = \begin{bmatrix} \sqrt{power_ant1} \\ \sqrt{power_ant2} \exp(j \text{ phase_diff}) \end{bmatrix} \tag{910}$$

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_{ph} subfield, and the UTRAN takes the power bit FSM_{po} 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 from slot 0 in the normal way. The UE may refine its choice of FSM in slots 1 to 3 from the set of weights allowed given the previously transmitted bits of the FSM.

The UTRAN Access Point operation is as follows. Until the first FSM_{po} bit is received and acted upon (depending on the timing control specified via the higher layer parameter described in section 7.1) the power in both antennas shall be set to 0.5. Until the first FSM_{ph} bit is received and acted upon the phase difference between antennas shall be π radians.

Before the first FSM message is received and during the reception of the first three FSM bits, the UTRAN Access Point shall initialise 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_{ph} bits received as given in table 12.

Table 12: FSM_{ph} normal initialisation for closed loop mode 2

FSM _{ph}	Phase difference between antennas (radians)
- - -	π (normal initialisation) or held from previous setting (compressed mode recovery)
0 - -	π
1 - -	0
0 0 -	π
0 1 -	$-\pi/2$
1 1 -	0
1 0 -	$\pi/2$
0 0 0	π
0 0 1	$-3\pi/4$
0 1 1	$-\pi/2$
0 1 0	$-\pi/4$
1 1 0	0
1 1 1	$\pi/4$
1 0 1	$\pi/2$
1 0 0	$3\pi/4$

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.

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

Recovery from compressed mode is described in the following. Downlink transmissions commence at the pilot field of slot N_{last} as described in [2].

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

If the uplink slot N_{last}+1 (modulo 15) occurs at the beginning of a FSM period (that is at slot 0,4,8, or 12), the UE sends the FSM message in the normal way, with 3 FSM_{ph} bits and with the FSM_{po} bit on slot 3, 7 or 11, and the UTRAN Access Point acts on the FSM_{ph} bits according to 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 slot N_{last}+1 (modulo 15) does not occur 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, that is from slot N_{last}+1 (modulo 15) until the final slot (slot 3, 7, 11 or 14), 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. During the following full FSM period, which starts on slot 0, 4, 8, or 12, the UE sends the FSM message in the normal way, with 3 FSM_{ph} bits and with the FSM_{po} bit on slot 3, 7 or 11, and the UTRAN Access Point acts on the FSM_{ph} bits according to table 12. 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 (radians)
-	held from previous setting
0	π
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 transmission gaps~~ as described in the previous subclause 7.3.3.1.

7.3.4 Mode 2 initialisation during compressed mode

When closed loop mode 2 is initialised during the downlink transmission gap of compressed mode there are slots for which no FSM bit is calculated and no previous sent FSM bit is available.

In this case, if the UE is required to send feedback in the uplink, the FB command to the UTRAN shall be '0'.

The UTRAN and the UE perform the functions of recovery after the downlink transmission gap as described in the previous subclause 7.3.3.1. If no previous phase setting is available, UTRAN shall use the phase offset π , until the first FSM_{ph} bit is received and acted upon.

Annex A (informative):

A.1 Antenna verification

In closed loop mode 1, if channel estimates are taken from the Primary CPICH, the performance will also suffer if the UE can not detect errors since the channel estimates will be taken for the incorrect phase settings. To mitigate this problem, antenna verification can be done, which can make use of antenna specific pilot patterns of the dedicated physical channel. The antenna verification can be implemented with several different algorithms. A straightforward algorithm can use a 4-hypothesis test per slot. Alternatively, a simplified beam former verification (SBV) requiring only a 2-hypothesis test per slot can be used. If we have orthogonal pilot patterns on the downlink DPCCCH we can apply the SBV as follows:

Consider:

$$2 \sum_{i=1}^{N_{path}} \frac{1}{\sigma_i^2} \left\{ \sqrt{2} \operatorname{Re}(\gamma h_{2,i}^{(d)} h_{2,i}^{(p)*}) \right\} > \ln \left(\frac{\bar{p}(\phi_{Rx} = \pi)}{\bar{p}(\phi_{Rx} = 0)} \right)$$

then define the variable x_0 as, $x_0 = 0$ if the above inequality holds good and $x_0 = \pi$ otherwise.

Similarly consider:

$$-2 \sum_{i=1}^{N_{path}} \frac{1}{\sigma_i^2} \left\{ \sqrt{2} \operatorname{Im}(\gamma h_{2,i}^{(d)} h_{2,i}^{(p)*}) \right\} > \ln \left(\frac{\bar{p}(\phi_{Rx} = -\pi/2)}{\bar{p}(\phi_{Rx} = \pi/2)} \right)$$

then define the variable x_1 as, $x_1 = -\pi/2$ if the above inequality holds good and $x_1 = \pi/2$ otherwise.

Whether x_0 or x_1 is to be calculated for each slot is given by the following table:

Slot	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	x_0	x_1	x_0	x_1	x_0	x_1	x_0	x_1	x_0	x_1	x_0	x_1	x_0	x_1	x_0

The estimate for the transmitted phase is now obtained as:

$$\sin(\phi_{Tx}) + j \cos(\phi_{Tx}) = \frac{\sum_{i=0}^1 \sin(x_i)}{\sqrt{2}} + j \frac{\sum_{i=0}^1 \cos(x_i)}{\sqrt{2}}$$

where:

- the x_i values are used corresponding to the current slot and the next slot, except in the case of slot 14 wherein the slot 14 and slot 1 of the next frame values are used;
- $h_{2,i}^{(p)}$ is the i 'th estimated channel tap of antenna 2 using the CPICH;
- $h_{2,i}^{(d)}$ is the i 'th estimated channel tap of antenna 2 using the DPCCCH;
- γ^2 is the DPCH Pilot SNIR/ CPICH SNIR;
- σ_i^2 is the noise plus interference power on the i 'th path.

In normal operation the *a priori* probability for selected pilot pattern is assumed to be 96% (assuming there are 4% of errors in the feedback channel for power control and antenna selection).

A.2 Computation of feedback information for closed loop transmit diversity

In non-soft handover case, the computation of feedback information can be accomplished by e.g. solving for weight vector, w , that maximises.

$$P = w^H H^H H w \quad (1)$$

where

$$H = [h_1 \ h_2] \text{ and } w = [w_1, w_2]^T$$

and where the column vectors h_1 and 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 w correspond to the adjustments computed by the UE.

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

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

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).

CR-Form-v4

CHANGE REQUEST

⌘ **25.214 CR 200** ⌘ rev **1** ⌘ Current version: **3.7.0** ⌘

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Proposed change affects: ⌘ (U)SIM ME/UE Radio Access Network Core Network

Title:	⌘ Correction to Random access procedure (Primitive from MAC)		
Source:	⌘ TSG RAN WG1		
Work item code:	⌘ TEI	Date:	⌘ 16 August 2001
Category:	⌘ F	Release:	⌘ R99
	Use <u>one</u> of the following categories: F (correction) A (corresponds to a correction in an earlier release) B (addition of feature), C (functional modification of feature) D (editorial modification) Detailed explanations of the above categories can be found in 3GPP TR 21.900.		Use <u>one</u> of the following releases: 2 (GSM Phase 2) R96 (Release 1996) R97 (Release 1997) R98 (Release 1998) R99 (Release 1999) REL-4 (Release 4) REL-5 (Release 5)

Reason for change:	⌘ The random access procedure is initiated by the PHY-ACCESS-REQ primitive, not the PHY-DATA-REQ primitive
Summary of change:	⌘ In the first sentence of section 6.1, reference to the Primitive is removed
Consequences if not approved:	⌘ The statement in the specification is incorrect and is not consistent with section 11.2.2 of 25.321 version 3.8.1

Clauses affected:	⌘ 6.1
Other specs affected:	⌘ <input type="checkbox"/> Other core specifications ⌘ <input type="checkbox"/> Test specifications <input type="checkbox"/> O&M Specifications
Other comments:	⌘

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- 1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.
- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under <ftp://ftp.3gpp.org/specs/>. For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

6.1 Physical random access procedure

The physical random access procedure described in this subclause is initiated upon request of a ~~PHY-Data-REQ primitive~~ from the MAC sublayer (cf. [9]).

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 set of available signatures and the set of available RACH sub-channels for each Access Service Class (ASC). Sub-channels are defined in subclause 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 $P_{p-m} = P_{\text{message-control}} - P_{\text{preamble}}$, 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 Derive the available uplink access slots, in the next full access slot set, for the set of available RACH sub-channels within the given ASC with the help of subclauses 6.1.1. and 6.1.2. Randomly select one access slot among the ones previously determined. If there is no access slot available in the selected set, randomly select one uplink access slot corresponding to the set of available RACH sub-channels within the given ASC from the next access slot set. The random function shall be such that each of the allowed selections is chosen with equal probability.
- 2 Randomly select a signature from the set of available signatures within the given ASC. The random function shall be such that each of the allowed selections is chosen with equal probability.
- 3 Set the Preamble Retransmission Counter to Preamble Retrans Max.
- 4 Set the parameter Commanded Preamble Power to Preamble_Initial_Power.
- 5 In the case that the Commanded Preamble Power exceeds the maximum allowed value, set the preamble transmission power to the maximum allowed power. In the case that the Commanded Preamble Power is below the minimum level required in [7], set the preamble transmission power to a value, which shall be at or above the Commanded Preamble Power and at or below the required minimum power specified in [7]. Otherwise set the preamble transmission power to the Commanded Preamble Power. Transmit a preamble using the selected uplink access slot, signature, and preamble transmission power.

- 6 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:
 - 6.1 Select the next available access slot in the set of available RACH sub-channels within the given ASC.
 - 6.2 Randomly select a new signature from the set of available signatures within the given ASC. The random function shall be such that each of the allowed selections is chosen with equal probability.
 - 6.3 Increase the Commanded Preamble Power by $\Delta P_0 = \text{Power Ramp Step [dB]}$. If the Commanded Preamble Power exceeds the maximum allowed power by 6dB, the UE may pass L1 status ("No ack on AICH") to the higher layers (MAC) and exit the physical random access procedure.
 - 6.4 Decrease the Preamble Retransmission Counter by one.
 - 6.5 If the Preamble Retransmission Counter > 0 then repeat from step 5. Otherwise pass L1 status ("No ack on AICH") to the higher layers (MAC) and exit the physical random access procedure.
- 7 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.
- 8 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 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 subclause 5.1.1.2.
- 9 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, ..., 11) consists of the following uplink access slots:

- Uplink access slot #i leading by τ_{p-a} chips the downlink access slot #i contained within the 10 ms interval that is time aligned with P-CCPCH frames for which $SFN \bmod 8 = 0$ or $SFN \bmod 8 = 1$.
- Every 12th 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

6.1.2 RACH access slot sets

The PRACH contains two sets of access slots as shown in Figure 2. Access slot set 1 contains PRACH slots 0 – 7 and starts τ_{p-a} chips before the downlink P-CCPCH frame for which $SFN \bmod 2 = 0$. Access slot set 2 contains PRACH slots 8 - 14 and starts ($\tau_{p-a} - 2560$) chips before the downlink P-CCPCH frame for which $SFN \bmod 2 = 1$.

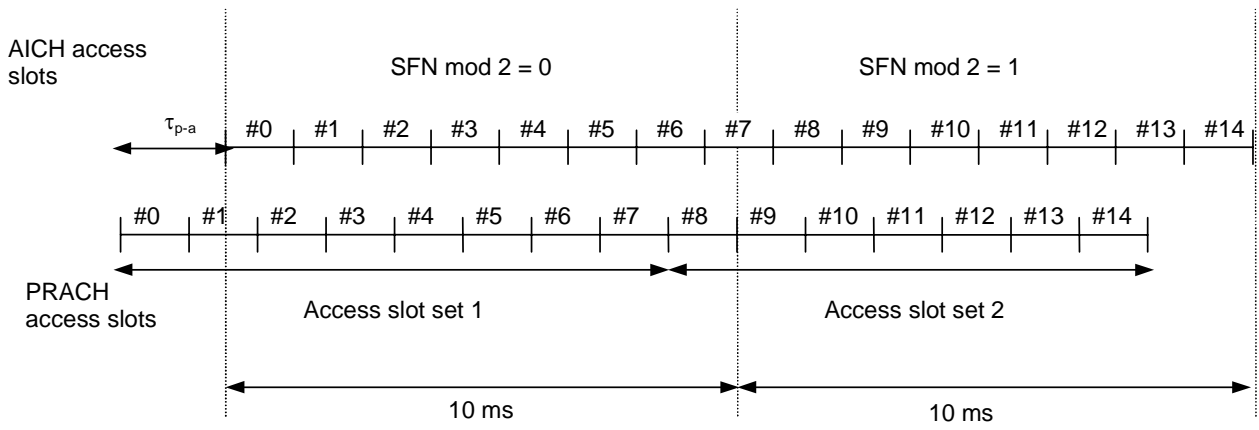


Figure 2: PRACH access slot and downlink AICH relation ($\tau_{p-a} = 7680$ chips)

CHANGE REQUEST

⌘ **25.214 CR 201** ⌘ rev **1** ⌘ Current version: **4.1.0** ⌘

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Proposed change affects: ⌘ (U)SIM ME/UE Radio Access Network Core Network

Title:	⌘ Correction to Random access procedure (Primitive from MAC)		
Source:	⌘ TSG RAN WG1		
Work item code:	⌘ TEI	Date:	⌘ 16 August 2001
Category:	⌘ A	Release:	⌘ REL-4
	Use <u>one</u> of the following categories: F (correction) A (corresponds to a correction in an earlier release) B (addition of feature), C (functional modification of feature) D (editorial modification) Detailed explanations of the above categories can be found in 3GPP TR 21.900.		Use <u>one</u> of the following releases: 2 (GSM Phase 2) R96 (Release 1996) R97 (Release 1997) R98 (Release 1998) R99 (Release 1999) REL-4 (Release 4) REL-5 (Release 5)

Reason for change:	⌘ The random access procedure is initiated by the PHY-ACCESS-REQ primitive, not the PHY-DATA-REQ primitive
Summary of change:	⌘ In the first sentence of section 6.1, reference to the Primitive is removed.
Consequences if not approved:	⌘ The statement in the specification is incorrect and is not consistent with section 11.2.2 of 25.321 version 4.1.0

Clauses affected:	⌘ 6.1
Other specs affected:	⌘ <input type="checkbox"/> Other core specifications ⌘ <input type="checkbox"/> Test specifications <input type="checkbox"/> O&M Specifications
Other comments:	⌘

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

- 1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.
- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under <ftp://ftp.3gpp.org/specs/>. For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

6.1 Physical random access procedure

The physical random access procedure described in this subclause is initiated upon request of a ~~PHY-Data-REQ primitive~~ from the MAC sublayer (cf. [9]).

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 set of available signatures and the set of available RACH sub-channels for each Access Service Class (ASC). Sub-channels are defined in subclause 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 $P_{p-m} = P_{\text{message-control}} - P_{\text{preamble}}$, 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 Derive the available uplink access slots, in the next full access slot set, for the set of available RACH sub-channels within the given ASC with the help of subclauses 6.1.1. and 6.1.2. Randomly select one access slot among the ones previously determined. If there is no access slot available in the selected set, randomly select one uplink access slot corresponding to the set of available RACH sub-channels within the given ASC from the next access slot set. The random function shall be such that each of the allowed selections is chosen with equal probability.
- 2 Randomly select a signature from the set of available signatures within the given ASC. The random function shall be such that each of the allowed selections is chosen with equal probability.
- 3 Set the Preamble Retransmission Counter to Preamble Retrans Max.
- 4 Set the parameter Commanded Preamble Power to Preamble_Initial_Power.
- 5 In the case that the Commanded Preamble Power exceeds the maximum allowed value, set the preamble transmission power to the maximum allowed power. In the case that the Commanded Preamble Power is below the minimum level required in [7], set the preamble transmission power to a value, which shall be at or above the Commanded Preamble Power and at or below the required minimum power specified in [7]. Otherwise set the preamble transmission power to the Commanded Preamble Power. Transmit a preamble using the selected uplink access slot, signature, and preamble transmission power.

- 6 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:
 - 6.1 Select the next available access slot in the set of available RACH sub-channels within the given ASC.
 - 6.2 Randomly select a new signature from the set of available signatures within the given ASC. The random function shall be such that each of the allowed selections is chosen with equal probability.
 - 6.3 Increase the Commanded Preamble Power by $\Delta P_0 = \text{Power Ramp Step [dB]}$. If the Commanded Preamble Power exceeds the maximum allowed power by 6dB, the UE may pass L1 status ("No ack on AICH") to the higher layers (MAC) and exit the physical random access procedure.
 - 6.4 Decrease the Preamble Retransmission Counter by one.
 - 6.5 If the Preamble Retransmission Counter > 0 then repeat from step 5. Otherwise pass L1 status ("No ack on AICH") to the higher layers (MAC) and exit the physical random access procedure.
- 7 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.
- 8 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 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 subclause 5.1.1.2.
- 9 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 leading by τ_{p-a} chips the downlink access slot #i contained within the 10 ms interval that is time aligned with P-CCPCH frames for which $SFN \bmod 8 = 0$ or $SFN \bmod 8 = 1$.
- Every 12th 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

6.1.2 RACH access slot sets

The PRACH contains two sets of access slots as shown in Figure 2. Access slot set 1 contains PRACH slots 0 – 7 and starts τ_{p-a} chips before the downlink P-CCPCH frame for which $SFN \bmod 2 = 0$. Access slot set 2 contains PRACH slots 8 - 14 and starts $(\tau_{p-a} - 2560)$ chips before the downlink P-CCPCH frame for which $SFN \bmod 2 = 1$.

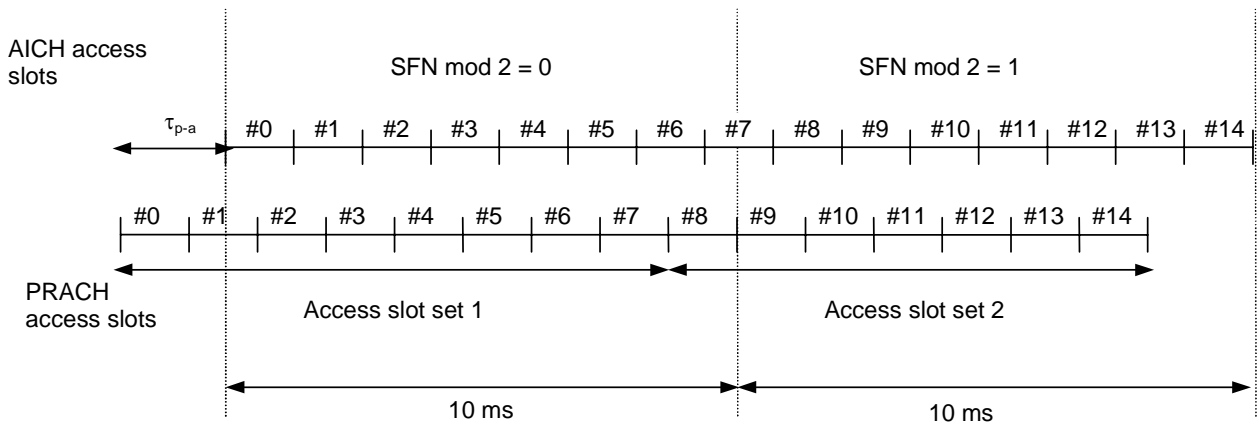


Figure 2: PRACH access slot and downlink AICH relation ($\tau_{p-a} = 7680$ chips)