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Contents

Foreword

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1 Scope

The present document specifies and establishes the characteristics of the physicals layer procedures in the FDD mode of UTRA.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1]   3GPP TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)".

[2]   3GPP TS 25.212: "Multiplexing and channel coding (FDD)".

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

[4]   3GPP TS 25.215: "Physical layer – Measurements (FDD)".

[5]   3GPP TS 25.331: "RRC Protocol Specification".

[6]   3GPP TS 25.433: "UTRAN Iub Interface NBAP Signalling".

[7]   3GPP TS 25.101: "UE Radio transmission and Reception (FDD)".

[8]   3GPP TS 25.133: "Requirements for Support of Radio Resource Management (FDD)".

[9]   3GPP TS 25.321: "MAC protocol specification".

[10]   3GPP TS 25.306: "UE Radio Access Capabilities".

3 Definitions and Abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

L1 combining period: An interval of contiguous TTIs when S-CCPCHs, each on different RLs, may be soft combined.

3.2 Abbreviations

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

ACK	Acknowledgement
AICH	Acquisition Indicator Channel
ASC	Access Service Class
BCH	Broadcast Channel
CCPCH	Common Control Physical Channel

CCTrCH	Coded Composite Transport Channel
CPICH	Common Pilot Channel
CQI	Channel Quality Indicator
CRC	Cyclic Redundancy Check
DCH	Dedicated Channel
DL	Downlink
DPCCH	Dedicated Physical Control Channel
DPCH	Dedicated Physical Channel
DPDCH	Dedicated Physical Data Channel
DTX	Discontinuous Transmission
E-DCH	Enhanced Dedicated Channel
E-DPCCH	E-DCH Dedicated Physical Control Channel
E-DPDCH	E-DCH Dedicated Physical Data Channel
E-AGCH	E-DCH Absolute Grant Channel
E-HICH	E-DCH HARQ Acknowledgement Indicator Channel
E-RGCH	E-DCH Relative Grant Channel
F-DPCH	Fractional Dedicated Physical Channel
HSDPA	High Speed Downlink Packet Access
HS-DSCH	High Speed Downlink Shared Channel
HS-PDSCH	High Speed Physical Downlink Shared Channel
HS-SCCH	High Speed Physical Downlink Shared Control Channel
MICH	MBMS Indicator Channel
NACK	Negative Acknowledgement
P-CCPCH	Primary Common Control Physical Channel
PCA	Power Control Algorithm
PICH	Paging Indicator Channel
PRACH	Physical Random Access Channel
RACH	Random Access Channel
RL	Radio Link
RPL	Recovery Period Length
RSCP	Received Signal Code Power
S-CCPCH	Secondary Common Control Physical Channel
SCH	Synchronisation Channel
SFN	System Frame Number
SIR	Signal-to-Interference Ratio
SNIR	Signal to Noise Interference Ratio
TFC	Transport Format Combination
TPC	Transmit Power Control
TrCH	Transport Channel
TTI	Transmission Time Interval
UE	User Equipment
UL	Uplink
UTRAN	UMTS Terrestrial Radio Access Network

4 Synchronisation procedures

4.1 Cell search

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

4.2 Common physical channel synchronisation

The radio frame timing of all common physical channels can be determined after cell search.

4.2.1   P-CCPCH radio frame timing

The P-CCPCH radio frame timing is found during cell search and the radio frame timing of all common physical channel are related to that timing as described in [1].

4.2.2   S-CCPCH soft combining timing

Higher layers will provide timing information when S-CCPCHs, each on different RLs,can be soft combined. The timing information allows the UE to determine the L1 combining period that applies to each S-CCPCH. The information also identifies the S-CCPCHs and the RLs that can be soft combined. The set of S-CCPCHs that can be combined does not change during an L1 combining period. When S-CCPCHs can be soft combined, all S-CCPCHs shall contain identical bits in their data fields, although the TFCI fields of the S-CCPCHs may be different. (TFC detection when S-CCPCHs may be soft combined is discussed in [2].) The maximum delay between S-CCPCHs that the UE may combine is set by UE performance requirements. The maximum number of S-CCPCHs that UE may simultaneously combine is defined by the UE capability in [10].

4.3   DPCCH/DPDCH/F-DPCH synchronisation

4.3.1   Synchronisation primitives

4.3.1.1   General

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

4.3.1.2   Downlink synchronisation primitives

Layer 1 in the UE shall every radio frame check synchronisation status of either the DPCH or the F-DPCH depending on which is configured. Synchronisation status is indicated to higher layers using the CPHY-Sync-IND and CPHY-Out-of-Sync-IND primitives.

The criteria for reporting synchronisation status are defined in two different phases.

The first phase starts when higher layers initiate physical dedicated channel establishment (as described in [5]) or whenever the UE initiates synchronisation procedure A (as described in section 4.3.2.1) and lasts until 160 ms after the downlink dedicated channel is considered established by higher layers (physical channel establishment is defined in [5]). During this time out-of-sync shall not be reported and in-sync shall be reported using the CPHY-Sync-IND primitive if the following criterion is fulfilled:

-    The UE estimates the DPCCH quality or the quality of the TPC fields of the F-DPCH frame received from the serving HS-DSCH cell over the previous 40 ms period to be better than a threshold Q_{in}. This criterion shall be assumed not to be fulfilled before 40 ms of DPCCH quality measurements have been collected. Q_{in} is defined implicitly by the relevant tests in [7].

The second phase starts 160 ms after the downlink dedicated channel is considered established by higher layers. During this phase both out-of-sync and in-sync are reported as follows.

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

-    The UE estimates the DPCCH quality or the quality of the TPC fields of the F-DPCH frame received from the serving HS-DSCH cell over the previous 160 ms period to be worse than a threshold Q_{out}. Q_{out} is defined implicitly by the relevant tests in [7].

-    The 20 most recently received transport blocks with a non-zero length CRC attached, as observed on all TrCHs using non-zero length CRC mapped to the DPDCH, have been received with incorrect CRC. In addition, over the previous 160 ms, all transport blocks with a non-zero length CRC attached have been received with incorrect CRC. In case no TFCI is used this criterion shall not be considered for the TrCH(s) not using guided detection if they do not use a non-zero length CRC in all transport formats. If no transport blocks with a non-zero length CRC attached are received over the previous 160 ms this criterion shall not be assumed to be fulfilled.

For a DPCH, in-sync shall be reported using the CPHY-Sync-IND primitive if both of the following criteria are fulfilled:

- The UE estimates the DPCCH quality over the previous 160 ms period to be better than a threshold Q_{in}. Q_{in} is defined implicitly by the relevant tests in [7].

- At least one transport block with a non-zero length CRC attached, as observed on all TrCHs using non-zero length CRC mapped to the DPDCH, is received in a TTI ending in the current frame with correct CRC. If no transport blocks are received, or no transport block has a non-zero length CRC attached in a TTI ending in the current frame and in addition over the previous 160 ms at least one transport block with a non-zero length CRC attached has been received with a correct CRC, this criterion shall be assumed to be fulfilled. If no transport blocks with a non-zero length CRC attached are received over the previous 160 ms this criterion shall also be assumed to be fulfilled. In case no TFCI is used this criterion shall not be considered for the TrCH(s) not using guided detection if they do not use a non-zero length CRC in all transport formats.

For a F-DPCH, in-sync shall be reported using the CPHY-Sync-IND primitive if the UE estimates the quality of the TPC fields of the F-DPCH frame received from the serving HS-DSCH cell over the previous 160 ms period to be better than a threshold Q_{in}. Q_{in} is defined implicitly by the relevant tests in [7].

How the primitives are used by higher layers is described in [5]. The above definitions may lead to radio frames where neither the in-sync nor the out-of-sync primitives are reported.

4.3.1.3 Uplink synchronisation primitives

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

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

4.3.2 Radio link establishment and physical layer reconfiguration for dedicated channels

4.3.2.1 General

Two synchronisation procedures are defined in order to obtain physical layer synchronisation of dedicated channels between UE and UTRAN:

- Synchronisation procedure A : This procedure shall be used when at least one downlink dedicated physical channel (i.e. a DPCH or F-DPCH) and one uplink dedicated physical channel are to be set up on a frequency and none of the radio links after the establishment/reconfiguration existed prior to the establishment/reconfiguration which also includes the following cases :

  - the UE was previously on another RAT i.e. inter-RAT handover

  - the UE was previously on another frequency i.e. inter-frequency hard handover

  - the UE has all its previous radio links removed and replaced by other radio links i.e. intra-frequency hard-handover

  - after it fails to complete an inter-RAT, intra- or inter-frequency hard-handover [8], the UE attempts to re-establish [5] all the dedicated physical channels which were already established immediately before the hard-handover attempt. In this case only steps c) and d) of synchronisation procedure A are applicable.

- Synchronisation procedure B : This procedure shall be used when one or several radio links are added to the active set and at least one of the radio links prior to the establishment/reconfiguration still exists after the establishment/reconfiguration.

- If higher layers indicate that the UE shall not perform any synchronisation procedure for timing maintained intra- and inter-frequency hard handover, the UE shall not perform any of the synchronisation procedures A or B. If higher layers indicate to the Node B timing maintained intra- or inter-frequency hard handover where the

UE does not perform any of the synchronisation procedures A or B, the Node B shall perform steps a) and b) of synchronisation procedure B.

For all physical layer reconfigurations not listed above, the UE and UTRAN shall not perform any of the synchronisation procedures listed above.

The two synchronisation procedures are described in subclauses 4.3.2.3 and 4.3.2.4 respectively.

4.3.2.2 Node B radio link set state machine

In Node B, each radio link set can be in three different states: initial state, out-of-sync state and in-sync state. Transitions between the different states is shown in figure 1 below. The state of the Node B at the start of radio link establishment is described in the following subclauses. Transitions between initial state and in-sync state are described in subclauses 4.3.2.3 and 4.3.2.4 and transitions between the in-sync and out-of-sync states are described in subclause 4.3.3.2.
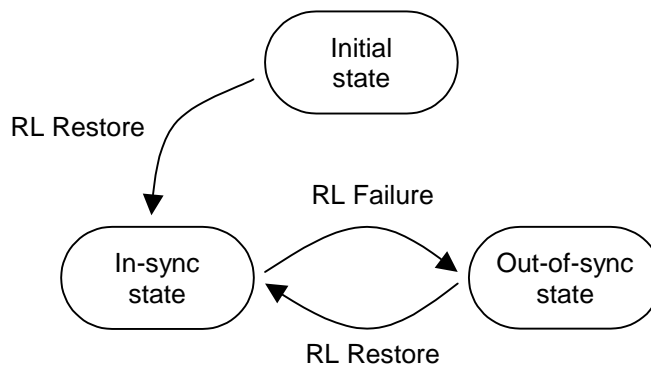
Figure 1: Node B radio link set states and transitions

4.3.2.3 Synchronisation procedure A

The synchronisation establishment procedure, which begins at the time indicated by higher layers (either immediately at receipt of upper layer signalling, or at an indicated activation time), is as follows:

a) Each Node B involved in the procedure sets all the radio link sets which are to be set-up for this UE in the initial state.

b) UTRAN shall start the transmission of the downlink DPCCH or F-DPCH and may start the transmission of DPDCH if any data is to be transmitted. The initial downlink DPCCH or F-DPCH transmit power is set by higher layers [6]. Downlink TPC commands are generated as described in 5.1.2.2.1.2.

c) The UE establishes downlink chip and frame synchronisation of DPCCH or F-DPCH, using the P-CCPCH timing and timing offset information notified from UTRAN. For DPCH, frame synchronisation can be confirmed using the frame synchronisation word. Downlink synchronisation status is reported to higher layers every radio frame according to subclause 4.3.1.2.

d) If higher layers indicate the usage of a post-verification period the UE shall start transmission on uplink immediately when the physical dedicated channel establishment is initiated by the UE.

If higher layers do not indicate the usage of a post-verification period, or if higher layers do indicate the usage of a post-verification period (as specified in 5.1.2.2.1.1) and the post-verification has failed, the UE shall not transmit on uplink until higher layers consider the downlink physical channel established;

- If no activation time for uplink DPCCH has been signalled to the UE or if the UE attempts to re-establish the DPCH after an inter-RAT, intra- or inter-frequency hard-handover failure [5], uplink DPCCH transmission shall start when higher layers consider the downlink physical channel established;

- If an activation time has been given, uplink DPCCH transmission shall not start before the downlink physical channel has been established and the activation time has been reached. Physical channel establishment and activation time are defined in [5].

The initial uplink DPCCH transmit power is set by higher layers [5]. In case the UE attempts to re-establish the DPCH after an inter-RAT, intra- or inter-frequency hard-handover failure [5] the initial uplink DPCCH power shall be the same as the one used immediately preceding the inter-RAT, intra- or inter-frequency hard-handover attempt. In case of physical layer reconfiguration the uplink DPCCH power is kept unchanged between before and after the reconfiguration except for inner loop power control adjustments.

A power control preamble shall be applied as indicated by higher layers. The transmission of the uplink DPCCH power control preamble shall start N_{pcp} radio frames prior to the radio frame where the uplink DPDCH/E-DPCCH/E-DPDCH transmission starts, where N_{pcp} is a higher layer parameter set by UTRAN [5]; in case the UE attempts to re-establish the DPCH after an inter-RAT, intra- or inter-frequency hard-handover failure [5] the UE shall use the value of N_{pcp} as specified in [5] for this case. Note that the transmission start delay between DPCCH and DPDCH/E-DPCCH/E-DPDCH may be cancelled using a power control preamble of 0 length. If higher layers indicate the usage of a post-verification period, and the start of the uplink DPCCH power control preamble with a length of N_{pcp} radio frames would be in a radio frame later than the first uplink radio frame after physical dedicated channel establishment is initiated by the UE, then the duration of the uplink DPCCH power control preamble shall be extended beyond N_{pcp} radio frames such that the uplink DPCCH power control preamble is transmitted from the first uplink radio frame after physical dedicated channel establishment is initiated by the UE.

The starting time for transmission of DPDCHs/E-DPCCH/E-DPDCHs shall also satisfy the constraints on adding transport channels to a CCTrCH, as defined in [2] sub-clause 4.2.14, independently of whether there are any bits mapped to the DPDCHs/E-DPCCH/E-DPDCHs. During the uplink DPCCH power control preamble, independently of the selected TFC, no transmission is done on the DPDCH/E-DPCCH/E-DPDCH.

e) UTRAN establishes uplink chip and frame synchronisation. Frame synchronisation can be confirmed using the frame synchronisation word. Radio link sets remain in the initial state until N_INSYNC_IND successive in-sync indications are received from layer 1, when Node B shall trigger the RL Restore procedure indicating which radio link set has obtained synchronisation. When RL Restore has been triggered the radio link set shall be considered to be in the in-sync state. The parameter value of N_INSYNC_IND is configurable, see [6]. The RL Restore procedure may be triggered several times, indicating when synchronisation is obtained for different radio link sets.

Note: The total signalling response delay for the establishment of a new DPCH shall not exceed the requirements given in [5] sub-clause 13.5.

4.3.2.4 Synchronisation procedure B

The synchronisation procedure B, which begins at the time indicated by higher layers (either immediately at receipt of upper layer signalling, or at an indicated activation time) is as follows:

a) The following applies to each Node B involved in the procedure:

- New radio link sets are set up to be in initial state.

- If one or several radio links are added to an existing radio link set, this radio link set shall be considered to be in the state the radio link set was prior to the addition of the radio link, i.e. if the radio link set was in the in-sync state before the addition of the radio link it shall remain in that state.

b) UTRAN starts the transmission of the downlink DPCCH/DPDCH or F-DPCH for each new radio link at a frame timing such that the frame timing received at the UE will be within $T_0 \pm 148$ chips prior to the frame timing of the uplink DPCCH/DPDCH at the UE. Simultaneously, UTRAN establishes uplink chip and frame synchronisation of each new radio link. Frame synchronisation can be confirmed using the frame synchronisation word. Radio link sets considered to be in the initial state shall remain in the initial state until N_INSYNC_IND successive in-sync indications are received from layer 1, when Node B shall trigger the RL Restore procedure indicating which radio link set has obtained synchronisation. When RL Restore is triggered the radio link set shall be considered to be in the in-sync state. The parameter value of N_INSYNC_IND is configurable, see [6]. The RL Restore procedure may be triggered several times, indicating when synchronisation is obtained for different radio link sets.

c) The UE establishes chip and frame synchronisation of each new radio link. Layer 1 in the UE keeps reporting downlink synchronisation status to higher layers every radio frame according to the second phase of sub-clause 4.3.1.2. For DPCH, frame synchronisation can be confirmed using the frame synchronisation word.

4.3.3 Radio link monitoring

4.3.3.1 Downlink radio link failure

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

4.3.3.2 Uplink radio link failure/restore

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

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

When the radio link set is in the in-sync state, Node B shall start timer T_RLFAILURE after receiving N_OUTSYNC_IND consecutive out-of-sync indications. Node B shall stop and reset timer T_RLFAILURE upon receiving successive N_INSYNC_IND in-sync indications. If T_RLFAILURE expires, Node B shall trigger the RL Failure procedure and indicate which radio link set is out-of-sync. When the RL Failure procedure is triggered, the state of the radio link set change to the out-of-sync state.

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

The specific parameter settings (values of T_RLFAILURE, N_OUTSYNC_IND, and N_INSYNC_IND) are configurable, see [6].

4.3.4 Transmission timing adjustments

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

When the UE autonomously adjusts its DPDCH/DPCCH transmission time instant, it shall simultaneously adjust the HS-DPCCH, E-DPCCH and E-DPDCH transmission time instant by the same amount so that the relative timing between DPCCH/DPDCH and HS-DPCCH is kept constant and that DPCCH/DPDCH and E-DPCCH/E-DPDCH remain time aligned.

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

The maximum rate of uplink TX time adjustment, and the valid range for the time between downlink DPCCH/DPDCH or F-DPCH reception and uplink DPCCH/DPDCH transmission in the UE are defined by the requirements specified in [8].

5 Power control

5.1 Uplink power control

5.1.1 PRACH

5.1.1.1 General

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

5.1.1.2 Setting of PRACH control and data part power difference

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

- β_c is the gain factor for the control part (similar to DPCCH);

- β_d is the gain factor for the data part (similar to DPDCH);

- no inner loop power control is performed.

5.1.2 DPCCH/DPDCH

5.1.2.1 General

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

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

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

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

Uplink power control shall be performed while the UE transmit power is below the maximum allowed output power.

The provisions for power control at the maximum allowed value and below the required minimum output power (as defined in [7]) are described in sub-clause 5.1.2.6.

5.1.2.2 Ordinary transmit power control

5.1.2.2.1 General

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

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

Upon reception of one or more TPC commands in a slot, the UE shall derive a single TPC command, TPC_cmd, for each slot, combining multiple TPC commands if more than one is received in a slot. Two algorithms shall be supported by the UE for deriving a TPC_cmd. Which of these two algorithms is used is determined by a UE-specific higher-layer parameter, "PowerControlAlgorithm", and is under the control of the UTRAN. If "PowerControlAlgorithm" indicates "algorithm1", then the layer 1 parameter PCA shall take the value 1 and if "PowerControlAlgorithm" indicates "algorithm2" then PCA shall take the value 2.

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

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

The step size Δ_{TPC} is a layer 1 parameter which is derived from the UE-specific higher-layer parameter "TPC-StepSize" which is under the control of the UTRAN. If "TPC-StepSize" has the value "dB1", then the layer 1 parameter Δ_{TPC} shall take the value 1 dB and if "TPC-StepSize" has the value "dB2", then Δ_{TPC} shall take the value 2 dB. The parameter "TPC-StepSize" only applies to Algorithm 1 as stated in [5]. For Algorithm 2 Δ_{TPC} shall always take the value 1 dB.

After deriving of the combined TPC command TPC_cmd using one of the two supported algorithms, the UE shall adjust the transmit power of the uplink DPCCH with a step of Δ_{DPCCH} (in dB) which is given by:

$$\Delta_{DPCCH} = \Delta_{TPC} \times TPC\_cmd.$$

5.1.2.2.1.1 Out of synchronisation handling

After 160 ms after physical channel establishment (defined in [5]), the UE shall control its transmitter according to a downlink DPCCH or F-DPCH quality criterion as follows:

- The UE shall shut its transmitter off when the UE estimates the DPCCH or F-DPCH quality over the last 160 ms period to be worse than a threshold Q_{out}. Q_{out} is defined implicitly by the relevant tests in [7].

- The UE can turn its transmitter on again when the UE estimates the DPCCH or F-DPCH quality over the last 160 ms period to be better than a threshold Q_{in}. Q_{in} is defined implicitly by the relevant tests in [7]. When transmission is resumed, the power of the DPCCH shall be the same as when the UE transmitter was shut off.

If higher layers indicate the usage of a post-verification period, the UE shall control its transmitter according to a downlink DPCCH or F-DPCH quality criterion as follows:

- When the UE estimates the DPCCH or F-DPCH quality over the first 40 ms period of the first phase of the downlink synchronisation status evaluation to be worse than a threshold Q_{in}, the UE shall shut its transmitter off and consider post-verification failed. Q_{in} is defined implicitly by the relevant tests in [7]. When the UE transmission is resumed, the transmission of the uplink DPCCH power control preamble shall start N_{pcp} radio frames prior to the start of uplink DPDCH transmission, where N_{pcp} is a higher layer parameter set by UTRAN [5].

In case F-DPCH is configured in the downlink, the F-DPCH quality criterion shall be estimated as explained in subclause 4.3.1.2.

5.1.2.2.1.2 TPC command generation on downlink during RL initialisation

When commanded by higher layers the TPC commands sent on a downlink radio link from Node Bs that have not yet achieved uplink synchronisation shall follow a pattern as follows:

If higher layers indicate by "First RLS indicator" that the radio link is part of the first radio link set sent to the UE and the value 'n' obtained from the parameter "DL TPC pattern 01 count" passed by higher layers is different from 0 then :

- the TPC pattern shall consist of n instances of the pair of TPC commands ("0" ,"1"), followed by one instance of TPC command "1", where ("0","1") indicates the TPC commands to be transmitted in 2 consecutive slots,

- the TPC pattern continuously repeat but shall be forcibly re-started at the beginning of each frame where CFN mod 4 = 0.

else

- The TPC pattern shall consist only of TPC commands "1".

The TPC pattern shall terminate once uplink synchronisation is achieved.

5.1.2.2.2 Algorithm 1 for processing TPC commands

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

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

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

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

5.1.2.2.2.2 Combining of TPC commands from radio links of the same radio link set

When a UE is in soft handover, multiple TPC commands may be received in each slot from different cells in the active set. In some cases, the UE has the knowledge that some of the transmitted TPC commands in a slot are the same. This is the case when the radio links are in the same radio link set. For these cases, the TPC commands from the same radio link set shall be combined into one TPC command, to be further combined with other TPC commands as described in subclause 5.1.2.2.2.3.

5.1.2.2.2.3 Combining of TPC commands from radio links of different radio link sets

This subclause describes the general scheme for combination of the TPC commands from radio links of different radio link sets.

First, the UE shall conduct a soft symbol decision W_i on each of the power control commands TPC_i, where i = 1, 2, …, N, where N is greater than 1 and is the number of TPC commands from radio links of different radio link sets, that may be the result of a first phase of combination according to subclause 5.1.2.2.2.2.

Finally, the UE derives a combined TPC command, TPC_cmd, as a function γ of all the N soft symbol decisions W_i:

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

The function γ shall fulfil the following criteria:

If the N TPC_i commands are random and uncorrelated, with equal probability of being transmitted as "0" or "1", the probability that the output of γ is equal to 1 shall be greater than or equal to $1/(2^N)$, and the probability that the output of γ is equal to -1 shall be greater than or equal to 0.5. Further, the output of γ shall equal 1 if the TPC commands from all the radio link sets are reliably "1", and the output of γ shall equal –1 if a TPC command from any of the radio link sets is reliably "0".

5.1.2.2.3 Algorithm 2 for processing TPC commands

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

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

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

The value of TPC_cmd shall be derived as follows:

- For the first 4 slots of a set, TPC_cmd = 0.

- For the fifth slot of a set, the UE uses hard decisions on each of the 5 received TPC commands as follows:

    - If all 5 hard decisions within a set are 1 then TPC_cmd = 1 in the 5th slot.

    - If all 5 hard decisions within a set are 0 then TPC_cmd = -1 in the 5th slot.

    - Otherwise, TPC_cmd = 0 in the 5th slot.

5.1.2.2.3.2 Combining of TPC commands from radio links of the same radio link set

When a UE is in soft handover, multiple TPC commands may be received in each slot from different cells in the active set. In some cases, the UE has the knowledge that some of the transmitted TPC commands in a slot are the same. This is the case when the radio links are in the same radio link set. For these cases, the TPC commands from radio links of the same radio link set shall be combined into one TPC command, to be processed and further combined with any other TPC commands as described in subclause 5.1.2.2.3.3.

5.1.2.2.3.3 Combining of TPC commands from radio links of different radio link sets

This subclause describes the general scheme for combination of the TPC commands from radio links of different radio link sets.

The UE shall make a hard decision on the value of each TPC_i, where i = 1, 2, …, N and N is the number of TPC commands from radio links of different radio link sets, that may be the result of a first phase of combination according to subclause 5.1.2.2.3.2.

The UE shall follow this procedure for 5 consecutive slots, resulting in N hard decisions for each of the 5 slots.

The sets of 5 slots shall be aligned to the frame boundaries and there shall be no overlap between each set of 5 slots.

The value of TPC_cmd is zero for the first 4 slots. After 5 slots have elapsed, the UE shall determine the value of TPC_cmd for the fifth slot in the following way:

The UE first determines one temporary TPC command, TPC_temp_i, for each of the N sets of 5 TPC commands as follows:

- If all 5 hard decisions within a set are "1", $TPC\_temp_i = 1$.

- If all 5 hard decisions within a set are "0", $TPC\_temp_i = -1$.

- Otherwise, $TPC\_temp_i = 0$.

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

TPC_cmd(5th slot) = γ (TPC_temp_1, TPC_temp_2, …, TPC_temp_N), where TPC_cmd(5th slot) can take the values 1, 0 or –1, and γ is given by the following definition:

- TPC_cmd is set to -1 if any of TPC_temp_1 to TPC_temp_N are equal to -1.

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

- Otherwise, TPC_cmd is set to 0.

5.1.2.3 Transmit power control in compressed mode

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

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

SIR_{cm_target} is the target SIR during compressed mode and fulfils

$$SIR_{cm\_target} = SIR_{target} + \Delta SIR_{PILOT} + \Delta SIR1\_coding + \Delta SIR2\_coding,$$

where $\Delta SIR1\_coding$ and $\Delta SIR2\_coding$ are computed from uplink parameters DeltaSIR1, DeltaSIR2, DeltaSIRafter1, DeltaSIRafter2 signalled by higher layers as:

- $\Delta SIR1\_coding$ = DeltaSIR1 if the start of the first transmission gap in the transmission gap pattern is within the current uplink frame.

- $\Delta SIR1\_coding$ = DeltaSIRafter1 if the current uplink frame just follows a frame containing the start of the first transmission gap in the transmission gap pattern.

- $\Delta SIR2\_coding$ = DeltaSIR2 if the start of the second transmission gap in the transmission gap pattern is within the current uplink frame.

- $\Delta SIR2\_coding$ = DeltaSIRafter2 if the current uplink frame just follows a frame containing the start of the second transmission gap in the transmission gap pattern.

- $\Delta SIR1\_coding$ = 0 dB and $\Delta SIR2\_coding$ = 0 dB in all other cases.

ΔSIR_{PILOT} is defined as: $\Delta SIR_{PILOT} = 10Log_{10} (N_{pilot,N}/N_{pilot,curr\_frame})$,

where $N_{pilot,curr\_frame}$ is the number of pilot bits per slot in the current uplink frame, and $N_{pilot,N}$ is the number of pilot bits per slot in a normal uplink frame without a transmission gap.

In the case of several compressed mode pattern sequences being used simultaneously, $\Delta SIR1\_coding$ and $\Delta SIR2\_coding$ offsets are computed for each compressed mode pattern and all $\Delta SIR1\_coding$ and $\Delta SIR2\_coding$ offsets are summed together.

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

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

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

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

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

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

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

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

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

The value of Δ_{RESUME} (in dB) shall be determined by the UE according to the Initial Transmit Power mode (ITP). The ITP is a UE specific parameter, which is signalled by the network with the other compressed mode parameters (see [4]). The different modes are summarised in table 1.

Table 1: Initial Transmit Power modes during compressed mode

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

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

δ_{last} shall be equal to the most recently computed value of δ_i. δ_i shall be updated according to the following recursive relations, which shall be executed in all slots in which both the uplink DPCCH and a downlink TPC command are transmitted, and in the first slot of an uplink transmission gap if a downlink TPC command is transmitted in that slot:

$$\delta_i = 0.9375\delta_{i-1} - 0.96875TPC\_cmd_i\Delta_{TPC}k_{sc}$$
$$\delta_{i-1} = \delta_i$$

where: TPC_cmd_i is the power control command derived by the UE in that slot;

$k_{sc} = 0$ if additional scaling is applied in the current slot and the previous slot as described in sub-clause 5.1.2.6, and $k_{sc} = 1$ otherwise.

δ_{i-1} is the value of δ_i computed for the previous slot. The value of δ_{i-1} shall be initialised to zero when the uplink DPCCH is activated, and also at the end of the first slot after each uplink transmission gap, and also at the end of the first slot after each downlink transmission gap. The value of δ_i shall be set to zero at the end of the first slot after each uplink transmission gap.

After a transmission gap in either the uplink or the downlink, the period following resumption of simultaneous uplink and downlink DPCCH or F-DPCH transmission is called a recovery period. RPL is the recovery period length and is expressed as a number of slots. RPL is equal to the minimum value out of the transmission gap length and 7 slots. If a transmission gap is scheduled to start before RPL slots have elapsed, then the recovery period shall end at the start of the gap, and the value of RPL shall be reduced accordingly.

During the recovery period, 2 modes are possible for the power control algorithm. The Recovery Period Power control mode (RPP) is signalled with the other compressed mode parameters (see [4]). The different modes are summarised in the table 2:

Table 2: Recovery Period Power control modes during compressed mode

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

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

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

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

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

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

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

5.1.2.4 Transmit power control in the uplink DPCCH power control preamble

An uplink DPCCH power control preamble is a period of uplink DPCCH transmission prior to the start of the uplink DPDCH transmission. The downlink DPCCH or F-DPCH shall also be transmitted during an uplink DPCCH power control preamble.

The length of the uplink DPCCH power control preamble is a higher layer parameter signalled by the network as defined in [5]. The uplink DPDCH transmission shall commence after the end of the uplink DPCCH power control preamble.

During the uplink DPCCH power control preamble the change in uplink DPCCH transmit power shall be given by:

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

During the uplink DPCCH power control preamble TPC_cmd is derived according to algorithm 1 as described in sub clause 5.1.2.2.1, regardless of the value of PCA.

Ordinary power control (see subclause 5.1.2.2), with the power control algorithm determined by the value of PCA and step size Δ_{TPC}, shall be used after the end of the uplink DPCCH power control preamble.

5.1.2.5 Setting of the uplink DPCCH/DPDCH relative powers

5.1.2.5.1 General

The uplink DPCCH and DPDCH(s) are transmitted on different codes as defined in subclause 4.2.1 of [3]. In the case that at least one DPDCH is configured, the gain factors β_c and β_d may vary for each TFC. There are two ways of controlling the gain factors of the DPCCH code and the DPDCH codes for different TFCs in normal (non-compressed) frames:

  – β_c and β_d are signalled for the TFC, or

  – β_c and β_d is computed for the TFC, based on the signalled settings for a reference TFC.

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

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

After applying the gain factors, the UE shall scale the total transmit power of the DPCCH and DPDCH(s), such that the DPCCH output power follows the changes required by the power control procedure with power adjustments of Δ_{DPCCH} dB, subject to the provisions of sub-clause 5.1.2.6.

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

5.1.2.5.2 Signalled gain factors

When the gain factors β_c and β_d are signalled by higher layers for a certain TFC, the signalled values are used directly for weighting of DPCCH and DPDCH(s). The variable A_j, called the nominal power relation is then computed as:

$$A_j = \frac{\beta_d}{\beta_c} \, .$$

5.1.2.5.3 Computed gain factors

The gain factors β_c and β_d may also be computed for certain TFCs, based on the signalled settings for a reference TFC.

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

Define the variable

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

where RM_i is the semi-static rate matching attribute for transport channel i (defined in [2] subclause 4.2.7), N_i is the number of bits output from the radio frame segmentation block for transport channel i (defined in [2] subclause 4.2.6.1), and the sum is taken over all the transport channels i in the reference TFC.

Similarly, define the variable

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

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

The variable A_j, called the nominal power relation is then computed as:

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

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

- If $A_j > 1$, then $\beta_{d,j} = 1.0$ and $\beta_{c,j}$ is the largest quantized β -value, for which the condition $\beta_{c,j} \le 1 / A_j$ holds. Since $\beta_{c,j}$ may not be set to zero, if the above rounding results in a zero value, $\beta_{c,j}$ shall be set to the lowest quantized amplitude ratio of 1/15 as specified in [3].

- If $A_j \le 1$, then $\beta_{d,j}$ is the smallest quantized β -value, for which the condition $\beta_{d,j} \ge A_j$ holds and $\beta_{c,j} = 1.0$.

The quantized β-values are defined in [3] subclause 4.2.1, table 1.

5.1.2.5.4 Setting of the uplink DPCCH/DPDCH relative powers in compressed mode

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

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

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

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

If $A_{C,j} > 1$, then $\beta_{d,C,j} = 1.0$ and $\beta_{c,C,j}$ is the largest quantized β-value, for which the condition $\beta_{c,C,j} \leq 1 / A_{C,j}$ holds. Since $\beta_{c,C,j}$ may not be set to zero, if the above rounding results in a zero value, $\beta_{c,C,j}$ shall be set to the lowest quantized amplitude ratio of 1/15 as specified in [3].

If $A_{C,j} \leq 1$, then $\beta_{d,C,j}$ is the smallest quantized β-value, for which the condition $\beta_{d,C,j} \geq A_{C,j}$ holds and $\beta_{c,C,j} = 1.0$.

The quantized β-values are defined in [3] subclause 4.2.1, table 1.

5.1.2.5A   Setting of the uplink HS-DPCCH power relative to DPCCH power

When an HS-DPCCH is active, the values for Δ_{ACK}, Δ_{NACK} and Δ_{CQI} set by higher layers are translated to the quantized amplitude ratios A_{hs} as specified in [3] subclause 4.2.1.2, and shall be set for each HS-DPCCH slot as follows.

For HS-DPCCH slots carrying HARQ Acknowledgement :

A_{hs} equals the quantized amplitude ratio translated from the signalled value Δ_{ACK} if the corresponding HARQ-ACK message is ACK;

A_{hs} equals the quantized amplitude ratio translated from the signalled value Δ_{NACK} if the corresponding HARQ-ACK message is NACK;

A_{hs} equals the quantized amplitude ratio translated from the greatest of the signalled values Δ_{ACK} and Δ_{NACK} if the corresponding HARQ-ACK message is PRE or POST.

For HS-DPCCH slots carrying CQI:

A_{hs} equals the quantized amplitude ratio translated from the signalled value Δ_{CQI}.

Then, in non-compressed frames β_{hs}, which is the gain factor defined in [3] subclause 4.2.1.2, is calculated according to

$$\beta_{hs} = \beta_c \cdot A_{hs},$$

where β_c value is signalled by higher-layer or calculated as described in subclause 5.1.2.5.2 or 5.1.2.5.3 if at least one DPDCH is configured. In case no DPDCH is configured, β_c value is set as described in subclause 5.1.2.5C.

With the exception of the start and end of compressed frames, any DPCCH power change shall not modify the power ratio between the DPCCH and the HS-DPCCH. The power ratio between the DPCCH and the HS-DPCCH during compressed DPCCH frames is described below.

During the period between the start and end of a compressed DPCCH frame, when HS-DPCCH is transmitted, β_{hs} is calculated according to

$$\beta_{hs} = \beta_{c,C,j} \cdot A_{hs} \cdot \sqrt{\frac{N_{pilot,C}}{N_{pilot,N}}},$$

where $\beta_{c,C,j}$ is calculated as described in subclause 5.1.2.5.4 if at least one DPDCH is configured. In case no DPDCH is configured, $\beta_{c,C,j}$ value is set as described in subclause 5.1.2.5C. $N_{pilot,C}$ is the number of pilot bits per slot on the DPCCH in compressed frames, and $N_{pilot,N}$ is the number of pilot bits per slot in non-compressed frames.

Thus the gain factor β_{hs} varies depending on the current quantized amplitude ratio A_{hs} and on whether the UL DPCCH is currently in a compressed frame.

5.1.2.5B   Setting of the uplink E-DPCCH and E-DPDCH powers relative to DPCCH power

5.1.2.5B.1   E-DPCCH/DPCCH

In non compressed frames, the E-DPCCH gain factor, β_{ec}, which is defined in [3] subclause 4.2.1.3, is calculated according to

$$\beta_{ec} = \beta_c \cdot A_{ec}$$

where β_c value is signalled by higher-layer or calculated as described in subclause 5.1.2.5.2 or 5.1.2.5.3 if at least one DPDCH is configured. In case no DPDCH is configured, β_c value is set as described in subclause 5.1.2.5C. A_{ec} is defined in [3] subcaluse 4.2.1.3.

During compressed frames where the E-DCH TTI is 2msec, the E-DPCCH gain factor, β_{ec}, which is defined in [3] subclause 4.2.1.3, is calculated according to:

$$\beta_{ec} = \beta_{c,C,j} \cdot A_{ec} \cdot \sqrt{\frac{N_{pilot,C}}{N_{pilot,N}}}$$

where $\beta_{c,C,j}$ is calculated as described in subclause 5.1.2.5.4 if at least one DPDCH is configured. In case no DPDCH is configured, the $\beta_{c,C,j}$ value is set as described in subclause 5.1.2.5C. $N_{pilot,C}$ is the number of pilot bits per slot on the DPCCH in compressed frames, and $N_{pilot,N}$ is the number of pilot bits per slot in non-compressed frames. $N_{slots,C}$ is the number of non DTX slots in the compressed frame

During compressed frames and where the E-DCH TTI is 10msec, the E-DPCCH gain factor, β_{ec}, which is defined in [3] subclause 4.2.1.3, is calculated according to:

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

where, $N_{slots,C}$ is the number of non DTX slots in the compressed frame.

5.1.2.5B.2   E-DPDCH/DPCCH

5.1.2.5B.2.1   General

The E-DPDCH gain factor, β_{ed}, which is defined in [3] subclause 4.2.1.3, may take a different value for each E-TFC and HARQ offset. The gain factors for different E-TFCs and HARQ offsets are computed as described in subclause 5.1.2.5B.2.3 based on reference gain factor(s) $\beta_{ed,ref}$ of E-TFC(s) signalled as reference E-TFC(s). The $\beta_{ed,ref}$ are computed as described in subclause 5.1.2.5B.2.2. At least one E-TFC of the set of E-TFCs configured by the network shall be signalled as a reference E-TFC.

The gain factors may vary on radio frame basis or sub-frame basis depending on the E-DCH TTI used. Further, the setting of gain factors is independent of the inner loop power control.

5.1.2.5B.2.2   Computation of reference gain factors

For each reference E-TFC, a reference gain factor $\beta_{ed,ref}$ is calculated according to

$$\beta_{ed,ref} = \beta_c \cdot A_{ed}$$

where β_c value is signalled by higher-layer or calculated as described in subclause 5.1.2.5.2 or 5.1.2.5.3 if at least one DPDCH is configured. In case no DPDCH is configured, β_c value is set as described in subclause 5.1.2.5C. A_{ed} is defined in [3] subclause 4.2.1.3.

5.1.2.5B.2.3 Computation of gain factors

The gain factor β_{ed} of an E-TFC is computed based on the signalled settings for its corresponding reference E-TFC.

Let $E\text{-}TFCI_{ref,m}$ denote the E-TFCI of the m:th reference E-TFC, where $m=1,2,\ldots,M$ and M is the number of signalled reference E-TFCs and $E\text{-}TFCI_{ref,1} < E\text{-}TFCI_{ref,2} < \ldots < E\text{-}TFCI_{ref,M}$. Let $E\text{-}TFCI_j$ denote the E-TFCI of the j:th E-TFC. For the j:th E-TFC:

if $E\text{-}TFCI_j \geq E\text{-}TFCI_{ref,M}$, the reference E-TFC is the M:th reference E-TFC.

if $E\text{-}TFCI_j < E\text{-}TFCI_{ref,1}$, the reference E-TFC is the 1st reference E-TFC.

if $E\text{-}TFCI_{ref,1} \leq E\text{-}TFCI_j < E\text{-}TFCI_{ref,M}$, the reference E-TFC is the m:th reference E-TFC such that $E\text{-}TFCI_{ref,m} \leq E\text{-}TFCI_j < E\text{-}TFCI_{ref,m+1}$.

$\beta_{ed,ref}$ denotes the reference gain factor of the reference E-TFC. Let $L_{e,ref}$ denote the number of E-DPDCHs used for the reference E-TFC and $L_{e,j}$ denote the number of E-DPDCHs used for the j:th E-TFC. If SF2 is used, $L_{e,ref}$ and $L_{e,j}$ are the equivalent number of physical channels assuming SF4. Let $K_{e,ref}$ denote the transport block size of the reference E-TFC and $K_{e,j}$ denote the transport block size of the j:th E-TFC, where the mapping between the E-TFC index and the E-DCH transport block size is defined in [9].

For the j:th E-TFC, the temporary variable $\beta_{ed,j,harq}$ is then computed as:

$$\beta_{ed,j,harq} = \beta_{ed,ref} \sqrt{\frac{L_{e,ref}}{L_{e,j}}} \sqrt{\frac{K_{e,j}}{K_{e,ref}}} \cdot 10^{\left(\frac{\Delta_{harq}}{20}\right)}$$

where the HARQ offset Δ_{harq} is defined in [3] subclause 4.2.1.3.

For the j:th E-TFC, the unquantized gain factor $\beta_{ed,k,j,uq}$ for the k:th E-DPDCH (denoted E-DPDCH$_k$ in [3] subclause 4.2.1.3) shall be set to $\sqrt{2} \times \beta_{ed,j,harq}$ if the spreading factor for E-DPDCH$_k$ is 2 and to $\beta_{ed,j,harq}$ otherwise.

If $\beta_{ed,k,j,uq}/\beta_c$ is less than the smallest quantized value of Table 1B.2 in [3] subclause 4.2.1.3, then the gain factor of E-DPDCH$_k$, $\beta_{ed,k}$ is set such that $\beta_{ed,k}/\beta_c$ is the smallest quantized value of Table 1B.2 in [3] subclause 4.2.1.3. Otherwise, $\beta_{ed,k}$ is set such that $\beta_{ed,k}/\beta_c$ is the largest quantized value of Table 1B.2 in [3] subclause 4.2.1.3, for which the condition $\beta_{ed,k} \leq \beta_{ed,k,j,uq}$ holds.

5.1.2.5B.2.4 E-DPDCH/DPCCH adjustments relating to compressed mode

The gain factor applied to E-DPDCH is adjusted as a result of compressed mode operation in the following cases:

• E-DCH transmissions that overlap a compressed frame

• For 10msec E-DCH TTI case, retransmissions that do not themselves overlap a compressed frame, but for which the corresponding initial transmission overlapped a compressed frame.

The gain factors used during a compressed frame for a certain E-TFC are calculated from the nominal power relation used in normal (non-compressed) frames for that E-TFC. Let $\beta_{ed,C,j}$ denote the gain factor used for the j:th E-TFC when the frame is compressed.

When the E-DCH TTI is 2msec, $\beta_{ed,C,j}$ is computed as:

$$\beta_{ed,C,j} = \beta_{c,C,j} \cdot A_{ed} \cdot \sqrt{\frac{L_{e,ref}}{L_{e,j}}} \cdot \sqrt{\frac{K_{e,j}}{K_{e,ref}}} \cdot 10^{\left(\frac{\Delta_{harq}}{20}\right)} \cdot \sqrt{\frac{N_{pilot,C}}{N_{pilot,N}}} \,,$$

where $\beta_{c,C,j}$ is calculated as described in subclause 5.1.2.5.4 if at least one DPDCH is configured. In case no DPDCH is configured, the $\beta_{c,C,j}$ value is set as described in subclause 5.1.2.5C. A_{ed} is as defined in [3] subcaluse 4.2.1.3, $L_{e,ref}$, $L_{e,j}$, $K_{e,ref}$ and $K_{e,j}$ are as defined in subclause 5.1.2.5B.2.3, Δ_{harq} is as defined in [3] subclause 4.2.1.3, $N_{pilot,C}$ is the number of pilot bits per slot on the DPCCH in compressed frames, and $N_{pilot,N}$ is the number of pilot bits per slot in non-compressed frames.

When the E-DCH TTI is 10msec and the current frame is compressed, $\beta_{ed,C,j}$ shall be calculated and applied as follows:

$$\beta_{ed,C,j} = \beta_{c,C,j} \cdot A_{ed} \cdot \sqrt{\frac{L_{e,ref}}{L_{e,j}}} \cdot \sqrt{\frac{K_{e,j}}{K_{e,ref}}} \cdot 10^{\left(\frac{\Delta_{harq}}{20}\right)} \cdot \sqrt{\frac{15 \cdot N_{pilot,C}}{N_{slots,I} \cdot N_{pilot,N}}} \;,$$

where $N_{slots,I}$ is the number of non DTX slots in the first frame used for transmitting the data.

When the E-DCH TTI is 10msec and the current frame is not compressed, but is a retransmission for which the corresponding first transmission was compressed, $\beta_{ed,R,,j}$ represents the gain factor that shall be applied to the jth TFC and shall be calculated as follows:

$$\beta_{ed,R,j} = \beta_{ed,j} \cdot \sqrt{\frac{15}{N_{slots,I}}}$$

where $\beta_{ed,j}$ is the gain factor used for the jth TFC in non compressed frames.

5.1.2.5C   Setting of the uplink DPCCH gain factor when no DPDCH is configured

In the case that no DPDCH is configured, the gain factor β_c is equal to 1. During a compressed frame, the gain factor $\beta_{c,C,j}$ is also equal to 1.

5.1.2.6   Maximum and minimum power limits

When E-DCH is not configured, in the case that the total UE transmit power (after applying DPCCH power adjustments and gain factors) would exceed the maximum allowed value, the UE shall apply additional scaling to the total transmit power so that it is equal to the maximum allowed power. This additional scaling shall be such that the power ratio between DPCCH and DPDCH and also DPCCH and HS-DPCCH remains as required by sub-clause 5.1.2.5 and 5.1.2.5A.

When E-DCH is configured, if the total UE transmit power (after applying DPCCH power adjustments and gain factors) would exceed the maximum allowed value, the UE shall firstly reduce all the E-DPDCH gain factors $\beta_{ed,k}$ by an equal scaling factor to respective values $\beta_{ed,k,reduced}$ so that the total transmit power would be equal to the maximum allowed power. After calculating the reduced E-DPDCH gain factors, quantization according to table 1B.2 in [3] subclause 4.2.1.3 may be applied, where each $\beta_{ed,k,reduced}$ is quantized such that $\beta_{ed,k}/\beta_c$ is the largest quantised value for which the condition $\beta_{ed,k} \leq \beta_{ed,k,reduced}$ holds.

In case a DPDCH is configured, if any $\beta_{ed,k,reduced}/\beta_c$ is less than the smallest quantized value of Table 1B.2 in [3] subclause 4.2.1.3, DTX may be used on that E-DPDCH (E-DPCCH is, however still transmitted using β_{ec}).

In case no DPDCH is configured, if any $\beta_{ed,k,reduced}/\beta_c$ is less than $(8/15)/\beta_c$, that $\beta_{ed,k}$ shall be set to $\beta_{ed,k,min}$ such that $\beta_{ed,k,min}/\beta_c = \min((8/15)/\beta_c, \beta_{ed,k,original}/\beta_c)$, where $\beta_{ed,k,original}$ denotes the E-DPDCH gain factor before reduction.

In the following cases, the UE shall then apply additional scaling to the total transmit power so that it is equal to the maximum allowed power:

-    if a DPDCH is configured and the total UE transmit power would still exceed the maximum allowed value even though DTX is used on all E-DPDCHs;

- if no DPDCH is configured and the total UE transmit power would still exceed the maximum allowed value even though $\beta_{ed,k}$ is equal to $\beta_{ed,k,min}$ for all k.

Any additional scaling of the total transmit power as described above shall be such that the power ratio between DPCCH and DPDCH, between DPCCH and HS-DPCCH, and between DPCCH and E-DPCCH, remains as required by sub-clauses 5.1.2.5, 5.1.2.5A and 5.1.2.5B.1, and such that the power ratio between each E-DPDCH and DPCCH remains as required by $\beta_{ed,k,min}/\beta_c$ if DTX is not used on E-DPDCH. Any slot-level scaling of β_{ed} or DTX of E-DPDCH as described above is applied at layer 1 only and is transparent to higher layers.

Any scaling, and any reduction in the E-DPDCH gain factor as described above, shall only be applied or changed at a DPCCH slot boundary. In order that the total UE transmit power does not exceed the maximum allowed value the scaling or E-DPDCH gain factor reduction shall be computed using the maximum HS-DPCCH power transmitted in the next DPCCH slot. In the case that either an ACK or a NACK transmission will start during the next DPCCH slot, the maximum HS-DPCCH power shall be computed using one of the following:

(a) whichever of Δ_{ACK} and Δ_{NACK} will be used according to whether the transmission will be ACK or NACK, *or*

(b) whichever of Δ_{ACK} and Δ_{NACK} is the largest.

When transmitting on a DPCH the UE is not required to be capable of reducing its total transmit power below the minimum level required in [7]. However, it may do so, provided that the power ratio between DPCCH and DPDCH and also between DPCCH and HS-DPCCH remains as specified in sub clause 5.1.2.5 and 5.1.2.5A. Some further regulations also apply as follows: In the case that the total UE transmit power (after applying DPCCH power adjustments and gain factors) would be at or below the total transmit power in the previously transmitted slot and also at or below the required minimum power specified in [7], the UE may apply additional scaling to the total transmit power, subject to the following restrictions:

- The total transmit power after applying any additional scaling shall not exceed the required minimum power, nor the total transmit power in the previously transmitted slot;

- The magnitude of any reduction in total transmit power between slots after applying any additional scaling shall not exceed the magnitude of the calculated power reduction before the additional scaling.

In the case that the total UE transmit power in the previously transmitted slot is at or below the required minimum power specfied in [7] and the DPCCH power adjustment and gain factors for the current slot would result in an increase in total power, then no additional scaling shall be used (i.e. power control shall operate as normal).

If the UE applies any additional scaling to the total transmit power as described above, this scaling shall be included in the computation of any DPCCH power adjustments to be applied in the next transmitted slot.

5.1.3   Void

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/F-DPCH

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. In case of F-DPCH, the power control loop adjusts the F-DPCH power.

For DPCH, 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 offsets PO1, PO2 and PO3 do not apply to F-DPCH.

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 in 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.

5.2.1.2.1.1 F-DPCH quality target control

The UTRAN sets a quality target for the F-DPCH. The UE autonomously sets a SIR target value and adjusts it in order to achieve the same quality as the quality target set by UTRAN. The quality target is set as a downlink TPC command error rate target value for the F-DPCH belonging to the radio link from the HS-DSCH serving cell as signalled by the UTRAN. The UE shall set the SIR target when the F-DPCH has been setup or reconfigured. It shall not increase the SIR target value before the power control has converged on the current value. The UE may estimate whether the power control has converged on the current value, by comparing the averaged measured SIR to the SIR target value.

5.2.1.2.2 UTRAN behaviour

Upon receiving the TPC commands UTRAN shall adjust its downlink DPCCH/DPDCH or F-DPCH 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

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

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].

In case of F-DPCH, the power of the transmitted symbol over one timeslot for a given UE shall not exceed Maximum_DL_Power (dB), nor shall it be below Minimum_DL_Power (dB). Transmitted symbol means here a complex QPSK symbol before spreading which does not contain DTX.

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 for a DPCH is offset by higher layer signalling. However due to transmission gaps in uplink compressed frames there may be incomplete sets of TPC commands when DPC_MODE=1.

UTRAN behaviour is as stated in section 5.2.1.2.2 except for DPC_MODE = 1 where missing TPC commands in the UL may lead the UTRAN to changing its power more frequently than every 3 slots.

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

The power of the DPCCH and DPDCH in the first slot after the transmission gap, or the power of the F-DPCH in the first slot after the transmission gap, should be set to the same value as in the slot just before the transmission gap.

During 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.

For DPC_MODE = 0 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}.

For DPC_MODE = 1, the sets of slots over which the TPC commands are processed shall remain aligned to the frame boundaries in the compressed frame. If this results in an incomplete set of TPC commands, the UE shall transmit the same TPC commands in all slots of the incomplete set.

The power control step size $\Delta_{STEP} = \Delta_{RP\text{-}TPC}$ 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.

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

For F-DPCH, $P_{SIR}(k) = 0$.

For DPCH, 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:

$$\delta P = \max (\Delta P1\_compression, \ldots, \Delta Pn\_compression) + \Delta P1\_coding + \Delta P2\_coding$$

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 = $ DeltaSIR1 if the start of the first transmission gap in the transmission gap pattern is within the current frame.

- $\Delta P1_coding = $ 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 = $ DeltaSIR2 if the start of the second transmission gap in the transmission gap pattern is within the current frame.

- $\Delta P2_coding = $ 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 $\Delta Pi\_compression$ is defined by :

- $\Delta Pi\_compression = 3$ dB for downlink frames compressed by reducing the spreading factor by 2.

- $\Delta Pi\_compression = 0$ 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 δP_{curr}, 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].

For F-DPCH, for all time slots except those in transmissions gaps the power of the transmitted symbol over one timeslot for a given UE shall not exceed Maximum_DL_Power (dB), nor shall it be below Minimum_DL_Power (dB). Transmitted symbol means here a complex QPSK symbol before spreading which does not contain DTX.

5.2.1.4   Void

5.2.2   Void

5.2.3   Void

5.2.4   AICH

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

5.2.5   PICH

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

5.2.6   S-CCPCH

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

5.2.7   Void

5.2.8   Void

5.2.9   Void

5.2.10   HS-SCCH

The HS-SCCH power control is under the control of the node B. It may e.g. follow the power control commands sent by the UE to the node B or any other power control procedure applied by the node B.

5.2.11   HS-PDSCH

The HS-PDSCH power control is under the control of the node B. When the HS-PDSCH is transmitted using 16-QAM, the UE may assume that the power is kept constant during the corresponding HS-DSCH subframe.

In case of multiple HS-PDSCH transmission to one UE, all the HS-PDSCHs intended for that UE shall be transmitted with equal power.

The sum of the powers used by all HS-PDSCHs, HS-SCCHs, E-AGCHs, E-RGCHs and E-HICHs in a cell shall not exceed the value of *HS-PDSCH, HS-SCCH, E-AGCH, E-RGCH and E-HICH Total Power* if signaled by higher layers [6].

5.2.12   E-AGCH

The E-AGCH power control is under the control of the node B. It may e.g. follow the power control commands sent by the UE to the node B or any other power control procedure applied by the node B.

5.2.13   E-HICH

The E-HICH power control is under the control of the node B. It may e.g. follow the power control commands sent by the UE to the node B or any other power control procedure applied by the node B.

5.2.14   E-RGCH

The E-RGCH power control is under the control of the node B. It may e.g. follow the power control commands sent by the UE to the node B or any other power control procedure applied by the node B.

5.2.15   MICH

The UE is informed about the relative transmit power of the MICH (measured as the power over the notification indicators) compared to the primary CPICH transmit power by the higher layers.

6   Random access procedure

6.1   Physical random access procedure

The physical random access procedure described in this subclause is initiated upon request 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 $P_{p-m} = P_{message-control} - P_{preamble}$, 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   If the Preamble_Initial_Power is below the minimum level required in [7], set the Commanded Preamble Power to a value, which shall be at or above the Preamble_Initial_Power and at or below the required minimum power specified in [7]. Otherwise 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 ΔP_0 = 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 mod 8 = 0 or SFN mod 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 $\tau_{p\text{-}a}$ chips before the downlink P-CCPCH frame for which SFN mod 2 = 0. Access slot set 2 contains PRACH slots 8 - 14 and starts $(\tau_{p\text{-}a} - 2560)$ chips before the downlink P-CCPCH frame for which SFN mod 2 = 1.
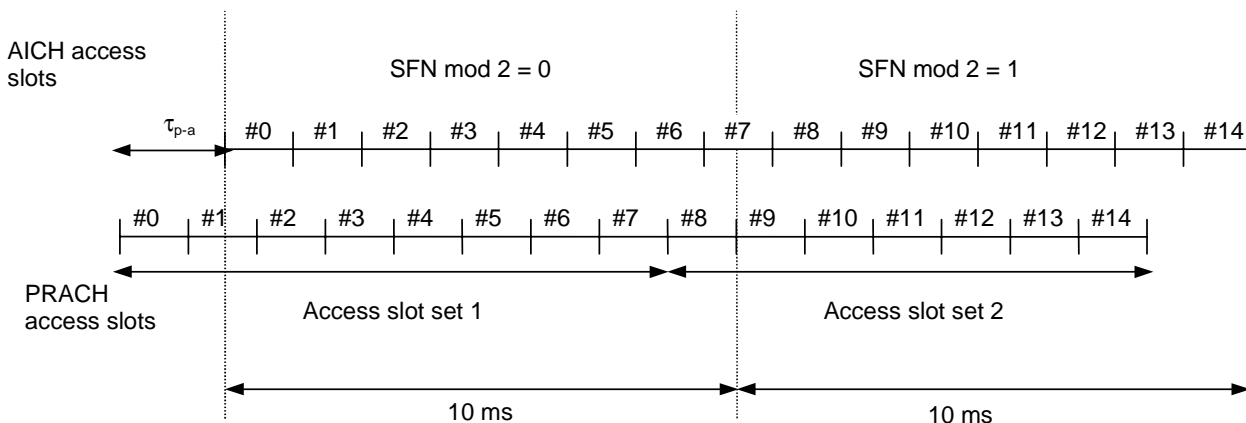
Figure 2: PRACH access slot and downlink AICH relation ($\tau_{p\text{-}a}$ = 7680 chips)

6.2   Void

6A   HS-DSCH-related procedures

6A .1   General procedure

Scheduling and transport format selection is controlled by the MAC-hs sublayer in the Node B [9].

The following physical layer parameters are signalled to the UE and the Node B from higher layers:

1) HS-SCCH set to be monitored

2) Repetition factor of ACK/NACK: N_acknack_transmit

3) Channel Quality Indicator (CQI) feedback cycle *k*.

4) Repetition factor of CQI: N_cqi_transmit

5) Measurement power offset Γ

6) Status of preamble/postamble transmission: HARQ_preamble_mode

6A .1.1   UE procedure for receiving HS-DSCH

In this sub-clause, sub-frame n on the HS-SCCHs refers to the sub-frame which is associated with sub-frame n on the HS-PDSCH as defined in [1], and sub-frame n on the HS-DPCCH refers to the sub-frame which is related to sub-frame n on the HS-PDSCH as defined in [1].

If the UE did not detect consistent control information intended for this UE on any of the HS-SCCHs in the HS-SCCH set in the immediately preceding subframe $n – 1$, the UE shall in sub-frame n monitor all HS-SCCHs in the HS-SCCH set. The maximum size of the HS-SCCH set is 4.

If the UE did detect consistent control information intended for this UE in the immediately preceding subframe $n – 1$, it is sufficient in sub-frame n to only monitor the same HS-SCCH used in the immediately preceding subframe $n – 1$.

When the UE monitors HS-SCCHs, the UE shall only consider the control information to be consistent

> if decoded 'channelization-code-set information' is lower than or equal to 'maximum number of HS-DSCH codes received' in its UE capability and

> if the decoded modulation scheme is valid in terms of its UE capability.

If a UE detects that one of the monitored HS-SCCHs in sub-frame n carries consistent control information intended for this UE, the UE shall start receiving the HS-PDSCHs indicated by this control information, and, if HARQ_preamble_mode = 1 and the information received on HS-SCCH is not discarded, the UE shall:

> transmit a HARQ Preamble (PRE) in the slot allocated to HARQ-ACK in HS-DPCCH sub-frame $n – 1$, unless an ACK or NACK is to be transmitted in sub-frame $n – 1$ as a result of an HS-DSCH transmission earlier than sub-frame n on the HS-PDSCH, and

> if N_acknack_transmit > 1, the UE shall transmit a HARQ Preamble in the slot allocated to HARQ-ACK in HS-DPCCH sub-frame $n – 2$, unless an ACK or NACK is to be transmitted in sub-frame $n – 2$ as a result of an HS-DSCH transmission earlier than sub-frame n on the HS-PDSCH.

The transport block size information shall be derived from the signaled TFRI value as defined in [9]. If the 'Hybrid-ARQ process information' is not included in the set configured by upper layers, the UE shall discard the information received on this HS-SCCH and on the HS-PDSCHs. Further, if the HS-SCCH CRC fails, the UE shall discard the information received on this HS-SCCH and on the HS-PDSCHs.

The UE shall transmit the ACK/NACK information received from MAC-hs in the slot allocated to the HARQ-ACK in the corresponding HS-DPCCH sub-frame as defined in [1]. When *N_ acknack_transmit* is greater than one, the UE shall:

> repeat the transmission of the ACK/NACK information over the next (*N_ acknack_transmit-1*) consecutive HS-DPCCH sub-frames, in the slots allocated to the HARQ-ACK as defined in [1] and

> not attempt to receive nor decode transport blocks from the HS-PDSCH in HS-DSCH sub-frames corresponding to HS-DPCCH sub-frames in which the ACK/NACK information transmission is repeated.

If ACK or NACK is transmitted in HS-DPCCH sub-frame n, and HARQ_preamble_mode = 1 and UE InterTTI $\leq N\_acknack\_transmit$, then the UE shall:

> transmit a HARQ Postamble (POST) in the slot allocated to HARQ-ACK in HS-DPCCH subframe $n + 2*N\_acknack\_transmt – 1$, unless ACK, NACK, or PRE is to be transmitted in this subframe, and

> if *N_acknack_transmit* > 1, transmit a HARQ Postamble (POST) in the slot allocated to HARQ-ACK in HS-DPCCH subframe $n + 2*N\_acknack\_transmit – 2$, unless an ACK, NACK or PRE is to be transmitted in this subframe.

If consistent control information is not detected on any of the HS-SCCHs in the HS-SCCH set, or if the information received on HS-SCCH is discarded, DTX shall be used on the HS-DPCCH in the corresponding HS-DPCCH subframe unless PRE or POST are transmitted as described above.

6A .1.2   UE procedure for reporting channel quality indication (CQI)

With the exception of the provisions of subclause 6A.3, the following shall apply:

1) The UE derives the CQI value as defined in 6A .2.

2) For k = 0, the UE shall not transmit the CQI value.
   For k > 0, the UE shall transmit the CQI value in each subframe that starts $m \times 256$ chips after the start of the associated uplink DPCCH frame with m fulfilling

$$\left(5 \times CFN + \lceil m \times 256chip / 7680chip \rceil\right) \bmod k' = 0 \text{ with } k' = k/(2ms),$$

   where CFN denotes the connection frame number for the associated DPCH and the set of five possible values of m is calculated as described in subclause 7.7 in [1].

3) The UE shall repeat the transmission of the CQI value derived in 1) over the next *(N_cqi_transmit – 1)* consecutive HS-DPCCH sub frames in the slots respectively allocated to the CQI as defined in [1]. UE does not support the case of $k' < N\_cqi\_transmit$.

4) The UE shall not transmit the CQI in other subframes than those described in 2) and 3).

6A .2   Channel quality indicator (CQI) definition

Based on an unrestricted observation interval, the UE shall report the highest tabulated CQI value for which a single HS-DSCH sub-frame formatted with the transport block size, number of HS-PDSCH codes and modulation corresponding to the reported or lower CQI value could be received in a 3-slot reference period ending 1 slot before the start of the first slot in which the reported CQI value is transmitted and for which the transport block error probability would not exceed 0.1. Depending on the UE category as defined in [10], either Table 7A, 7B, 7C, 7D, or 7E should be used.

For the purpose of CQI reporting, the UE shall assume a total received HS-PDSCH power of
$$P_{HSPDSCH} = P_{CPICH} + \Gamma + \Delta \text{ in dB,}$$

where the total received power is evenly distributed among the HS-PDSCH codes of the reported CQI value, the measurement power offset Γ is signaled by higher layers and the reference power adjustment Δ is given by Table 7A, 7B, 7C, 7D, or 7E depending on the UE category.

Further, UE shall assume the number of soft channel bits available in the virtual IR buffer (N_{IR}), and redundancy and constellation version parameter (X_{RV}) as given by Table 7A, 7B, 7C, 7D, or 7E depending on the UE category.

If higher layer signaling informs the UE that for the radio link from the serving HS-DSCH cell it may use a S-CPICH as a phase reference and the P-CPICH is not a valid phase reference, P_{CPICH} is the received power of the S-CPICH used by the UE, otherwise P_{CPICH} is the received power of the P-CPICH. If closed loop transmit diversity is used for the radio link from the serving HS-DSCH cell, P_{CPICH} denotes the power of the combined received CPICH from both transmit antennas, determined as if error-free transmitter weights had been applied to the CPICH, where those weights are determined as described in sub-clause 7.2. If STTD is used, P_{CPICH} denotes the combined CPICH power received from each transmit antenna and if no transmit diversity is used P_{CPICH} denotes the power received from the non diversity antenna.

For the purpose of CQI reporting the UE shall assume that all HS-PDSCH channelisation codes it may receive are under the same scrambling code as the Common Pilot Channel used to determine P_{CPICH}.

Table 7A: CQI mapping table for UE categories 1 to 6.

CQI value	Transport Block Size	Number of HS-PDSCH	Modulation	Reference power adjustment Δ	N_{IR}	X_{RV}
0	N/A	Out of range				
1	137	1	QPSK	0	9600	0
2	173	1	QPSK	0		
3	233	1	QPSK	0		
4	317	1	QPSK	0		
5	377	1	QPSK	0		
6	461	1	QPSK	0		
7	650	2	QPSK	0		
8	792	2	QPSK	0		
9	931	2	QPSK	0		
10	1262	3	QPSK	0		
11	1483	3	QPSK	0		
12	1742	3	QPSK	0		
13	2279	4	QPSK	0		
14	2583	4	QPSK	0		
15	3319	5	QPSK	0		
16	3565	5	16-QAM	0		
17	4189	5	16-QAM	0		
18	4664	5	16-QAM	0		
19	5287	5	16-QAM	0		
20	5887	5	16-QAM	0		
21	6554	5	16-QAM	0		
22	7168	5	16-QAM	0		
23	7168	5	16-QAM	-1		
24	7168	5	16-QAM	-2		
25	7168	5	16-QAM	-3		
26	7168	5	16-QAM	-4		
27	7168	5	16-QAM	-5		
28	7168	5	16-QAM	-6		
29	7168	5	16-QAM	-7		
30	7168	5	16-QAM	-8		

Table 7B: CQI mapping table for UE categories 7 and 8.

CQI value	Transport Block Size	Number of HS-PDSCH	Modulation	Reference power adjustment Δ	N_{IR}	X_{RV}
0	N/A	Out of range				
1	137	1	QPSK	0	19200	0
2	173	1	QPSK	0		
3	233	1	QPSK	0		
4	317	1	QPSK	0		
5	377	1	QPSK	0		
6	461	1	QPSK	0		
7	650	2	QPSK	0		
8	792	2	QPSK	0		
9	931	2	QPSK	0		
10	1262	3	QPSK	0		
11	1483	3	QPSK	0		
12	1742	3	QPSK	0		
13	2279	4	QPSK	0		
14	2583	4	QPSK	0		
15	3319	5	QPSK	0		
16	3565	5	16-QAM	0		
17	4189	5	16-QAM	0		
18	4664	5	16-QAM	0		
19	5287	5	16-QAM	0		
20	5887	5	16-QAM	0		
21	6554	5	16-QAM	0		
22	7168	5	16-QAM	0		
23	9719	7	16-QAM	0		
24	11418	8	16-QAM	0		
25	14411	10	16-QAM	0		
26	14411	10	16-QAM	-1		
27	14411	10	16-QAM	-2		
28	14411	10	16-QAM	-3		
29	14411	10	16-QAM	-4		
30	14411	10	16-QAM	-5		

Table 7C: CQI mapping table for UE category 9.

CQI value	Transport Block Size	Number of HS-PDSCH	Modulation	Reference power adjustment Δ	N_{IR}	X_{RV}
0	N/A	Out of range				
1	137	1	QPSK	0	28800	0
2	173	1	QPSK	0		
3	233	1	QPSK	0		
4	317	1	QPSK	0		
5	377	1	QPSK	0		
6	461	1	QPSK	0		
7	650	2	QPSK	0		
8	792	2	QPSK	0		
9	931	2	QPSK	0		
10	1262	3	QPSK	0		
11	1483	3	QPSK	0		
12	1742	3	QPSK	0		
13	2279	4	QPSK	0		
14	2583	4	QPSK	0		
15	3319	5	QPSK	0		
16	3565	5	16-QAM	0		
17	4189	5	16-QAM	0		
18	4664	5	16-QAM	0		
19	5287	5	16-QAM	0		
20	5887	5	16-QAM	0		
21	6554	5	16-QAM	0		
22	7168	5	16-QAM	0		
23	9719	7	16-QAM	0		
24	11418	8	16-QAM	0		
25	14411	10	16-QAM	0		
26	17237	12	16-QAM	0		
27	17237	12	16-QAM	-1		
28	17237	12	16-QAM	-2		
29	17237	12	16-QAM	-3		
30	17237	12	16-QAM	-4		

Table 7D: CQI mapping table for UE category 10.

CQI value	Transport Block Size	Number of HS-PDSCH	Modulation	Reference power adjustment Δ	N$_{IR}$	X$_{RV}$
0	N/A	Out of range				
1	137	1	QPSK	0	28800	0
2	173	1	QPSK	0		
3	233	1	QPSK	0		
4	317	1	QPSK	0		
5	377	1	QPSK	0		
6	461	1	QPSK	0		
7	650	2	QPSK	0		
8	792	2	QPSK	0		
9	931	2	QPSK	0		
10	1262	3	QPSK	0		
11	1483	3	QPSK	0		
12	1742	3	QPSK	0		
13	2279	4	QPSK	0		
14	2583	4	QPSK	0		
15	3319	5	QPSK	0		
16	3565	5	16-QAM	0		
17	4189	5	16-QAM	0		
18	4664	5	16-QAM	0		
19	5287	5	16-QAM	0		
20	5887	5	16-QAM	0		
21	6554	5	16-QAM	0		
22	7168	5	16-QAM	0		
23	9719	7	16-QAM	0		
24	11418	8	16-QAM	0		
25	14411	10	16-QAM	0		
26	17237	12	16-QAM	0		
27	21754	15	16-QAM	0		
28	23370	15	16-QAM	0		
29	24222	15	16-QAM	0		
30	25558	15	16-QAM	0		

Table 7E: CQI mapping table for UE categories 11 and 12.

CQI value	Transport Block Size	Number of HS-PDSCH	Modulation	Reference power adjustment Δ	N_{IR}	X_{RV}
0	N/A	Out of range				
1	137	1	QPSK	0	4800	0
2	173	1	QPSK	0		
3	233	1	QPSK	0		
4	317	1	QPSK	0		
5	377	1	QPSK	0		
6	461	1	QPSK	0		
7	650	2	QPSK	0		
8	792	2	QPSK	0		
9	931	2	QPSK	0		
10	1262	3	QPSK	0		
11	1483	3	QPSK	0		
12	1742	3	QPSK	0		
13	2279	4	QPSK	0		
14	2583	4	QPSK	0		
15	3319	5	QPSK	0		
16	3319	5	QPSK	-1		
17	3319	5	QPSK	-2		
18	3319	5	QPSK	-3		
19	3319	5	QPSK	-4		
20	3319	5	QPSK	-5		
21	3319	5	QPSK	-6		
22	3319	5	QPSK	-7		
23	3319	5	QPSK	-8		
24	3319	5	QPSK	-9		
25	3319	5	QPSK	-10		
26	3319	5	QPSK	-11		
27	3319	5	QPSK	-12		
28	3319	5	QPSK	-13		
29	3319	5	QPSK	-14		
30	3319	5	QPSK	-15		

6A .3 Operation during compressed mode on the associated DPCH or F-DPCH

During compressed mode on the associated DPCH or F-DPCH, the following applies for the UE for transmission of HS-DPCCH and reception of HS-SCCH and HS-PDSCH:

- The UE shall neglect a HS-SCCH or HS-PDSCH transmission, if a part of the HS-SCCH or a part of the corresponding HS-PDSCH overlaps with a downlink transmission gap on the associated DPCH or F-DPCH. In this case, neither ACK, nor NACK shall be transmitted by the UE to respond to the corresponding downlink transmission.

- If a part of a HS-DPCCH slot allocated to HARQ-ACK overlaps with an uplink transmission gap on the associated DPCH, the UE shall use DTX on the HS-DPCCH in that HS-DPCCH slot.

- If in a HS-DPCCH sub-frame a part of the slots allocated for CQI information overlaps with an uplink transmission gap on the associated DPCH, the UE shall not transmit CQI information in that sub-frame.

- If a CQI report is scheduled in the current CQI field according to subclause 6A.1.2 paragraph (2), and the corresponding 3-slot reference period (as defined in subclause 6A.2) wholly or partly overlaps a downlink transmission gap, then the UE shall use DTX in the current CQI field and in the CQI fields in the next ($N\_cqi\_transmit$–1) subframes.

6B   E-DCH related procedures

The following physical layer parameters are signalled to the UE from higher layers:

1) E-HICH set to be monitored

2) E-RGCH set to be monitored

6B.1   ACK/NACK detection

The physical layer in the UE shall detect ACK or NACK within the E-HICH set that is monitored by the UE in the subframes where ACK/NACK is transmitted by the UTRAN and deliver the ACK/NACK to the higher layers as follows:

- When a UE is not in soft handover, an ACK shall be delivered to the higher layers if a reliable ACK is detected by the physical layer in the UE, else a NACK shall be delivered to the higher layers.

- When a UE is in soft handover, multiple ACK/NACKs may be received in an E-DCH TTI from different cells in the active set. In some cases, the UE has the knowledge that some of the transmitted ACK/NACKs are the same. This is the case when the radio links are in the same radio link set. For these cases, ACK/NACKs from the same radio link set shall be soft combined into one ACK/NACK information and delivered to higher layers. If a radio link set contains only one radio link, the detection shall be done as specified above for the case where the UE is not in soft handover. For each radio link set containing multiple radio links, an ACK shall be delivered to the higher layers if a reliable ACK is detected by the physical layer in the UE after soft combining, else a NACK shall be delivered to the higher layers.

6B.2   Relative grants detection

The physical layer in the UE shall detect relative grants within the E-RGCH set that is monitored by the UE and deliver the relative grants to the higher layers as follows:

- When a UE is not in soft handover, an UP shall be delivered to the higher layers if a reliable UP is detected by the physical layer in the UE, else a DOWN shall be delivered to the higher layers if a reliable DOWN is detected by the UE, else a HOLD shall be delivered to the higher layers.

- When a UE is in soft handover, multiple relative grants may be received in an E-DCH TTI from different cells in the E-DCH active set. The UE shall handle the E-RGCH received from these cells as follows:

    o If the E-DCH serving radio link set contains only one radio link, the detection shall be done as specified above for the case where the UE is not in soft handover. If the E-DCH serving radio link set contains more than one radio link, the relative grants from the E-DCH serving radio link set are the same and shall be soft combined into one single relative grant information; an UP shall be delivered to the higher layers if a reliable UP is detected by the physical layer in the UE after soft combining, else a DOWN shall be delivered to the higher layers if a reliable DOWN is detected by the UE after soft combining, else a HOLD shall be delivered to the higher layers.

    o Furthermore, for each relative grant received from a radio link which does not belong to the E-DCH serving radio link set, a DOWN shall be delivered to the higher layers if a reliable DOWN is detected

by the UE, else a HOLD shall be delivered to the higher layers. The UE shall not soft combine relative grants received from radio links which do not belong to the E-DCH serving radio link set.

6B.3   E-DCH control timing

In sub-clauses 6B.3.1 and 6B.3.2 the word "first" refers to the earliest point in time.

6B.3.1   10 ms E-DCH TTI

For each cell in the E-DCH active set, the UE shall associate the control data received in the E-HICH frame associated with SFN i to the data transmitted in the E-DPDCH frame associated with SFN i-3.

For each cell which belongs to the serving E-DCH radio link set, the UE shall first take into account E-DCH control data received in the E-RGCH frame associated with SFN i in the higher layer procedures which correspond to E-DCH transmission in the E-DPDCH frame associated with SFN $i+1$.

For each cell which does not belong to the serving E-DCH radio link set the UE shall first take into account E-DCH control data received in the E-RGCH frame associated with SFN i in the higher layer procedures which correspond to E-DCH transmission in the E-DPDCH frame associated with SFN $i+1+s$ where:

$$s = \left\lceil \frac{160 - \left(\tau_{DPCH,n}/256\right)}{150} \right\rceil$$

The UE shall first take into account E-DCH control data received in the E-AGCH frame associated with SFN i in the higher layer procedures which correspond to E-DCH transmission in the E-DPDCH frame associated with SFN $i+1+s$ where:

$$s = \left\lceil \frac{100 - \left(\tau_{DPCH,n}/256\right)}{150} \right\rceil$$

6B.3.2   2 ms E-DCH TTI

For each cell in the E-DCH active set, the UE shall associate the E-DCH control data received in sub-frame j of the E-HICH frame associated with SFN i to sub-frame t of the E-DPDCH frame associated with SFN i-s where:

$$s = 1 - \lfloor j/3 \rfloor, \text{ and } t = (j+2) \bmod 5$$

For each cell which belongs to the serving E-DCH radio link set, the UE shall first take into account E-DCH control data received in sub-frame j of the E-RGCH frame associated with SFN i in the higher layer procedures which correspond to E-DCH transmission in sub-frame j of the E-DPDCH frame associated with SFN $i+1$.

For each cell which does not belong to the serving E-DCH radio link set the UE shall first take into account E-DCH control data received in the E-RGCH frame associated with SFN i in the higher layer procedures which correspond to E-DCH transmission in sub-frame t of the E-DPDCH frame associated with SFN $i+1+s$ where:

$$s = \left\lfloor \frac{\left\lceil \dfrac{160 - \left(\tau_{DPCH,n}/256\right)}{30} \right\rceil}{5} \right\rfloor, \text{ and } t = \left\lceil \frac{160 - \left(\tau_{DPCH,n}/256\right) - 150s}{30} \right\rceil$$

The UE shall first take into account E-DCH control data received in sub-frame j of the E-AGCH frame associated with SFN i in the higher layer procedures which correspond to E-DCH transmission in sub-frame t of the E-DPDCH frame associated with SFN $i+s$ where:

$$s = \left\lfloor \frac{\left\lceil \dfrac{30j+100-\left(\tau_{DPCH,n}/256\right)}{30} \right\rceil}{5} \right\rfloor , \text{ and } t = \left\lceil \frac{30j+100-\left(\tau_{DPCH,n}/256\right)-150s}{30} \right\rceil$$

6B.4   Operation during compressed mode

6B.4.1   Uplink compressed mode

When E-DCH TTI length is 2 ms, the UE shall not transmit E-DCH data in a TTI which fully or partly overlaps with an uplink transmission gap.

Handling of uplink compressed mode when the E-DCH TTI is 10msec is described in [2].

6B.4.2   Downlink compressed mode

The following applies for the UE for reception of E-HICH, E-RGCH and E-AGCH, during compressed mode on the DPCH or F-DPCH:

-    A UE shall decode E-HICH, E-RGCH or E-AGCH transmissions to the UE using all the slots which do not overlap a downlink transmission gap.

-    The UE may discard E-HICH, E-RGCH or E-AGCH slots which overlap a downlink transmission gap.

7   Closed loop mode 1 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 factor w_1 is a constant scalar and the weight factor w_2 is complex valued signal.

The weight factor w_2 (actually the corresponding phase adjustment) is determined by the UE, and signalled to the UTRAN access point (i.e. cell transceiver) using the FBI field of uplink DPCCH.

For the closed loop mode 1 different orthogonal dedicated pilot symbols in the DPCCH are sent on the 2 different antennas.
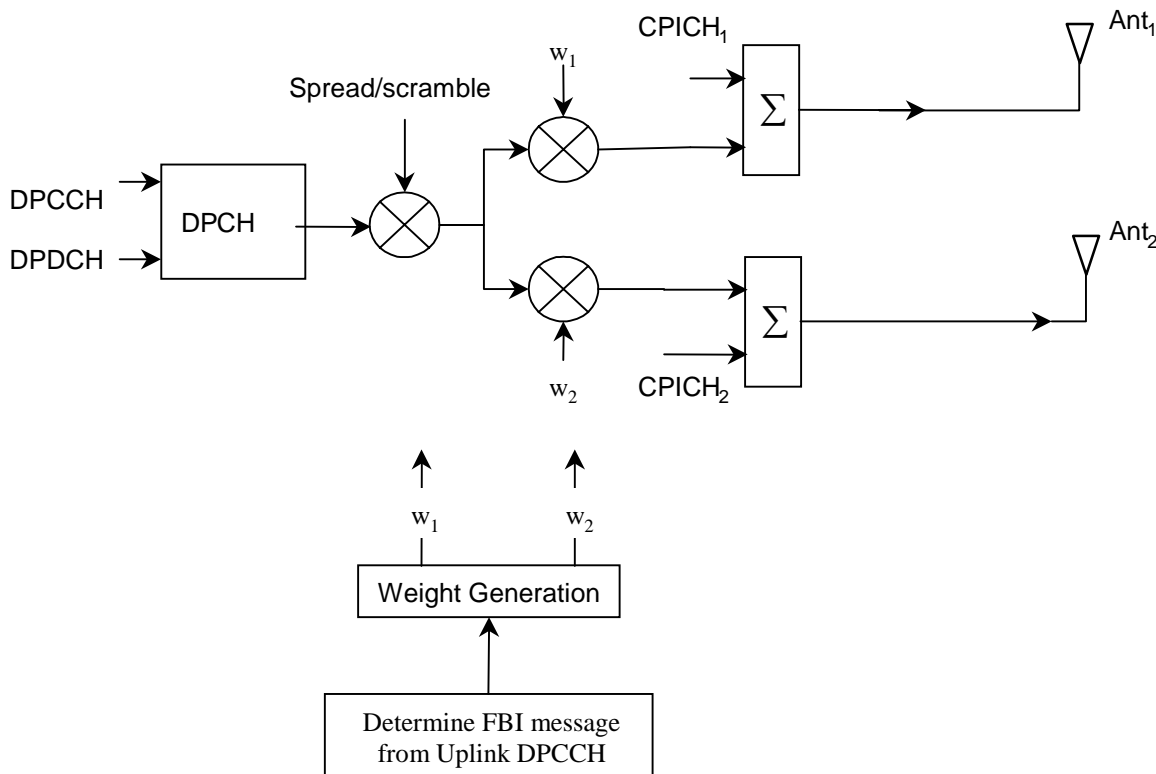
Figure 3: The generic downlink transmitter structure to support closed loop mode transmit diversity for DPCH transmission.

Closed loop mode 1 characteristics are summarised in the table 8. The use of the closed loop mode 1 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 closed loop mode 1.

N_{FBD}	N_W	Update rate	Feedback bit rate	N_{po}	N_{ph}	Constellation rotation
1	1	1500 Hz	1500 bps	0	1	$\pi/2$

7.1 General procedure

The UE uses the CPICH to separately estimate the channels seen from each antenna.

Once every slot, the UE computes the phase adjustment, ϕ, that should be applied at the UTRAN access point to maximise the UE received power. During soft handover, the UE computes the phase adjustment to maximise the total UE received power from the cells in the active set. In the case that a HS-PDSCH is associated with a DPCH for which closed loop mode 1 is applied, the antenna weights applied to the HS-PDSCH, are the same as the antenna weights applied to the associated DPCH. In case a HS-PDSCH is associated with a DPCH during soft handover, the UE may emphasize the radio link transmitted from HS-DSCH serving cell, respectively, when calculating the antenna weights. An example of how the computations can be accomplished is given in Annex A.2.

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 FBI field of uplink DPCCH slot(s) (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.

MSB   LSB

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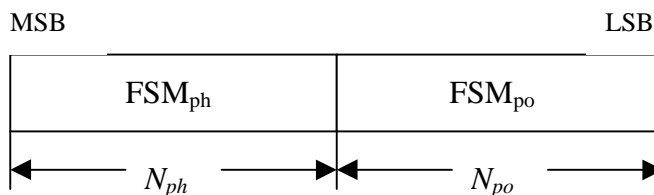
Figure 4: Format of feedback signalling message. FSM_{po} transmits the power setting and FSM_{ph} the phase setting.

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 approximately 1024 chips 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) mod 15.

2) When feedback command is transmitted in uplink slot *i*, which is transmitted approximately 1024 chips 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) mod 15.

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

In case of soft handover, Layer 1 shall support different adjustment timing values for different radio links in the same active set.

The timing of the weight adjustment of the HS-PDSCH is such that the HS-PDSCH weight adjustment is done at the HS-PDSCH slot border, respectively, M chips after the adjustment of the associated DPCH, where $0 \leq M < 2560$.

7.2 Determination of feedback information

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:

$$\phi_Q = \begin{cases} \pi, & \text{if } \pi/2 < \phi - \phi_r(i) \leq 3\pi/2 \\ 0, & \text{otherwise} \end{cases} \quad (1)$$

where:

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

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 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	$\pi/2$	0
	1	π	$-\pi/2$	π	$-\pi/2$	π	$-\pi/2$	π	$-\pi/2$	π	$-\pi/2$	π	$-\pi/2$	π	$-\pi/2$	π

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

$$w_2 = \frac{\sum_{i=n-1}^{n} \cos(\phi_i)}{2} + j \frac{\sum_{i=n-1}^{n} \sin(\phi_i)}{2} \tag{3}$$

where:

$$\phi_i \in \{0, \pi, \pi/2, -\pi/2\} \tag{4}$$

For antenna 1, w_1 is constant:

$$w_1 = 1/\sqrt{2} \tag{5}$$

7.2.1 End of frame adjustment

In closed loop mode 1 at frame borders the averaging operation is slightly modified. Upon reception of the FB command for slot 0 of 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 current frame, i.e. ϕ_i from slot 14 is not used:

$$w_2 = \frac{\cos(\phi_{13}^{j-1}) + \cos(\phi_0^j)}{2} + j \frac{\sin(\phi_{13}^{j-1}) + \sin(\phi_0^j)}{2} \tag{6}$$

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 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 w_2 as follows:

$$w_2 = \frac{\cos(\pi/2) + \cos(\phi_0)}{2} + j \frac{\sin(\pi/2) + \sin(\phi_0)}{2} \tag{7}$$

where:

ϕ_0 = phase adjustment from slot 0 of the first frame.

7.2.3 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 it's Tx diversity related functions in the same way as in non-compressed downlink mode.

In 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 $N_{last}+1$ (if $N_{last}+1 = 15$, 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 $N_{last}+1$.

7.2.3.2   Both downlink and uplink in compressed mode

During the uplink transmission gaps no FB commands are sent from UE to UTRAN. When transmission in downlink is started again in downlink slot $N_{last}+1$ (if $N_{last}+1 = 15$, 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 $N_{last}+1$.

The UTRAN continues to update the weight w_2 until the uplink transmission gap starts and no more FB commands are received. When the transmission in downlink resumes in slot $N_{last}+1$, the value of w_2, calculated after receiving the last FB command before the start of the uplink 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 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.

Note that for $N_{last} = 13$ the end of frame adjustment procedure shall be based on the FB commands for the last odd slot prior to the uplink transmission gap and slot 0.

7.2.3.3   Uplink in compressed mode and downlink in normal mode

The UTRAN continues to update the value of w_2 until the uplink transmission gap starts and no more FB commands are received. Then, the value of w_2 calculated after receiving the last FB command before the uplink transmission gap is

applied to the antenna 2 signal. When the UE resumes transmission in uplink, it shall send FB commands according to section 7.2 equations 2 and 3 (normal operation) and the UTRAN Access Point shall interpret the FB commands according to Table 9.

The calculation of w_2 by the UTRAN following the uplink transmission gap, and before the first two FB commands following the gap are received is not specified.

7.2.4 Initialisation during compressed mode

7.2.4.1 Downlink in 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 $N_{last}+1$ (if $N_{last}+1 = 15$, 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 $N_{last}+1$. Having received this feedback command the UTRAN calculates w_2 as follows:

$$w_2 = \frac{\cos(\phi_i) + \cos(\phi_j)}{2} + j\frac{\sin(\phi_i) + \sin(\phi_j)}{2} \qquad (8)$$

where:

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

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

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

7.2.4.2 Uplink in compressed mode

Initialisation of closed loop mode 1 operation during uplink compressed mode only is not specified.

7.3 Void

8 Idle periods for IPDL location method

8.1 General

To support time difference measurements for location services, idle periods can be created in the downlink (hence the name IPDL) during which time transmission of all channels from a Node B is temporarily seized. During these idle periods the visibility of neighbour cells from the UE is improved.

The idle periods are arranged in a predetermined pseudo random fashion according to higher layer parameters. Idle periods differ from compressed mode in that they are shorter in duration, all channels are silent simultaneously, and no attempt is made to prevent data loss.

In general there are two modes for these idle periods:

- Continuous mode, and

- Burst mode.

In continuous mode the idle periods are active all the time. In burst mode the idle periods are arranged in bursts where each burst contains enough idle periods to allow a UE to make sufficient measurements for its location to be calculated. The bursts are separated by a period where no idle periods occur.

8.2 Parameters of IPDL

The following parameters are signalled to the UE via higher layers:

IP_Status: This is a logic value that indicates if the idle periods are arranged in continuous or burst mode.

IP_Spacing: The number of 10 ms radio frames between the start of a radio frame that contains an idle period and the next radio frame that contains an idle period. Note that there is at most one idle period in a radio frame.

IP_Length: The length of the idle periods, expressed in symbols of the CPICH.

IP_Offset: A cell specific offset that can be used to synchronise idle periods from different sectors within a Node B.

Seed: Seed for the pseudo random number generator.

Additionally in the case of burst mode operation the following parameters are also communicated to the UE.

Burst_Start: Specifies the start of the first burst of idle periods. 256×Burst_Start is the SFN where the first burst of idle periods starts.

Burst_Length: The number of idle periods in a burst of idle periods.

Burst_Freq: Specifies the time between the start of a burst and the start of the next burst. 256×Burst_Freq is the number of radio frames of the primary CPICH between the start of a burst and the start of the next burst.

8.3 Calculation of idle period position

In burst mode, burst #0 starts in the radio frame with SFN = 256×Burst_Start. Burst #k starts in the radio frame with SFN = 256×Burst_Start + k×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 burst #0 followed by 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 × IP_Spacing × 150) + (rand(x modulo 64) modulo (150 – IP_Length)) + IP_Offset;

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

$$rand(0) = Seed;$$

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

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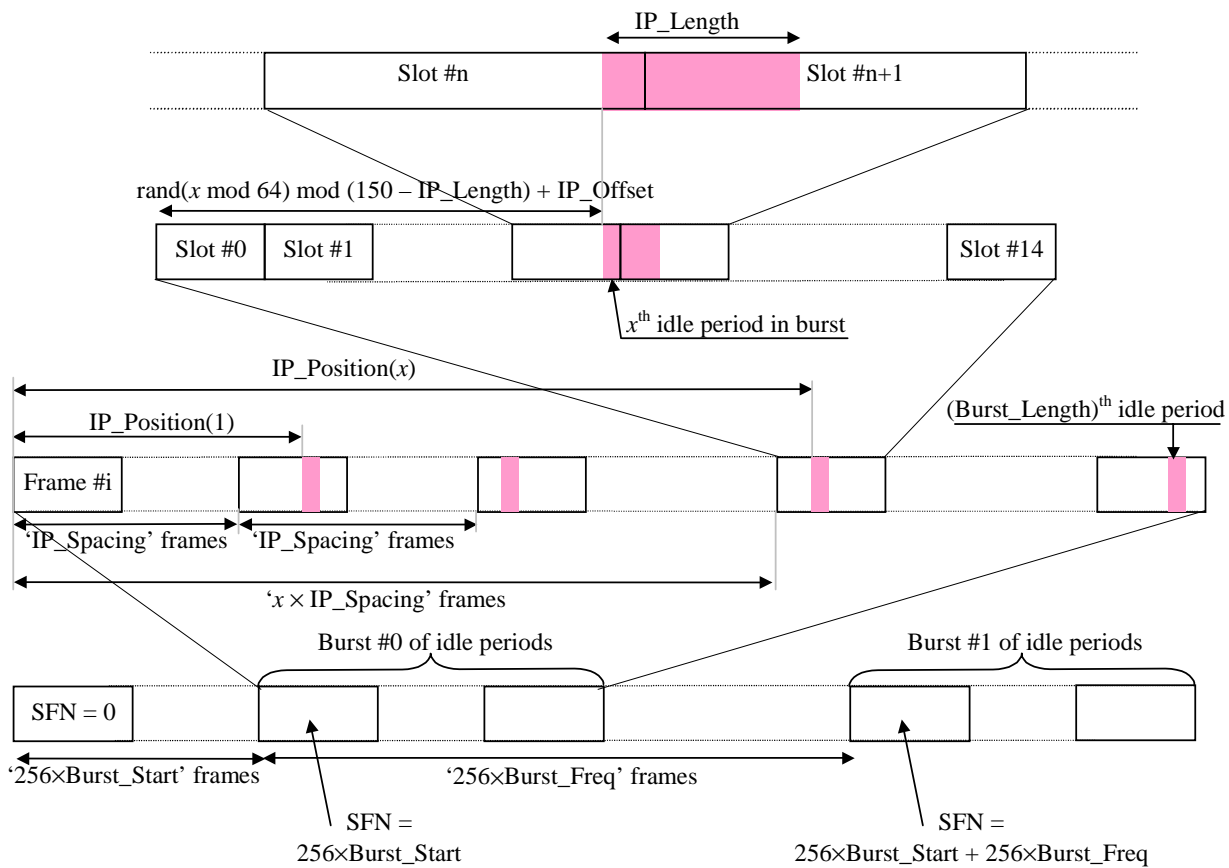
Figure 6: Idle Period placement in the case of burst mode operation

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 cannot 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.

Consider

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

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

Similarly consider

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

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

Whether x_0 or x_1 is to be calculated for each slot is given by the following table , where the first row contains the UL slot index of the feedback bit to be verified.

UL	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 from

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

where:

- the x_i values are used corresponding to the current slot and the previous slot taking into account the end-of-frame adjustment and the used CL timing adjustment delay

- $h_{2,i}^{(p)}$ 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 DPCCH;

- 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 mode 1 transmit diversity

In non-soft handover case, the computation of feedback information 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

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

and where the column vectors $\underline{h_1}$ and $\underline{h_2}$ represent the estimated channel impulse responses for the transmission antennas 1 and 2, of length equal to the length of the channel impulse response. The elements of $\underline{w}$ correspond to the adjustments computed by the UE.

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

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

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.

If HS-PDSCH is present, the UE may emphasize the HS-PDSCH serving cell. In this case the antenna weight vector, $\underline{w}$ can be, for example, determined so as to maximise the criteria function:

$$P = \underline{w}^H (\alpha(H_1{}^H H_1) + (1-\alpha)(H_2{}^H H_2 + \cdots)) \underline{w}$$

where BS#1 is the HS-PDSCH serving cell and coefficient α is less than or equal to 1. For example $\alpha = 0.7$ enhances HS-DSCH performance while ensuring that there is only a small degradation on the DPCH.

Annex B (Informative):
Power control

B.1 Downlink power control timing

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

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

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

Figure B.1 illustrates an example of transmitter power control timings when a DPCH is configured on the downlink.
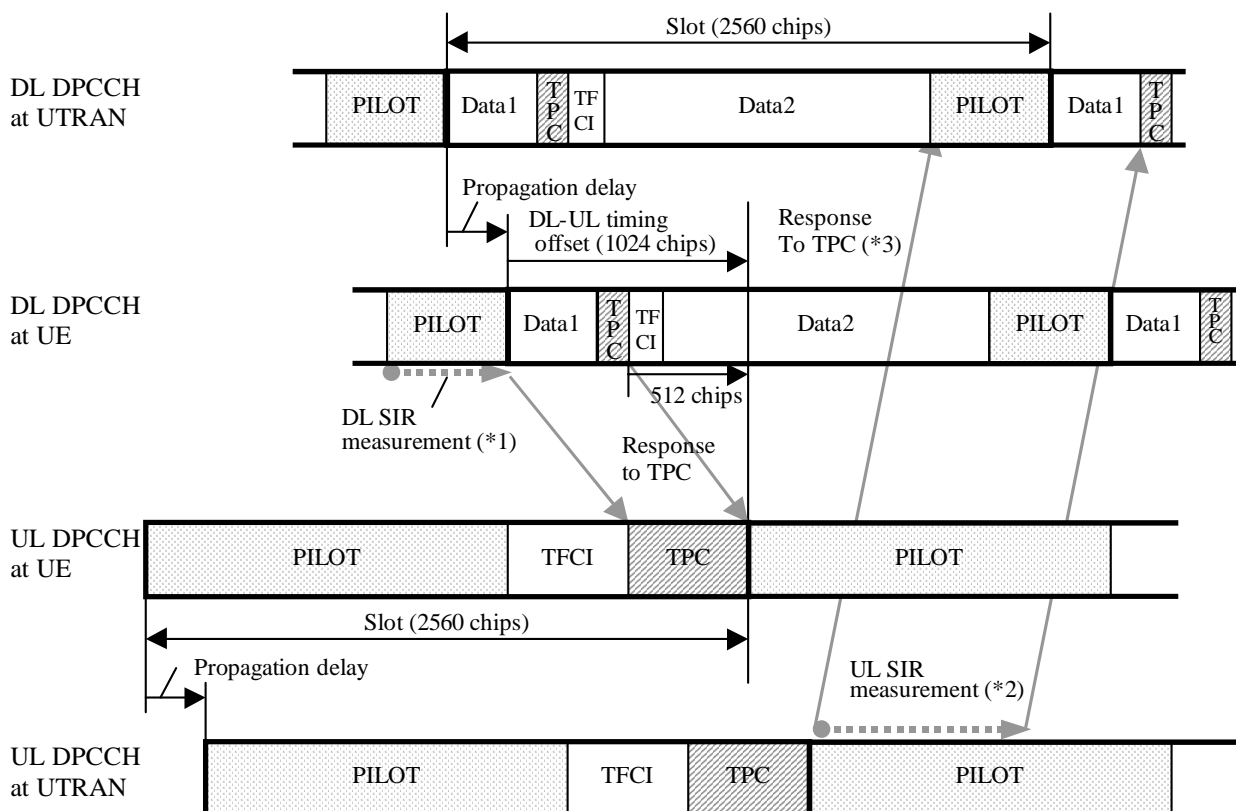
1,2 The SIR measurement periods illustrated here are examples. Other ways of measurement are allowed to achieve accurate SIR estimation.

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

Figure B.1: Transmitter power control timing for DPCH

Figure B.2 illustrates an example of transmitter power control timings when F-DPCH is configured on the downlink.
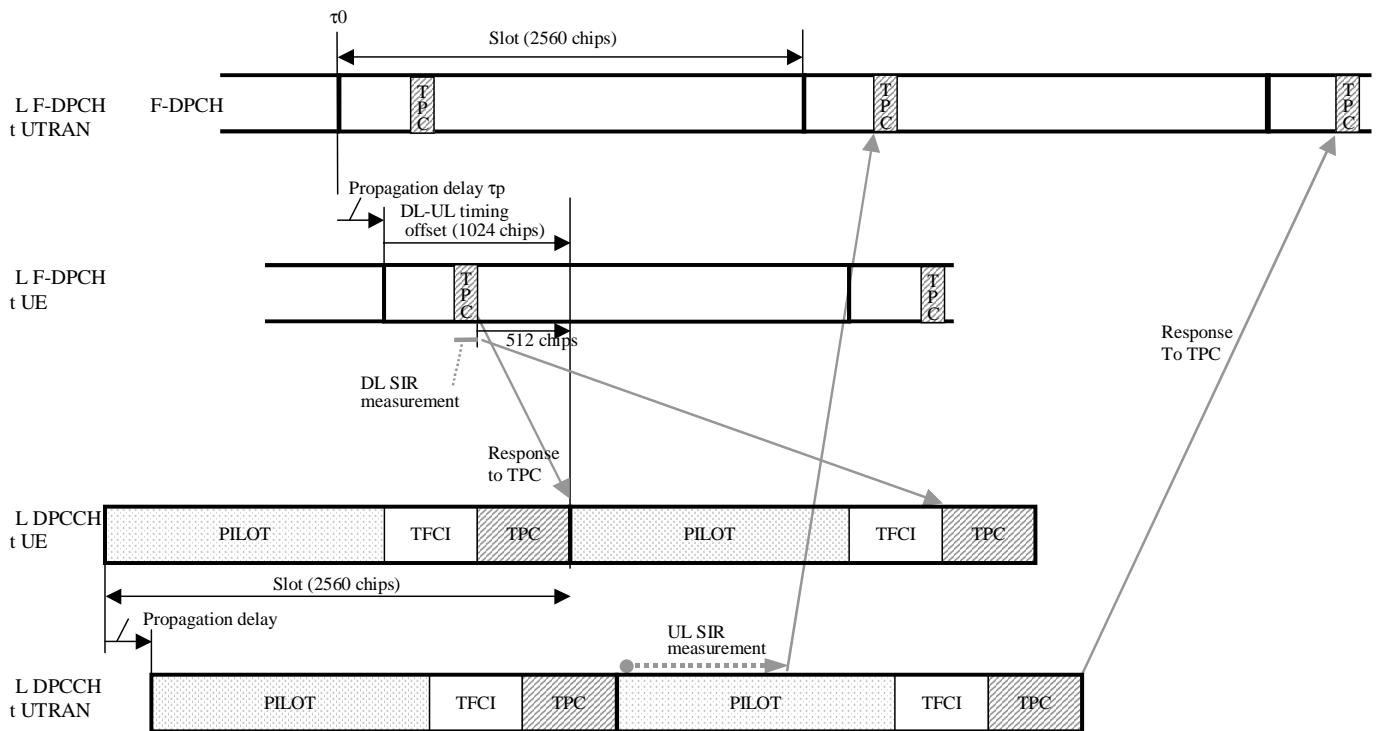
Figure B.2: Transmitter power control timing for F-DPCH

B.2 Example of implementation in the UE

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

The UE should estimate the received downlink DPCCH/DPDCH power of the connection to be power controlled. Simultaneously, the UE should estimate the received interference and calculate the signal-to-interference ratio, SIR_{est}. SIR_{est} can be calculated as RSCP/ISCP, where RSCP refers to the received signal code power on one code and ISCP refers to the non-orthogonal interference signal code power of the received signal on one code. Note that due to the specific SIR target offsets described in [5] that can be applied during compressed frames, the spreading factor shall not be considered in the calculation of SIR_{est}.

The obtained SIR estimate SIR_{est} is then used by the UE to generate TPC commands according to the following rule: if $SIR_{est} > SIR_{target}$ then the TPC command to transmit is "0", requesting a transmit power decrease, while if $SIR_{est} < SIR_{target}$ then the TPC command to transmit is "1", requesting a transmit power increase.

When the UE is in soft handover, the UE should estimate SIR_{est} from the downlink signals of all cells in the active set.

B.3 UL power control when losing UL synchronisation

Each Node B operates the uplink power control independently of the other Node Bs that may be providing RLS to the same UE. In case of multiple RLS the UE derives the decision on power adjustment based on all the commands received according the rules specified in section 5.1.2. In this scenario, transmission of a down command by one or more of the involved Node Bs will likely result in the UE decreasing its transmit power.

Consequently, if and when, after successful initial RL synchronisation, the Node B loses UL synchronisation for a UE and if the current number of RLS configured for that UE is greater than one and if the Node B reverts to a TPC pattern in such situation (i.e. generates DL TPC commands independently of actual RL measurements), the Node B should not use TPC commands '0' in the TPC pattern.

Annex C (Informative): Cell search procedure

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

Step 1: Slot synchronisation

During the first step of the cell search procedure the UE uses the SCH"s primary synchronisation code to acquire slot synchronisation to a cell. This is typically done with a single matched filter (or any similar device) matched to the primary synchronisation code which is common to all cells. The slot timing of the cell can be obtained by detecting peaks in the matched filter output.

Step 2: Frame synchronisation and code-group identification

During the second step of the cell search procedure, the UE uses the SCH"s secondary synchronisation code to find frame synchronisation and identify the code group of the cell found in the first step. This is done by correlating the received signal with all possible secondary synchronisation code sequences, and identifying the maximum correlation value. Since the cyclic shifts of the sequences are unique the code group as well as the frame synchronisation is determined.

Step 3: Scrambling-code identification

During the third and last step of the cell search procedure, the UE determines the exact primary scrambling code used by the found cell. The primary scrambling code is typically identified through symbol-by-symbol correlation over the CPICH with all codes within the code group identified in the second step. After the primary scrambling code has been identified, the Primary CCPCH can be detected. And the system- and cell specific BCH information can be read.

If the UE has received information about which scrambling codes to search for, steps 2 and 3 above can be simplified.

Annex D (informative):
Change history

					Change history		
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
	RAN_05	RP-99531	-		Approved at TSG RAN #5 and placed under Change Control	-	3.0.0
14/01/00	RAN_06	RP-99686	003	2	Flexible timing of UTRAN response to uplink closed loop Tx diversity feedback commands	3.0.0	3.1.0
14/01/00	RAN_06	RP-99686	006	2	CPCH power control preamble length	3.0.0	3.1.0
14/01/00	RAN_06	RP-99686	007	-	Removal of open loop power control	3.0.0	3.1.0
14/01/00	RAN_06	RP-99687	008	-	Power offset of AICH and PICH	3.0.0	3.1.0
14/01/00	RAN_06	RP-99686	009	1	Update of Random Access Procedure	3.0.0	3.1.0
14/01/00	RAN_06	RP-99686	010	1	oft symbol combining for uplink power control	3.0.0	3.1.0
14/01/00	RAN_06	RP-99685	011	-	Clarification of closed loop transmit diversity figure in clause 8 and closed loop operation in compressed mode for mode 2 in subclause 8.3 of TS 25.214	3.0.0	3.1.0
14/01/00	RAN_06	RP-99686	012	-	Uplink power control maximum TX power	3.0.0	3.1.0
14/01/00	RAN_06	RP-99686	013	1	Setting of beta values for multi-code	3.0.0	3.1.0
14/01/00	RAN_06	RP-99686	014	-	Consolidation of CPCH Power Control Preamble Information	3.0.0	3.1.0
14/01/00	RAN_06	RP-99686	015	1	Consolidation of Power Control Information for DCH Initialisation	3.0.0	3.1.0
14/01/00	RAN_06	RP-99686	016	-	Uplink power control in compressed mode	3.0.0	3.1.0
14/01/00	RAN_06	RP-99686	018	1	Timing for initialisation procedures	3.0.0	3.1.0
14/01/00	RAN_06	RP-99687	021	-	20 ms RACH message length	3.0.0	3.1.0
14/01/00	RAN_06	RP-99684	023	1	Maximum Tx Power at uplink compressed Mode	3.0.0	3.1.0
14/01/00	RAN_06	RP-99687	024	2	Setting of power in uplink compressed mode	3.0.0	3.1.0
14/01/00	RAN_06	RP-99687	025	-	Cleanup of synchronisation procedures	3.0.0	3.1.0
14/01/00	RAN_06	RP-99686	026	2	Downlink power control	3.0.0	3.1.0
14/01/00	RAN_06	RP-99687	029	-	Out-of-synch handling	3.0.0	3.1.0
14/01/00	RAN_06	RP-99687	030	2	State update rule addition to SSDT specification	3.0.0	3.1.0
14/01/00	RAN_06	RP-99687	033	-	Uplink TX timing adjustment	3.0.0	3.1.0
14/01/00	RAN_06	RP-99687	036	-	Inclusion of idle periods for the IPDL LCS	3.0.0	3.1.0
14/01/00	RAN_06	RP-99686	041	-	Revision of power control timing text	3.0.0	3.1.0
14/01/00	RAN_06	RP-99687	042	1	Inclusion of adjustment loop in downlink power control	3.0.0	3.1.0
14/01/00	-	-	-		Change history was added by the editor	3.1.0	3.1.1
31/03/00	RAN_07	RP-000064	043	1	Optimum ID Codes for SSDT Power Control	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	044	-	Editorial clarification to subclause 5.1.2.2.2	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	047	1	Additional description of TX diversity for PDSCH	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	048	-	Power offset on S-CCPCH	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	050	2	Corrections to uplink power control	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	055	-	Correction of Adjustment loop description	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	056	1	Clarification of TPC command combining for Algorithm 1	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	057	-	Clarification of TPC command combining for Algorithm 2	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	059	2	CPCH:CD subslot-related additions to 6.2	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	061	1	CPCH: editorial changes and clarifications of 6.2	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	062	-	Editorial corrections	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	064	1	Editorial improvement of the IPDL section	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	065	1	PRACH power offset definition	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	066	1	Radio link synchronisation in UTRA/FDD	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	068	-	Definition for maximum and minimum DL power	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	069	4	Channel assignment and UE channel selection methods of CPCH	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	071	-	Channelization code allocation method for PCPCH message part	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	072	1	Limited power raise used -parameter in DL PC	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	080	-	Downlink power control	3.1.1	3.2.0
31/03/00	RAN_07	RP-000064	081	-	Editorial improvement on SSDT power control section	3.1.1	3.2.0
31/03/00	RAN_07	RP-000065	082	2	Emergency Stop of CPCH transmission and Start of Message Indicator	3.1.1	3.2.0
31/03/00	RAN_07	RP-000065	083	-	Clean up of USTS related specifications	3.1.1	3.2.0
26/06/00	RAN_08	RP-000268	084	-	Addition of CSICH power parameter	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	085	-	Correction to power control in compressed mode recovery period	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	086	1	Revisions to power control for CPCH	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	087	-	Corrections to uplink DCH power control sections	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	090	3	Level of specification of downlink power control	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	091	1	Clarification of TX diversity power setting	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	092	-	PICH undefined bits	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	095	1	DPDCH/DPCCH gain factors	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	096	3	Correction to RACH subchannel definition	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	097	1	The power setting of the CCC field of DL DPCCH for CPCH	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	098	4	Procedure for end of transmission indicator in CPCH	3.2.0	3.3.0

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Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
26/06/00	RAN_08	RP-000268	099	-	Downlink inner-loop power control in compressed mode	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	100	-	Definition of vector transmission weight entity	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	101	1	Number of slots for DPCCH power control preamble	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	102	-	Clarification of UTRAN Tx diversity reponse timing description in 25.214	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	103	2	Corrections to transmit diversity section	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	104	1	Corrections to uplink power control in compressed mode	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	105	-	Clarification of downlink power control mode	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	106	-	Clarification of radio link set	3.2.0	3.3.0
26/06/00	RAN_08	RP-000268	107	1	Clarification of radio link synchronisation procedure	3.2.0	3.3.0
26/06/00	RAN_08	RP-000269	108	-	Correctly quantized gainfactors for uplink compressed mode	3.2.0	3.3.0
23/09/00	RAN_09	RP-000342	110	4	Downlink inner-loop power control in compressed mode	3.3.0	3.4.0
23/09/00	RAN_09	RP-000342	112	-	Adding reference for power offset variation text in TS 25.214	3.3.0	3.4.0
23/09/00	RAN_09	RP-000342	113	-	Combining TPC commands in soft handover	3.3.0	3.4.0
23/09/00	RAN_09	RP-000342	115	1	Corrections to power control	3.3.0	3.4.0
23/09/00	RAN_09	RP-000342	116	-	Corrections to 25.214	3.3.0	3.4.0
23/09/00	RAN_09	RP-000342	117	-	Clarification to downlink power control	3.3.0	3.4.0
23/09/00	RAN_09	RP-000342	118	3	Clarification of power control at maximum and minimum power	3.3.0	3.4.0
23/09/00	RAN_09	RP-000342	119	-	Clarification of SSDT text	3.3.0	3.4.0
23/09/00	RAN_09	RP-000342	120	-	Corrections to CL transmit diversity mode 1	3.3.0	3.4.0
23/09/00	RAN_09	RP-000342	121	1	Clarification of SSDT ID code bit transmission order	3.3.0	3.4.0
23/09/00	RAN_09	RP-000342	122	1	Clarification on RACH and CPCH subchannel definition	3.3.0	3.4.0
23/09/00	RAN_09	RP-000342	123	1	DPCH initialisation procedure	3.3.0	3.4.0
23/09/00	RAN_09	RP-000342	124	-	Clarification of closed loop mode TX diversity initialisation	3.3.0	3.4.0
23/09/00	RAN_09	RP-000342	127	2	Uplink power control in compressed mode	3.3.0	3.4.0
15/12/00	RAN_10	RP-000540	128	1	Clarification of downlink quality measurement in SSDT	3.4.0	3.5.0
15/12/00	RAN_10	RP-000540	129	-	Formula typography and reference corrections	3.4.0	3.5.0
15/12/00	RAN_10	RP-000540	130	1	Radio link establishment and sync status reporting	3.4.0	3.5.0
15/12/00	RAN_10	RP-000540	133	-	Correction of RACH/CPCH physical random access procedure	3.4.0	3.5.0
15/12/00	RAN_10	RP-000540	134	-	Correction of uplink power control algorithm 2	3.4.0	3.5.0
15/12/00	RAN_10	RP-000540	135	1	TPC command generation on downlink during RLS initialisation	3.4.0	3.5.0
15/12/00	RAN_10	RP-000540	136	1	Clarification of RACH behaviour at maximum and minimum power	3.4.0	3.5.0
15/12/00	RAN_10	RP-000540	137	-	Clarifications on the description of the radio link establishment procedure (when no radio link exists)	3.4.0	3.5.0
15/12/00	RAN_10	RP-000540	138	1	Corrections on power control preambles	3.4.0	3.5.0
15/12/00	RAN_10	RP-000540	139	1	Clarification of RACH procedure	3.4.0	3.5.0
15/12/00	RAN_10	RP-000540	140	-	Uplink power control in compressed mode	3.4.0	3.5.0
15/12/00	RAN_10	RP-000540	141	1	Revision of the abbreviation list	3.4.0	3.5.0
16/03/01	RAN_11	-	-	-	Approved as Release 4 specification (v4.0.0) at TSG RAN #11	3.5.0	4.0.0
16/03/01	RAN_11	RP-010060	142	1	Uplink power control in compressed mode	3.5.0	4.0.0
16/03/01	RAN_11	RP-010060	144	-	Removal of the power balancing algorithm from TS 25.214	3.5.0	4.0.0
16/03/01	RAN_11	RP-010254	145	2	Clarification of Nid parameter – when SSDT and uplink compressed mode are in operation	3.5.0	4.0.0
16/03/01	RAN_11	RP-010060	146	-	Clarification of closed loop transmit diversity mode 1 and mode 2 operation during compressed mode	3.5.0	4.0.0
16/03/01	RAN_11	RP-010060	148	1	Clarification of UE SIR estimation	3.5.0	4.0.0
16/03/01	RAN_11	RP-010060	150	1	Clarification of the order of SSDT signalling in 2 bit FBI	3.5.0	4.0.0
16/03/01	RAN_11	RP-010244	154	2	Uplink power control preamble	3.5.0	4.0.0
16/03/01	RAN_11	RP-010060	155	-	Correction of limited power raise	3.5.0	4.0.0
16/03/01	RAN_11	RP-010060	156	-	Clarification of initialisation procedure	3.5.0	4.0.0
16/03/01	RAN_11	RP-010060	158	-	Definition of power control step size for algorithm 2	3.5.0	4.0.0
16/03/01	RAN_11	RP-010060	161	1	Correction of the UE behaviour in SSDT mode	3.5.0	4.0.0
16/03/01	RAN_11	RP-010060	163	-	Correction on downlink synchronisation primitives	3.5.0	4.0.0
16/03/01	RAN_11	RP-010074	149	1	DSCH Power Control Improvement in soft handover	3.5.0	4.0.0
15/06/01	RAN_12	RP-010334	166	1	Limited power raise: aligning of terminology with TS25.433	4.0.0	4.1.0
15/06/01	RAN_12	RP-010334	167	1	Correction of IPDL burst parameters	4.0.0	4.1.0
15/06/01	RAN_12	RP-010334	169	1	Correction of synchronisation primitives	4.0.0	4.1.0
15/06/01	RAN_12	RP-010334	177	1	Clarification on TPC command generation on downlink during RL initialisation	4.0.0	4.1.0
15/06/01	RAN_12	RP-010482	181	4	Clarification of synchronisation procedures	4.0.0	4.1.0
15/06/01	RAN_12	RP-010334	183	-	Clarification of initialisation of closed loop mode 1 and 2 during compressed mode	4.0.0	4.1.0
15/06/01	RAN_12	RP-010334	186	-	DL maximum power level in compressed mode	4.0.0	4.1.0
15/06/01	RAN_12	RP-010341	164	1	Clarification on the usage of SSDT signaling in uplink	4.0.0	4.1.0
21/09/01	RAN_13	RP-010520	192	-	Corrections and Clarifications for calculation of idle period position in subclause 8.3 in 25.214	4.1.0	4.2.0
21/09/01	RAN_13	RP-010520	194	1	Minor modifications to the CPCH access procedure	4.1.0	4.2.0
21/09/01	RAN_13	RP-010520	197	-	Downlink power control in compressed mode	4.1.0	4.2.0
21/09/01	RAN_13	RP-010520	199	1	Improvements of closed loop TX diversity description	4.1.0	4.2.0
21/09/01	RAN_13	RP-010520	201	1	Correction to Random access procedure (Primitive from MAC)	4.1.0	4.2.0

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Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
21/09/01	RAN_13	RP-010677	205	1	Proposed CR to TS25.214: Clarification of the SSDT behaviour with beam forming	4.1.0	4.2.0
21/09/01	RAN_13	RP-010527	195	1	Enhanced PDSCH power control clarification	4.1.0	4.2.0
14/12/01	RAN_14	RP-010739	207	1	Power control in compressed mode when DPC_MODE=1	4.2.0	4.3.0
14/12/01	RAN_14	RP-010739	209	-	Clarification of closed loop mode 1 and 2 Tx diversity operation during compressed mode	4.2.0	4.3.0
14/12/01	RAN_14	RP-010739	211	-	Downlink phase reference reconfiguration	4.2.0	4.3.0
14/12/01	RAN_14	RP-010739	219	1	Downlink power control for channels supporting CPCH	4.2.0	4.3.0
14/12/01	RAN_14	RP-010739	223	-	Removal of slow power control from TS 25.214	4.2.0	4.3.0
14/12/01	RAN_14	RP-010775	216	-	Uplink TPC command processing in SHO with SSDT	4.2.0	4.3.0
14/12/01	RAN_14	RP-010744	217	2	DSCH power control clarification	4.2.0	4.3.0
14/12/01	RAN_14	RP-010933	229	-	Restriction to SSDT and closed loop mode transmit diversity combination	4.2.0	4.3.0
08/03/02	RAN_15	RP-020047	227	-	Clarification on DPCCH dedicated pilot bits with closed loop mode1	4.3.0	4.4.0
08/03/02	RAN_15	RP-020261	231	3	Qth threshold parameter in SSDT	4.3.0	4.4.0
08/03/02	RAN_15	RP-020047	240	1	TPC procedure in UE when SSDT is activated	4.3.0	4.4.0
08/03/02	RAN_15	RP-020053	236	1	Clarification of closed loop transmit diversity during soft handover	4.3.0	4.4.0
08/03/02	RAN_15	RP-020054	250	1	Description of SSDT operation for TFCI power control in hard split mode	4.3.0	5.0.0
08/03/02	RAN_15	RP-020058	237	2	Introduction of HSDPA feature to TS25.214	4.3.0	5.0.0
08/03/02	RAN_15	RP-020058	251	-	Introduction of power control aspects for HSDPA feature in TS25.214	4.3.0	5.0.0
07/06/02	RAN_16	RP-020316	255	2	Correction on the operation of HSDPA during compressed mode	5.0.0	5.1.0
07/06/02	RAN_16	RP-020316	259	1	Clarification of UE transmission timing adjustment with HS-DPCCH	5.0.0	5.1.0
07/06/02	RAN_16	RP-020316	260	4	Definition of CQI reporting	5.0.0	5.1.0
07/06/02	RAN_16	RP-020316	266	-	Correction to the setting of DPCCH/HS-DPCCH power difference	5.0.0	5.1.0
07/06/02	RAN_16	RP-020316	267	-	Inclusion of CQI table	5.0.0	5.1.0
07/06/02	RAN_16	RP-020318	265	1	Definition of Qth threshold parameter in SSDT	5.0.0	5.1.0
17/09/02	RAN_17	RP-020584	263	-	Clarification of total HS-SCCH/HS-PDSCH power	5.1.0	5.2.0
17/09/02	RAN_17	RP-020571	272	-	Reversal of unwanted corrections resulting from CR 25.211-122 & CR 25.214-226	5.1.0	5.2.0
17/09/02	RAN_17	RP-020584	273	2	Clarification of total HS-PDSCH power in CQI reporting procedure	5.1.0	5.2.0
17/09/02	RAN_17	RP-020584	274	1	Closed loop transmit diversity mode 2 with antenna verification	5.1.0	5.2.0
17/09/02	RAN_17	RP-020589	279	-	Correction of maximum power adjustment in case of compressed mode	5.1.0	5.2.0
17/09/02	RAN_17	RP-020574	282	1	Enhanced DSCH power control parameter name change	5.1.0	5.2.0
17/09/02	RAN_17	RP-020584	287	2	Correction of CQI definition	5.1.0	5.2.0
17/09/02	RAN_17	RP-020587	288	-	Inclusion of closed loop transmit diversity for HSDPA	5.1.0	5.2.0
17/09/02	RAN_17	RP-020588	289	-	Correction of timing of CQI reporting	5.1.0	5.2.0
17/09/02	RAN_17	RP-020529	294	-	Correction of reference linked to approval of CR 25.133-471	5.1.0	5.2.0
17/09/02	RAN_17	RP-020584	296	-	The clarification of CQI feedback parameter k value	5.1.0	5.2.0
17/09/02	RAN_17	RP-020584	298	-	Clarification of CQI definition and reference period	5.1.0	5.2.0
17/09/02	RAN_17	RP-020584	286	1	Numbering corrections	5.1.0	5.2.0
20/12/02	RAN_18	RP-020847	300	1	Corrections and clarifications to FDD CQI description	5.2.0	5.3.0
20/12/02	RAN_18	RP-020847	301	1	Criterion to determine primary cell for DSCH power control improvement	5.2.0	5.3.0
20/12/02	RAN_18	RP-020851	304	2	Introduction of Transport Block Size signaling procedure reference.	5.2.0	5.3.0
20/12/02	RAN_18	RP-020841	307	-	Clarification of closed loop timing adjustment mode	5.2.0	5.3.0
26/03/03	RAN_19	RP-030136	299	5	CQI reporting with TxD	5.3.0	5.4.0
26/03/03	RAN_19	RP-030136	313	1	On closed loop transmit diversity mode 1 verification algorithm	5.3.0	5.4.0
26/03/03	RAN_19	RP-030136	315	2	Clarification of SSDT and HSDPA	5.3.0	5.4.0
26/03/03	RAN_19	RP-030132	318	-	Correction on verification algorithm in Annex 1	5.3.0	5.4.0
23"06/03	RAN_20	RP-030273	314	1	Correction of TPC command combining in SHO	5.4.0	5.5.0
23"06/03	RAN_20	RP-030273	319	-	Correction for HS-DPCCH gain factor in compressed frame	5.4.0	5.5.0
23"06/03	RAN_20	RP-030273	320	1	Clarification of HS-SCCH reception in case of minimum interTTI interval is not 1	5.4.0	5.5.0
23"06/03	RAN_20	RP-030273	321	-	Correction of description of CQI transmission timing calculation	5.4.0	5.5.0
23"06/03	RAN_20	RP-030273	322	1	Clarification of the reference power for HS-DPCCH	5.4.0	5.5.0
21/09/03	RAN_21	RP-030458	325	-	Correction of CQI definition table	5.5.0	5.6.0
21/09/03	RAN_21	RP-030462	326	-	Removal of the combination of TxAA Mode 1 with HS-SCCH	5.5.0	5.6.0
21/09/03	RAN_21	RP-030458	328	2	Clarification of power scaling with HS-DPCCH	5.5.0	5.6.0
21/09/03	RAN_21	RP-030458	329	3	Correction of CQI reporting in DL compressed mode	5.5.0	5.6.0
21/09/03	RAN_21	RP-030458	330	1	Clarification of HS-SCCH reception	5.5.0	5.6.0
21/09/03	RAN_21	RP-030458	333	1	Clarification on CQI repetition behaviour	5.5.0	5.6.0
21/09/03	RAN_21	RP-030547	335	3	TPC pattern during loss of RL synchronisation	5.5.0	5.6.0
06/01/04	RAN_22	RP-030649	335	1	Clarification of HS-SCCH reception	5.6.0	5.7.0
06/01/04	RAN_22	RP-030649	336	1	Clarification of CQI definition	5.6.0	5.7.0
06/01/04	RAN_22	RP-030649	337	1	Clarification of the HS-SCCH detection	5.6.0	5.7.0

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Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
06/01/04	RAN_22	RP-030661	338	-	Remove inconsistency among specifications on signalling support for power control during loss of RL synchronisation	5.6.0	5.7.0
06/01/04	RAN_22	RP-030712	339	-	Alignment of "Soft channel bits" terminology with 25.306	5.6.0	5.7.0
13/01/04	RAN_22	-	-	-	Created for M.1457 update	5.7.0	6.0.0
23/03/04	RAN_23	RP-040086	341	-	Beta values for HS-DPCCH in compressed mode	6.0.0	6.1.0
23/03/04	RAN_23	RP-040086	346	1	ACK/NACK repetition factor	6.0.0	6.1.0
09/06/04	RAN_24	RP-040257	350	3	Clarification of UE procedure in case of HHO failure	6.1.0	6.2.0
28/09/04	RAN_25	RP-040318	352	1	Clarification of SSDT uplink only signalling	6.2.0	6.3.0
13/12/04	RAN_26	RP-040449	361	1	Introduction of E-DCH	6.3.0	6.4.0
13/12/04	RAN_26	RP-040450	351	-	Introduction of MICH	6.3.0	6.4.0
13/12/04	RAN_26	RP-040448	356	1	Introduction of MBMS Soft Combining	6.3.0	6.4.0
13/12/04	RAN_26	RP-040447	360	-	Correction of downlink transmit power control in compressed mode	6.3.0	6.4.0
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