

CR-Formv3	
<b>CHANGE REQUEST</b>	
✎ <b>25.224 CR 47</b> ✎ rev <b>1</b> ✎ Current version: <b>3.5.0</b> ✎	

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

<b>Title:</b>	✎ Inclusion of 1.28Mcps TDD in TS 25.224	
<b>Source:</b>	✎ Siemens, CWTS, CATT	
<b>Work item code:</b>	✎ LCRTDD	<b>Date:</b> ✎ 28.02.2001
<b>Category:</b>	✎ <b>B</b>	<b>Release:</b> ✎ REL-4
	Use <u>one</u> of the following categories: <b>F</b> (essential correction) <b>A</b> (corresponds to a correction in an earlier release) <b>B</b> (Addition of feature), <b>C</b> (Functional modification of feature) <b>D</b> (Editorial modification) Detailed explanations of the above categories can be found in 3GPP TR 21.900.	Use <u>one</u> of the following releases: 2 (GSM Phase 2) R96 (Release 1996) R97 (Release 1997) R98 (Release 1998) R99 (Release 1999) REL-4 (Release 4) REL-5 (Release 5)

<b>Reason for change:</b>	✎ Inclusion of 1.28 Mcps TDD	
<b>Summary of change:</b>	✎ ?? The basis for this document was CR047, R1-01-0224 ✎ ?? Contributions, which have been approved by WG1 at meeting #19 have been included in revision 1	
<b>Consequences if not approved:</b>	✎	

<b>Clauses affected:</b>	✎ New section 5, new Annex D, new Annex A.3, A.4 and A.5	
<b>Other specs affected:</b>	✎ <input checked="" type="checkbox"/> Other core specifications ✎ 25.201, 25.221, 25.222, 25.223, 25.225 ✎ <input type="checkbox"/> Test specifications ✎ <input type="checkbox"/> O&M Specifications	
<b>Other comments:</b>	✎	

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4 Physical layer procedures [for the 3.84 Mcps option](#) ~~(TDD)~~

## 5 Physical layer procedures for the 1.28 Mcps option

### 5.1 Transmitter Power Control

The basic purpose of power control is to limit the interference level within the system thus reducing the intercell interference level and to reduce the power consumption in the UE.

The main characteristics of power control are summarized in the following table.

**Table 2: Transmit Power Control characteristics**

	<u>Uplink</u>	<u>Downlink</u>
<u>Power control rate</u>	<u>Variable</u> <u>Closed loop: 0-200 cycles/sec.</u> <u>Open loop: (about 200us – 3575us delay )</u>	<u>Variable</u> <u>Closed loop: 0-200 cycles/sec.</u>
<u>Step size</u>	<u>1.2.3 dB (closed loop)</u>	<u>1.2.3 dB (closed loop)</u>
<u>Remarks</u>	<u>All figures are without processing and measurement times</u>	<u>Within one timeslot the powers of all active codes may be balanced to within a range of 20 dB</u>

Note: All codes within one timeslot allocated to the same CCTrCH use the same transmission power in case they have the same Spreading Factor.

#### 5.1.1 Uplink Control

##### 5.1.1.1 General limits

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

##### 5.1.1.2 UpPTS

Open loop power control is used for UpPTS.

The transmit power level by a UE on the UpPTS shall be calculated based on the following equation:

$$P_{\text{UpPTS}} = L_{\text{P-CCPCH}} + \text{PRX}_{\text{UpPTS,des}}$$

where,  $P_{\text{UpPTS}}$ : transmit power level in dBm.

$L_{\text{P-CCPCH}}$ : measured path loss in dB (P-CCPCH reference transmit power level is broadcast on BCH).

$\text{PRX}_{\text{UpPTS,des}}$ : desired RX power level at cell's receiver in dBm, which is an average value and is broadcast on BCH.

##### 5.1.1.3 PRACH

In 1.28Mcps TDD, the F-PACH is the response of a node B to the SYNC-UL burst of the UE. The response, a one burst long message, shall bring besides the acknowledgement to the received SYNC-UL burst, the timing and power level indications to prepare the transmission of the RACH burst.

The transmit power level on the PRACH is calculated by the following equation:

$$P_{\text{PRACH}} = L_{\text{P-CCPCH}} + \text{PRX}_{\text{PRACH,des}}$$

Where,  $P_{\text{PRACH}}$  is the UE transmit power level on the PRACH;

$\text{PRX}_{\text{PRACH,des}}$  is the desired receive power level on the PRACH, which is signalled by the higher layer signalling on the F-PACH.

#### 5.1.1.4 DPCH and PUSCH

The closed loop power control makes use of layer 1 symbol in the DPCH. The power control step can take the values 1,2,3 dB within the overall dynamic range 80dB. The initial transmission power of the uplink Dedicated Physical Channel is signalled by the UTRAN.

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

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

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

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

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

##### 5.1.1.4.1 Out of synchronization handling

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

### 5.1.2 Downlink Control

#### 5.1.2.1 P-CCPCH

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

#### 5.1.2.2 The power of the F-PACH

The transmit power for the F-PACH is set by the higher layer signalling.

#### 5.1.2.3 S-CCPCH, PICH

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

#### 5.1.2.4 DPCH, PDSCH

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

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

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

When TSTD is applied, the UE can use two consecutive measurements of the received SIR in two consecutive sub-frames to generate the power control command. An example implementation of DL power control procedure for 1.28 Mcps TDD when TSTD is applied is given in Annex A.4.

### 5.1.2.3.1 out of synchronisation handling

Same as that of 3.84Mcps TDD, cf. [4.2.3.3.1 Out of synchronisation handling].

## 5.2 UL Synchronisation

### 5.2.1 General Description

Support of UL synchronization is mandatory for the UE.

#### 5.2.1.1 Preparation of uplink synchronization (downlink synchronization)

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

#### 5.2.1.2 Establishment of uplink synchronization

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

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

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

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

#### 5.2.1.3 Maintenance of uplink synchronisation

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

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

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

### 5.2.2 UpPCH

Open loop uplink synchronisation control is used for UpPCH.

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

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

$$T_{TX-UPPCH} = T_{RX-DwPCH} - 2t_p + 12 \cdot 16 T_C$$

in multiple of 1/8 chips, where

$T_{TX-UPPCH}$  is the beginning time of UpPCH transmission with the UE's timing.

$T_{RX-DwPCH}$  is the received beginning time of DwPCH with the UE's timing.

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

### 5.2.3 PRACH

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

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

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

in multiple of 1/8 chips, where

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

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

### 5.2.4 DPCH and PUSCH

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

The Node B will continuously measure the timing of the UE and send the necessary synchronisation shift commands in each sub-frame. On receipt of these synchronisation shift commands the UE shall adjust the timing of its transmissions accordingly, in steps of  $\pm k/8$  chips or do nothing, each M sub-frames.

The default value of M (1-8) and k (1-8) is broadcast in the BCH. The value of M and k can also be adjusted during call setup or readjusted during the call.

During a 1.28 Mcps TDD to 1.28 Mcps TDD hand-over the UE shall transmit in the new cell with timing advance TA adjusted by the relative timing difference  $\Delta t$  between the new and the old cell:

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

#### 5.2.4.1 Out of synchronization handling

Same as that of 3.84 Mcps TDD, cf. [4.2.2.3.3 Out of synchronisation handling. 1]

## 5.3 Synchronisation procedures

### 5.3.1 Cell search

During the initial cell search, the UE searches for a cell. It then determines the DwPTS synchronisation, scrambling code and basic midamble code, control multi-frame synchronisation and then reads the BCH. How cell search is typically done is described in Annex D.

### 5.3.2 DCH synchronization

The DPCH synchronisation is the same as that of 3.84Mcps TDD, cf. [4.4.2 Dedicated channel synchronisation].

## 5.4 Discontinuous transmission (DTX) of Radio Frames

DTX is the same as in the 3.84 Mcps TDD option, cf. [4.5 Discontinuous transmission (DTX) of Radio Frames]. The special burst is transmitted in both consecutive subframes (subframe#1 and #2).



## 5.5 Downlink Transmit Diversity

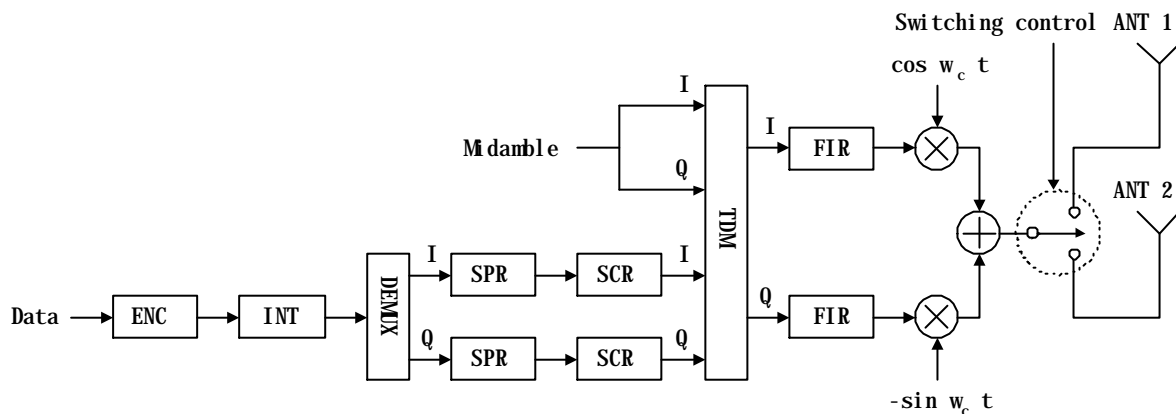
Downlink transmit diversity for DPCH, P-CCPCH, and DwPTS is optional in UTRAN. Its support is mandatory at the UE.

### 5.5.1 Transmit Diversity for DPCH

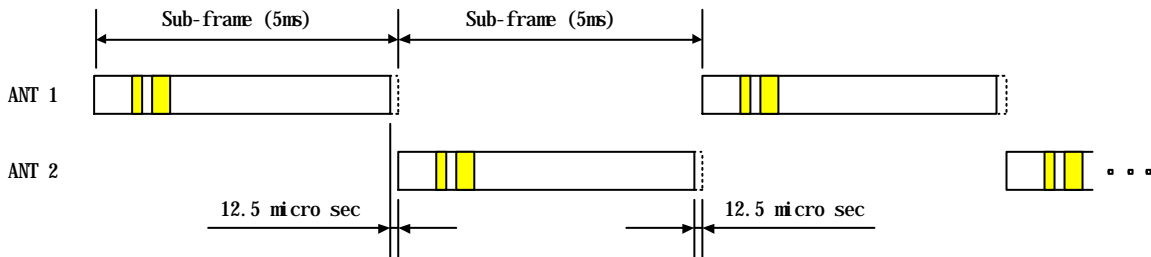
Closed loop Transmit Diversity or Time Switched Transmit Diversity (TSTD) may be employed as transmit diversity scheme for downlink DPCH.

#### 5.5.1.1 TSTD for DPCH

TSTD can be employed as transmit diversity scheme for downlink DPCH. An example for the transmitter structure of the TSTD transmitter is shown in figure [6]. Channel coding, rate matching, interleaving, bit-to-symbol mapping, spreading, and scrambling are performed as in the non-diversity mode. Then the data is time multiplexed with the midamble sequence. Then, after pulse shaping, modulation and amplification, DPCH is transmitted from antenna 1 and antenna 2 alternately every sub-frame. Not all DPCH in the sub-frame need to be transmitted on the same antenna and not all DPCH within a sub-frame have to use TSTD. Figure [7] shows an example for the antenna switching pattern for the transmission of DPCH for the case that all physical channels are transmitted with TSTD and are using the same antenna in the sub-frame.



**Figure [6]: Example for TSTD Transmitter structure for DPCH and P-CCPCH.**



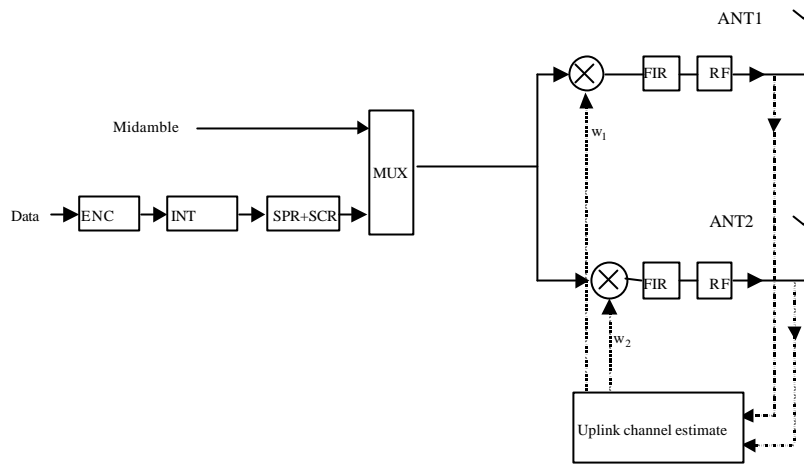
**Figure [7]: Example for the antenna switching pattern for TSTD transmission of DPCH and P-CCPCH: all physical channels are transmitted with TSTD and are using the same antenna in the sub-frame.**

#### 5.5.1.2 Closed Loop Tx Diversity for DPCH

The transmitter structure to support transmit diversity for DPCH transmission is shown in figure [8]. Channel coding, interleaving and spreading are done as in non-diversity mode. The spread complex valued signal is fed to both TX

antenna branches, and weighted with antenna specific weight factors  $w_1$  and  $w_2$ . The weight factors are complex valued signals (i.e.,  $w_i = a_i + jb_i$ ), in general. These weight factors are calculated on a per slot and per user basis.

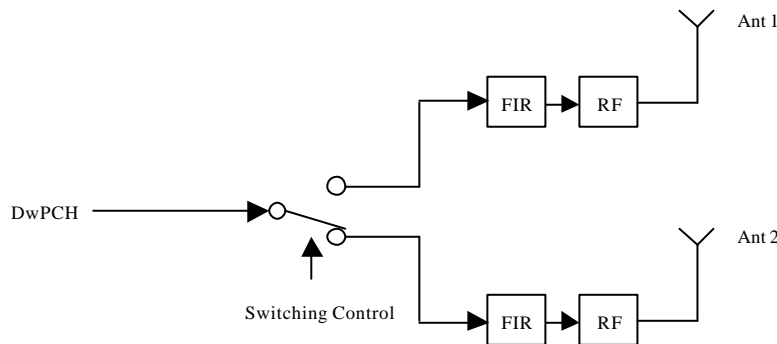
The weight factors are determined by the UTRAN.



**Figure [8]: Downlink transmitter structure to support Transmit Diversity for DPCH transmission (UTRAN Access Point) in 1.28Mcps TDD**

### 5.5.2 Transmit Diversity for DwPTS

The transmitter structure to support transmit diversity for DwPCH transmission is shown in figure [9]. DwPCH is transmitted from antenna 1 and antenna 2 alternatively.



**Figure [9]: Downlink transmitter structure to support Transmit Diversity for DwPCH transmission (UTRAN Access Point) in 1.28Mcps TDD**

### 5.5.3 Transmit Diversity for P-CCPCH

TSTD or Block Space Time Transmit Diversity (Block STTD) can be employed as transmit diversity scheme for the Primary Common Control Physical Channel (P-CCPCH)

### 5.5.3.1 TSTD Transmission Scheme for P-CCPCH

A block diagram of an example of a TSTD transmitter is shown in figure [6]. Channel coding, rate matching, interleaving, bit-to-symbol mapping, spreading, and scrambling are performed as in the non-diversity mode. Then the data is time multiplexed with the midamble sequence. Then, after pulse shaping and modulation and amplification, P-CCPCH is transmitted from antenna 1 and antenna 2 alternately every sub-frame. If there is a DPCH that uses TSTD, TSTD is also applied to P-CCPCH. An example of the antenna-switching pattern is shown in figure [7].

### 5.5.3.2 Block STTD Transmission Scheme for P-CCPCH

The open loop downlink transmit diversity employs a Block Space Time Transmit Diversity scheme (Block STTD).

A block diagram of the Block STTD transmitter is shown in figure [10]. Before Block STTD encoding, channel coding, rate matching, interleaving and bit-to-symbol mapping are performed as in the non-diversity mode.

Block STTD encoding is separately performed for each of the two data fields present in a burst (each data field contains N data symbols). For each data field at the encoder input, 2 data fields are generated at its output, corresponding to each of the diversity antennas. The Block STTD encoding operation is illustrated in figure [11], where the superscript \* stands for complex conjugate. If N is an odd number, the first symbol of the block shall not be STTD encoded and the same symbol will be transmitted with equal power from both antennas.

After Block STTD encoding both branches are separately spread and scrambled as in the non-diversity mode.

The use of Block STTD encoding will be indicated by higher layers.

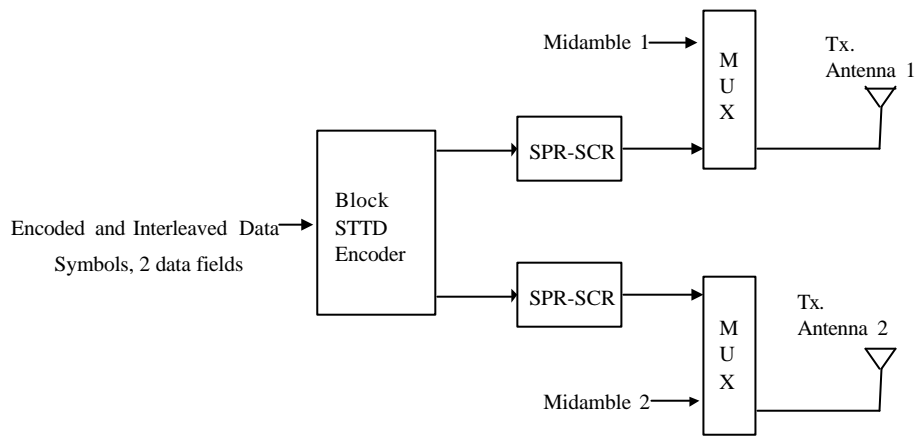


Figure [10]: Block Diagram of the transmitter (STTD) in 1.28Mcps TDD

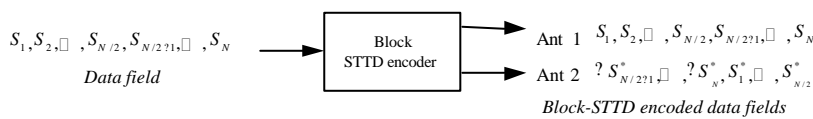


Figure [11]: Block Diagram of Block STTD encoder in 1.28Mcps TDD.

The symbols  $S_i$  are QPSK. N is the length of the block to be encoded.

## 5.6 Random Access Procedure

The physical random access procedure described below is invoked whenever a higher layer requests transmission of a message on the RACH. The physical random access procedure is controlled by primitives from RRC and MAC.

### 5.6.1 Definitions

FPACH<sub>i</sub> : FPACH number i

L<sub>i</sub> : Length of RACH message associated to FPACH<sub>i</sub> in sub-frames

N<sub>RACHi</sub> : The number of PRACHs associated to the i<sup>th</sup> FPACH

n<sub>RACHi</sub> : The number of a PRACH associated to the i<sup>th</sup> FPACH ranging from 0 to N<sub>RACHi</sub>-1

M : Maximum number transmissions in the UpPCH

WT : Maximum number of sub-frames to wait for the network acknowledgement to a sent signature

SFN' : The sub-frame number counting the sub-frames. At the beginning of the frame with the system frame number SFN=0 the sub-frame number is set to zero.

### 5.6.2 Preparation of random access

When the UE is in Idle mode, it will keep the downlink synchronisation and read the cell broadcast information. From the used SYNC-DL code in DwPCH, the UE will get the code set of 8 SYNC-UL codes (signatures) assigned to UpPCH for random access.

The description (codes, spreading factor, midambles, time slots) of the P-RACH, FPACH, and S-CCPCH (carrying the FACH logical channel) channel is broadcast on the BCH.

Thus, when sending a SYNC-UL sequence, the UE knows which FPACH resources, P-RACH resources and CCPCH resources will be used for the access.

The UE needs to decode the BCH information regarding the random access prior to transmission on the UpPCH.

The physical random access procedure described in this sub-clause is initiated upon request of a PHY-Data-REQ primitive from the MAC sub-layer (see [18] and [19]).

Before the physical random-access procedure can be initiated, Layer 1 shall receive the following information by a CPHY-TrCH-Config-REQ from the RRC layer:

- The association between which signatures and which FPACHs; which FPACHs and which PRACHs; which PRACHs and which CCPCHs; including the parameter values for each listed physical channel.
- The length L<sub>i</sub> of a RACH message associated to FPACH<sub>i</sub> can be configured to be either 1 or 2 or 4 sub-frames corresponding to a length in time of either 5 ms or 10 ms or 20 ms.

NOTE 1: N<sub>RACHi</sub> PRACHs can be associated with to FPACH<sub>i</sub>. The maximum allowed N<sub>RACHi</sub> is L<sub>i</sub>.
- The available UpPCH sub-channels for each Access Service Class (ASC):

NOTE 2: An UpPCH sub-channel is defined by a (sub-set of) signature(s) and sub-frame numbers.
- The set of Transport Format parameters for the PRACH message;
- The "M" maximum number transmissions in the UpPCH;
- The "WT" maximum number of sub-frames to wait for the network acknowledgement to a sent signature: (1..4) the maximum value supported by Layer 1 is 4 sub-frames.
- The initial signature power "Signature Initial Power";

NOTE 2: 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 specific PRACH message;
- The ASC for the specific Random Access procedure with the timing and power level indication;
- The data to be transmitted (Transport Block Set).

### 5.6.3 Random access procedure

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

UE side:

- 1 Set the Signature Re-Transmission Counter to M.
- 2 Set the Signature transmission power to Signature Initial Power.
- 3 Randomly select the UpPCH sub-channel from the available ones for the given ASC. The random function shall be such that each of the allowed selections is chosen with equal probability.
- 4 Transmit a signature using the selected UpPCH sub-channel at the signature transmission power.
- 5 After sending a signature, listen to the relevant FPACH for the next WT sub-frames to get the network acknowledgement. The UE will read the FPACH<sub>i</sub> associated to the transmitted UpPCH only in the sub-frames fulfilling the following relation:

$$(SFN' \bmod L) = n_{RACHi}; n_{RACHi} = 0, \dots, N_{RACHi} - 1.$$

- 6 In case no valid answer is detected in the due time: decrease the Signature Re-transmission counter by one and if it is still greater than 0, then repeat from step 3; else report a random access failure to the MAC sub-layer.
- 7 In case a valid answer is detected in the due time
  - a) set the timing and power level values according to the indication received by the network in the FPACH<sub>i</sub>;
  - b) send at the sub-frame coming 2 sub-frames after the one carrying the signature acknowledgement, the RACH message on the relevant PRACH. In case L<sub>i</sub> is bigger than one and the sub-frame number of the acknowledgement is odd the UE will wait one more sub-frame. The relevant PRACH is the n<sub>RACHi</sub><sup>th</sup> PRACH associated to the FPACH<sub>i</sub> if the following equation is fulfilled:

$$(SFN' \bmod L) = n_{RACHi};$$

Here SFN' is the sub-frame number of the arrival of the acknowledgement.

Both on the UpPCH and on the PRACH, the transmit power level shall never exceed the indicated value signalled by the network.

Network side:

The node B will transmit the FPACH<sub>i</sub> associated the transmitted UpPCH only in the sub-frames fulfilling the following relation:

$$(SFN' \bmod L) = n_{RACHi}; n_{RACHi} = 0, \dots, N_{RACHi} - 1.$$

The Node B will not acknowledge UpPCHs transmitted more than WT sub-frames ago

At the reception of a valid signature:

Measure the timing deviation with respect to the reference time T<sub>ref</sub> of the received first path in time from the UpPCH and acknowledge the detected signature sending the FPACH burst on the relevant FPACH.

For examples on the random access procedure refer to Annex E.

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

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

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

#### 5.6.3.1.1 Signature Reference Number

The Signature Reference Number field contains the number of the acknowledged signature. The user equipment shall use this information to verify whether it is the recipient of the FPACH message.

#### 5.6.3.1.2 Relative Sub-Frame Number

The Relative Sub-Frame Number field indicates the current sub-frame number with respect to the sub-frame at which the acknowledged signature has been detected.

The user equipment shall use this information to verify whether it is the recipient of the FPACH message.

#### 5.6.3.1.3 Received starting position of the UpPCH ( $UpPCH_{POS}$ )

The *received starting position of the UpPCH ( $UpPCH_{POS}$ )* field indirectly indicates to the user equipment the timing adjustment it has to implement for the following transmission to the network. The node B computes the proper value for this parameter according to the following rules:  $UpPCH_{POS} = UpPTS_{Rxpath} - UpPTS_{TS}$

where

$UpPTS_{Rxpath}$ : time of the reception in the Node B of the SYNC-UL to be used in the uplink synchronization process

$UpPTS_{TS}$ : time instance two symbols prior to the end of the DwPCH according to the Node B internal timing

This information shall be used by the UE to adjust its timing when accessing the network, as described in section [5.2 'Uplink Synchronisation'] .

#### 5.6.3.1.4 Transmit Power Level Command for the RACH message

This field indicates to the user equipment the power level to use for the RACH message transmission on the FPACH associated P-RACH.

The network may set this value based on the measured interference level (I) (in dBm) on the specific PRACH and on the desired signal to interference ratio (SIR) (in dB) on this channel as follows:

$$\text{Transmit Power Level Command for the PRACH}(\text{PRX}_{\text{PRACH,des}})$$

$PRX_{\text{PRACH,des}}$  is the desired receive power level on the PRACH.

The UE shall add to this value the estimated path-loss to compute the power level to transmit for the PRACH.

### 5.6.4 Random access collision

When a collision is very likely or in bad propagation environment, the Node B does not transmit the FPACH or cannot receive the SYNC-UL. In this case, the UE will not get any response from the Node B. Thus the UE will have to adjust its Tx time and Tx power level based on a new measurement and send a SYNC-UL again after a random delay.

Note that at each (re-)transmission, the SYNC-UL sequence will be randomly selected again by the UE.

Note : Due to the two-step approach a collision most likely happens on the UpPCH. The RACH RUs are virtually collision free. This two-step approach will guarantee that the RACH RUs can be handled with conventional traffic on the same UL time slots.

## Annex A (informative): Power Control

### A.1 An Example for Calculating $\alpha$

This annex presents an example for calculating the path loss weighting parameter for open loop power control  $\alpha$ .

$\alpha$  can be calculated as  $\alpha = 1 - (D-1)/6$  where D is the delay, expressed in number of slots, between the uplink slot and the most recent downlink slot. Note that  $\alpha = 1$  for a delay of one slot (minimal delay), and  $\alpha = 0$  for a delay of 7 slots (maximal delay).

### A.2 Example Implementation of Downlink Power Control in the UE

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

In case of a downlink transmission pause on the DPCH or PDSCH, the receive power (RSCP) of the data can no longer be used for inner loop SIR calculations in the UE. In this case the UE should trace the fluctuations of the pathloss based on the P-CCPCH and use these values instead for generating the TPC commands. This pathloss together with the timeslot ISCP measurement in the data timeslot, which is ongoing, should be used to calculate a virtual SIR value:

$$SIR_{virt}(i) = RSCP_{virt}(i) \cdot ISCP(i),$$

$$RSCP_{virt}(i) = RSCP_0 + L_0 - L(i) + \sum_{k=i-1}^{i-1} TPC(k),$$

RSCP: Received signal code power in dB

ISCP: Interference signal code power in the DPCH / PDSCH timeslot in dB

L: pathloss in dB measured on the P-CCPCH. The same weighting of the long- and short-term pathloss should be used as for uplink open loop power control, see Annex A.1

i: index for the frames during a transmission pause,  $1 \leq i \leq N$  number of frames in the pause

$L_0$ : weighted pathloss in the last frame before the transmission pause

$RSCP_0$ : RSCP of the data that was used in the SIR calculation of the last frame before the pause

TPC (k):  $\alpha$  power control stepsize in dB according to the TPC bit generated and transmitted in frame k, TPC bit "up" =  $+\alpha$ stepsize, TPC bit "down" =  $-\alpha$ stepsize

### A.3 Example Implementation of Closed Loop Uplink Power Control in Node B for 1.28 Mcps TDD

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

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

## A.4 Example Implementation of Downlink Power Control in UE for 1.28 Mcps TDD when TSTD is used

When TSTD is applied, the UE can use the consecutive measurements of SIR to calculate  $SIR_{AVG}$ :

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

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

In case of a downlink transmission pause on the DPCH, the example in Annex A.2 can be used for DL power control with  $RSCP_{virt}(i)$  and  $ISCP(i)$  replaced by  $RSCP_{AVG}(i)$  and  $ISCP_{AVG}(i)$ , where

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

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

## A.5 Example Implementation of open Loop Power Control for access procedure for 1.28 Mcps TDD

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



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Annex C (informative):  
Cell search procedure for 3.84Mcps TDD

## Annex D (informative):

### Cell search procedure for 1.28Mcps TDD

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

#### Step 1: Search for DwPTS

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

#### Step 2: Scrambling and basic midamble code identification

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

#### Step 3: Control multi-frame synchronisation

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

#### Step 4: Read the BCH

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

## Annex E (informative): Examples random access procedure for 1.28Mcps TDD

**Figure E-1 Single burst RACH WT=4, L =1, SF4 PRACH**

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

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

**Figure E-2 Two burst RACH WT=4, L =2, SF8 RACH**

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

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

**Figure E-3 four burst RACH WT=4, L =4, SF16 RACH**

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

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

**Figure E-4 four burst RACH WT=4, L =4, SF16 RACH**

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

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

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

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

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

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

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Annex ~~D~~F(informative):  
Change history