CR-Form-v3

CHANGE REQUEST

✎   **25.224 CR CR-Num** ✎ rev **-** ✎   Current version: **3.4.0** ✎

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

Title: ✎	CR for TS25.224 regarding 1.28 Mcps TDD
Source: ✎	CWTS/CATT
Work item code: ✎	1.28 Mcps TDD Physical Layer ***Date:*** ✎
Category: ✎	**B** ***Release:*** ✎ REL-4

Use one of the following categories:
    F (essential correction)
    A (corresponds to a correction in an earlier release)
    B (Addition of feature),
    C (Functional modification of feature)
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Use one of the following releases:
    2   (GSM Phase 2)
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    REL-5   (Release 5)

Reason for change: ✎	
Summary of change: ✎	
Consequences if not approved: ✎	

Clauses affected: ✎	
Other specs affected: ✎	☐ Other core specifications ✎ ☐ Test specifications ☐ O&M Specifications
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2 References

<For clarity, this chapter will currently collect only the references that are needed in addition to the already existing abbreviations. In its last version this chapter has to be modified, so that it includes the revisions with respect to the latest versions of TS25.224.>

3 Abbreviations

<For clarity, this chapter will currently collect only the abbreviations that are needed in addition to the already existing abbreviations. In its last version this chapter has to be modified, so that it includes the revisions with respect to the latest versions of TS25.224.>

4 Physical layer procedures for the 3.84 Mcps option(TDD)

<No changes will be made in this chapter in this CR, only the title has to be changed. >

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 -11: Transmit Power Control characteristics

	Uplink	Downlink
Power control rate	Variable Closed loop: 0-200 cycles/sec. Open loop: (about 200us – 3575us delay)	Variable Closed loop: 0-200 cycles/sec.
Step size	1,2,3 dB (closed loop)	1,2,3 dB (closed loop)
Remarks	All figures are without processing and measurement times	Within one timeslot the powers of all active codes may be balanced to within a range of 20 dB

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:

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

where, P_{UpPTS} : transmit power level in dBm,

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

   $PRX_{UpPTS,des}$: 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 system, the F-PACH brings the answer to the SYNC_UL burst of the UE. The answer, 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:

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

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

$PRX_{PRACH,des}$ is the desired receive power level on the PRACH,which is signalled by the higher layer signallling 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 SIR_{est} of the received uplink DPCH. The node B should then generate TPC commands and transmit the commands according to the following rule: if $SIR_{est} > SIR_{target}$ then the TPC command to transmit is "down", while if $SIR_{est} < SIR_{target}$ then the TPC command to transmit is "up".

At the UE, soft decision on the TPC bits is performed, and when it 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

5.1.2 Downlink Control

5.1.2.1 P-CCPCH, PICH

The primary CCPCH/PICH transmit power is set by high layer signalling and can be changed based on higher layer determination. The reference power of P-CCPCH is signalled on the BCCH on a periodic basis.

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.~~2~~3 S-CCPCH

5.1.2.~~3~~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 SIR_{est} of the received downlink DPCH. The UE should then generate TPC commands and transmit the commands according to the following rule: if $SIR_{est} > SIR_{target}$ then the TPC command to transmit is "down", while if $SIR_{est} < SIR_{target}$ then the TPC command to transmit is "up".

At the Node B, soft decision on the TPC bits is performed, and when it 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 Timing Advance

5.2.1 With UL Synchronization

5.2.1.1 General limits

5.2.1.2 UpPTS

5.2.1.3 PRACH

5.2.1.4 DPCH and PUSCH

5.2.1.4.1 Out of synchronization handling

5.2.1.5 The establishment of uplink synchronization

5.2.1.5.1 Preparation of uplink synchronization (downlink synchronization)

5.2.1.5.2 Establishment uplink synchronization

5.2.1.6 Maintenance of uplink synchronisation

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 synchronization, scrambling and basic midamble code identification, 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   (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].

5.5   Downlink Transmit Diversity

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 [F1]. 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 [F2] 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.
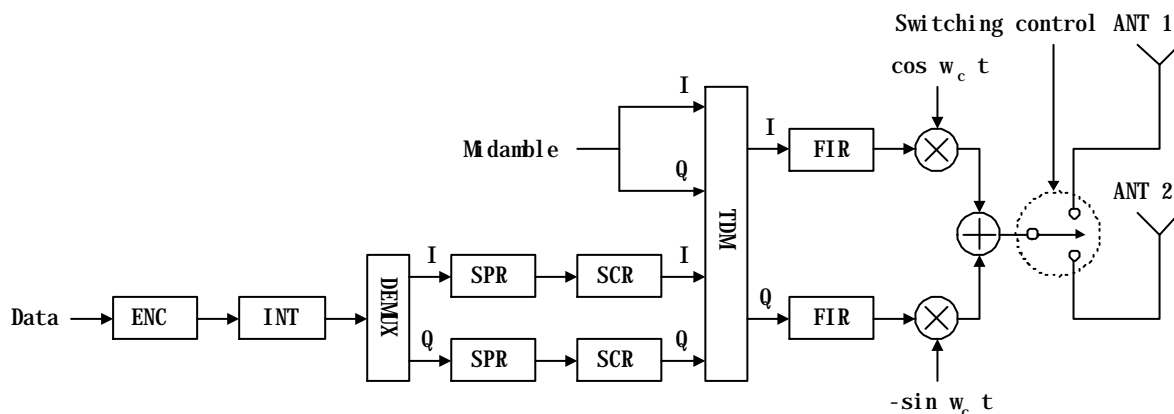

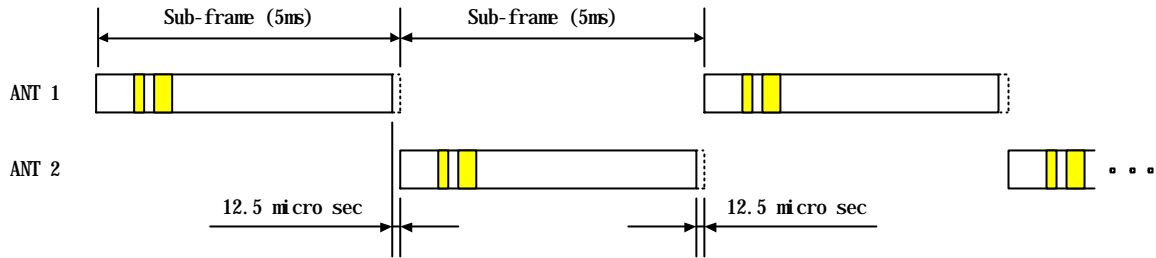**Figure [F1]: Example for TSTD Transmitter structure for DPCH and P-CCPCH.**

Figure [F2]: Example for the antenna swithing 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 [F3]. 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 w1 and w2. The weight factors are complex valued signals (i.e., wi = ai + jbi), in general. These weight factors are calculated on a per slot and per user basis.
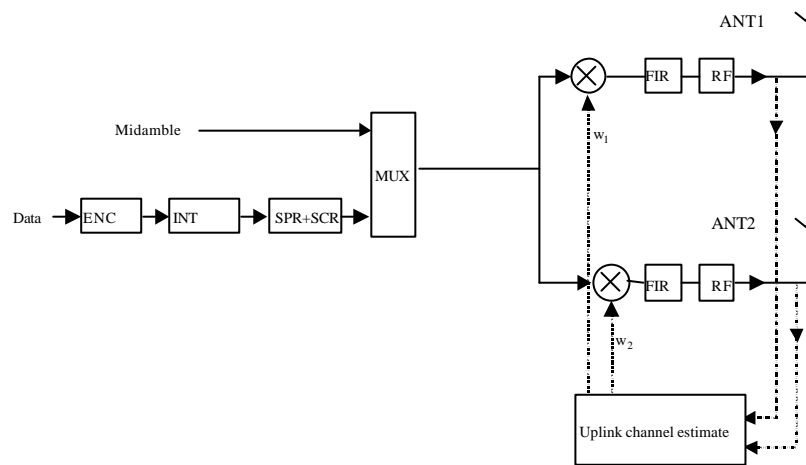
The weight factors are determined by the UTRAN.

Figure [F3]: 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 [F4]. DwPCH is transmitted from antenna 1 and antenna 2 alternatively.
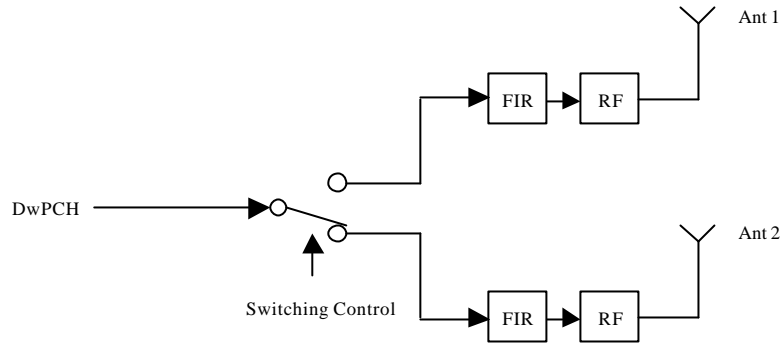
Figure [F4]: Downlink transmitter structure to support Transmit Diversity for DwPCH transmission (UTRAN Access Point) in 1.28Mcps TDd

5.5.3   Transmit Diversity for ~~FPACH~~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 [F2]. 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 [F2].

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 [F5]. 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 [F6], 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.

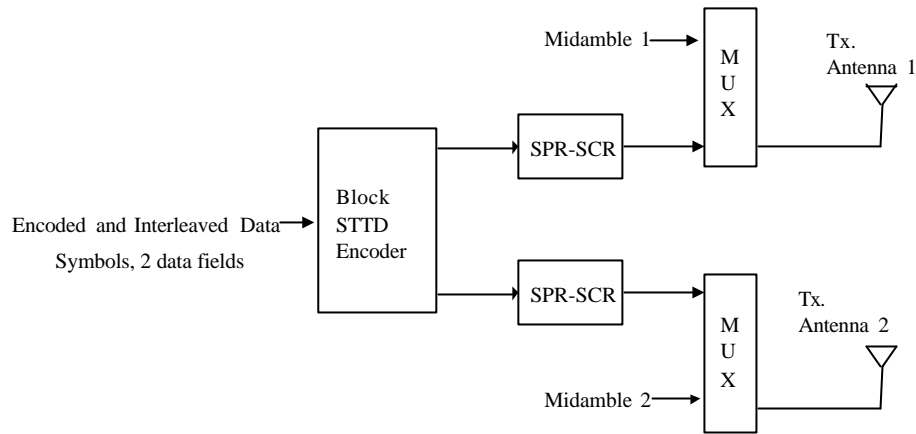The use of Block STTD encoding will be indicated by higher layers.

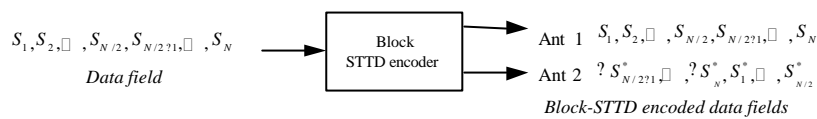**Figure [F5]: Block Diagram of the transmitter (STTD) in 1.28Mcps TDD**

Figure [F6]: 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

5.6.1   Preparation of random access

5.6.2   Random access procedures

5.6.2.1.   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.

5.6.2.1.1   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.

5.6.2.1.2   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.

5.6.2.1.3   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 network computes the proper value for this parameter, based on the correlation instant to the acknowledged signature from the UpPCH 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.

The UE can use the *received starting position of the UpPCH (UpPCH$_{POS}$)* to estimate the propagation delay (T$_{propagation\ delay}$) according to the following law:

$$T_{propagation\ delay} = (UpPCH_{adv} + UpPCH_{POS} - 8*16\ T_c)/2$$

where:

- UpPCH$_{adv}$ is the difference between the RX timing (received DL at UE) and initial TX timing (transmitted UL at UE) of a UE for UpPCH transmission (timing advance of the UpPCH);

- T$_c$ is the Time chip duration.

The timing advance for the RACH RACH$_{ADV}$ is 2* T$_{propagation\ delay}$.

5.6.2.1.4   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:

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

PRX$_{PRACH,des}$ 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.

5.6.3   Random access collision

Annex A (informative):
Power Control

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 consequtive measurements of SIR to calculate SIR$_{AVG}$:

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

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

In case of a downlink transmission pause on the DPCH, the example in Annex A.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

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

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

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.

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

<No changes will be made in this chapter in this CR, only the title has to be changed. >

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 QPSK phase modulation of the DwPTS with respect to the P-CCPCH midamble. The control multi-frame is positioned by a sequence of QPSK symbols modulated on the DwPTS. [n] consecutive DwPTS are sufficient for detecting the current position in the control multi-frame. According to the result of the control multi-frame synchronisation for the right midamble code, UE may go to next step or go back to step 2.

Step 4: Read the BCH

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