**3GPP TSG RAN Meeting #18** **RP-020852**
**New Orleans, Louisiana, USA, 3 - 6 December, 2002**

**Title:** **CRs (Rel-4 and Rel-5) for "Editorial modification to the section numbering"**

**Source:** **TSG-RAN WG1**

**Agenda item:** **7.1.6**

**CRs \for Specific Subject**

**CRs on "Editorial modification to the section numbering" (RP-020852)**

| No. | Spec | CR | Rev | WG T-doc | Subject | Phase | Cat | Workitem | V_old | V_new |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25.221 | 106 | - | R1-02-1389 | Editorial modification to the section numberings | Rel-4 | D | TEI4 | 4.6.0 | 4.7.0 |
| 2 | 25.221 | 107 | - | R1-02-1389 | Editorial modification to the section numberings | Rel-5 | D | TEI5 | 5.2.0 | 5.3.0 |
| 3 | 25.222 | 106 | - | R1-02-1390 | Editorial modification to the section numberings | Rel-4 | D | TEI | 4.5.0 | 4.6.0 |
| 4 | 25.222 | 107 | - | R1-02-1390 | Editorial modification to the section numberings | Rel-5 | D | TEI | 5.2.1 | 5.3.0 |
| 5 | 25.223 | 32 | - | R1-02-1391 | Editorial modification to the section numberings | Rel-4 | D | TEI4 | 4.4.0 | 4.5.0 |
| 6 | 25.223 | 33 | - | R1-02-1391 | Editorial modification to the section numberings | Rel-5 | D | TEI5 | 5.1.0 | 5.3.0 |
| 7 | 25.224 | 104 | - | R1-02-1392 | Editorial modification to the section numberings | Rel-4 | D | TEI4 | 4.6.0 | 4.7.0 |
| 8 | 25.224 | 105 | - | R1-02-1392 | Editorial modification to the section numberings | Rel-5 | D | TEI5 | 5.2.1 | 5.3.0 |

**3GPP TSG-RAN1 Meeting #29** ***R1-02-1389***
**Shanghai, China, 5 – 8 November 2002**

*CR-Form-v7*

# CHANGE REQUEST

| | | | | | |
|---|---|---|---|---|---|
| ⌘ **25.221** | **CR 106** | ⌘ **rev** | **-** | ⌘ Current version: | **4.6.0** ⌘ |

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

***Proposed change affects:*** UICC apps⌘ [ ] ME [X] Radio Access Network [X] Core Network [ ]

| | | | | |
|---|---|---|---|---|
| ***Title:*** | ⌘ | Editorial modification to the section numberings | | |
| ***Source:*** | ⌘ | TSG RAN WG1 | | |
| ***Work item code:*** | ⌘ | TEI4 | ***Date:*** ⌘ | 25/10/2002 |
| ***Category:*** | ⌘ | **D** | ***Release:*** ⌘ | Rel-4 |
| | | *Use one of the following categories:*<br>***F*** *(correction)*<br>***A*** *(corresponds to a correction in an earlier release)*<br>***B*** *(addition of feature),*<br>***C*** *(functional modification of feature)*<br>***D*** *(editorial modification)*<br>Detailed explanations of the above categories can be found in 3GPP TR 21.900. | | *Use one of the following releases:*<br>*2 (GSM Phase 2)*<br>*R96 (Release 1996)*<br>*R97 (Release 1997)*<br>*R98 (Release 1998)*<br>*R99 (Release 1999)*<br>*Rel-4 (Release 4)*<br>*Rel-5 (Release 5)*<br>*Rel-6 (Release 6)* |

| | | |
|---|---|---|
| ***Reason for change:*** | ⌘ | The numbering used is not consistent with TS21.801. |
| ***Summary of change:*** | ⌘ | The sections, figures, and tables numberings are adjusted to follow the guidlines given in TS21.801. |
| ***Consequences if not approved:*** | ⌘ | Confusion and misunderstanding, not consistent with specification guidelines and the rest of the document. |

| | | | | | |
|---|---|---|---|---|---|
| ***Clauses affected:*** | ⌘ | All the document | | | |
| | | **Y** | **N** | | |
| ***Other specs affected:*** | ⌘ | | **X** | Other core specifications | ⌘ |
| | | | **X** | Test specifications | |
| | | | **X** | O&M Specifications | |
| ***Other comments:*** | ⌘ | | | | |

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1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

# Contents

# Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

# 1 Scope

The present document describes the characteristics of the physicals channels and the mapping of the transport channels to physical channels in the TDD 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.


[1] 3GPP TS 25.201: "Physical layer - general description".

[2] 3GPP TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)".

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

[4] 3GPP TS 25.213: "Spreading and modulation (FDD)".

[5] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[6] 3GPP TS 25.215: "Physical layer – Measurements (FDD)".

[7] 3GPP TS 25.222: "Multiplexing and channel coding (TDD)".

[8] 3GPP TS 25.223: "Spreading and modulation (TDD)".

[9] 3GPP TS 25.224: "Physical layer procedures (TDD)".

[10] 3GPP TS 25.225: "Physical layer – Measurements (TDD)".

[11] 3GPP TS 25.301: "Radio Interface Protocol Architecture".

[12] 3GPP TS 25.302: "Services Provided by the Physical Layer".

[13] 3GPP TS 25.401: "UTRAN Overall Description".

[14] 3GPP TS 25.402: "Synchronisation in UTRAN, Stage 2".

[15] 3GPP TS 25.304: " UE Procedures in Idle Mode and Procedures for Cell Reselection in Connected Mode".

[16] 3GPP TS 25.427: "UTRAN Iur and Iub interface user plane protocols for DCH data streams".

[17] 3GPP TS 25.435: "UTRAN $I_{ub}$ Interface User Plane Protocols for Common Transport Channel Data Streams".

# 3 Abbreviations

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

| | |
|---|---|
| BCH | Broadcast Channel |
| CCPCH | Common Control Physical Channel |
| CCTrCH | Coded Composite Transport Channel |
| CDMA | Code Division Multiple Access |
| DCH | Dedicated Channel |
| DL | Downlink |
| DPCH | Dedicated Physical Channel |
| DRX | Discontinuous Reception |
| DSCH | Downlink Shared Channel |
| DTX | Discontinuous Transmission |
| DwPCH | Downlink Pilot Channel |
| DwPTS | Downlink Pilot Time Slot |
| FACH | Forward Access Channel |
| FDD | Frequency Division Duplex |
| FEC | Forward Error Correction |
| GP | Guard Period |
| GSM | Global System for Mobile Communication |
| MIB | Master Information Block |
| NRT | Non-Real Time |
| OVSF | Orthogonal Variable Spreading Factor |
| P-CCPCH | Primary CCPCH |
| PCH | Paging Channel |
| PDSCH | Physical Downlink Shared Channel |
| PI | Paging Indicator (value calculated by higher layers) |
| PICH | Page Indicator Channel |
| $P_q$ | Paging Indicator (indicator set by physical layer) |
| PRACH | Physical Random Access Channel |
| PUSCH | Physical Uplink Shared Channel |
| RACH | Random Access Channel |
| RF | Radio Frame |
| RT | Real Time |
| S-CCPCH | Secondary CCPCH |
| SCH | Synchronisation Channel |
| SCTD | Space Code Transmit Diversity |
| SF | Spreading Factor |
| SFN | Cell System Frame Number |
| TCH | Traffic Channel |
| TDD | Time Division Duplex |
| TDMA | Time Division Multiple Access |
| TFC | Transport Format Combination |
| TFCI | Transport Format Combination Indicator |
| TFI | Transport Format Indicator |
| TPC | Transmitter Power Control |
| TrCH | Transport Channel |
| TSTD | Time Switched Transmit Diversity |
| TTI | Transmission Time Interval |
| UE | User Equipment |
| UL | Uplink |
| UMTS | Universal Mobil Telecommunications System |
| UpPTS | Uplink Pilot Time Slot |
| UpPCH | Uplink Pilot Channel |
| USCH | Uplink Shared Channel |
| UTRAN | UMTS Terrestrial Radio Access Network |

# 4 Services offered to higher layers

## 4.1 Transport channels

Transport channels are the services offered by layer 1 to the higher layers. A transport channel is defined by how and with what characteristics data is transferred over the air interface. A general classification of transport channels is into two groups:

- Dedicated Channels, using inherent addressing of UE
- Common Channels, using explicit addressing of UE if addressing is needed

General concepts about transport channels are described in [12].

### 4.1.1 Dedicated transport channels

The Dedicated Channel (DCH) is an up- or downlink transport channel that is used to carry user or control information between the UTRAN and a UE.

### 4.1.2 Common transport channels

There are six types of transport channels: BCH, FACH, PCH, RACH, USCH, DSCH

#### 4.1.2.1 BCH - Broadcast Channel

The Broadcast Channel (BCH) is a downlink transport channel that is used to broadcast system- and cell-specific information.

#### 4.1.2.2 FACH – Forward Access Channel

The Forward Access Channel (FACH) is a downlink transport channel that is used to carry control information to a mobile station when the system knows the location cell of the mobile station. The FACH may also carry short user packets.

#### 4.1.2.3 PCH – Paging Channel

The Paging Channel (PCH) is a downlink transport channel that is used to carry control information to a mobile station when the system does not know the location cell of the mobile station.

#### 4.1.2.4 RACH – Random Access Channel

The Random Access Channel (RACH) is an up link transport channel that is used to carry control information from mobile station. The RACH may also carry short user packets.

#### 4.1.2.5 USCH – Uplink Shared Channel

The uplink shared channel (USCH) is an uplink transport channel shared by several UEs carrying dedicated control or traffic data.

#### 4.1.2.6 DSCH – Downlink Shared Channel

The downlink shared channel (DSCH) is a downlink transport channel shared by several UEs carrying dedicated control or traffic data.

## 4.2 Indicators

Indicators are means of fast low-level signalling entities which are transmitted without using information blocks sent over transport channels. The meaning of indicators is implicit to the receiver.

The indicator(s) defined in the current version of the specifications are: Paging Indicator.

# 5 Physical channels for the 3.84 Mcps option

All physical channels take three-layer structure with respect to timeslots, radio frames and system frame numbering (SFN), see [14]. Depending on the resource allocation, the configuration of radio frames or timeslots becomes different. All physical channels need a guard period in every timeslot. The time slots are used in the sense of a TDMA component to separate different user signals in the time domain. The physical channel signal format is presented in figure 1.

A physical channel in TDD is a burst, which is transmitted in a particular timeslot within allocated Radio Frames. The allocation can be continuous, i.e. the time slot in every frame is allocated to the physical channel or discontinuous, i.e. the time slot in a subset of all frames is allocated only. A burst is the combination of two data parts, a midamble part and a guard period. The duration of a burst is one time slot. Several bursts can be transmitted at the same time from one transmitter. In this case, the data parts must use different OVSF channelisation codes, but the same scrambling code. The midamble parts are either identicaly or differently shifted versions of a cell-specific basic midamble code, see section 5.2.3.

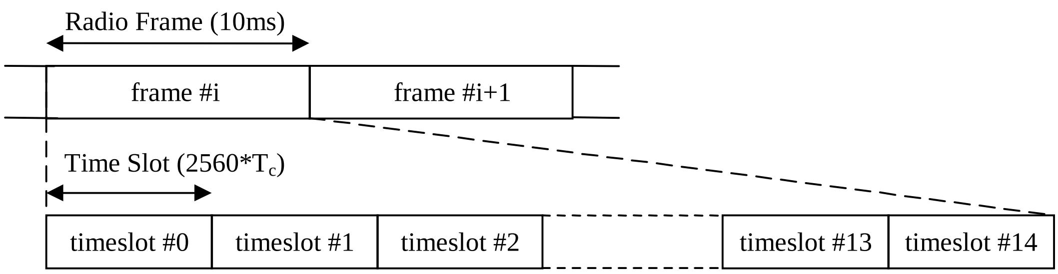



**Figure 1: Physical channel signal format**

The data part of the burst is spread with a combination of channelisation code and scrambling code. The channelisation code is a OVSF code, that can have a spreading factor of 1, 2, 4, 8, or 16. The data rate of the physical channel is depending on the used spreading factor of the used OVSF code.

The midamble part of the burst can contain two different types of midambles: a short one of length 256 chips, or a long one of 512 chips. The data rate of the physical channel is depending on the used midamble length.

So a physical channel is defined by frequency, timeslot, channelisation code, burst type and Radio Frame allocation. The scrambling code and the basic midamble code are broadcast and may be constant within a cell. When a physical channel is established, a start frame is given. The physical channels can either be of infinite duration, or a duration for the allocation can be defined.

## 5.1 Frame structure

The TDMA frame has a duration of 10 ms and is subdivided into 15 time slots (TS) of 2560*$T_c$ duration each. A time slot corresponds to 2560 chips. The physical content of the time slots are the bursts of corresponding length as described in subclause 5.2.2.

Each 10 ms frame consists of 15 time slots, each allocated to either the uplink or the downlink (figure 2). With such a flexibility, the TDD mode can be adapted to different environments and deployment scenarios. In any configuration at least one time slot has to be allocated for the downlink and at least one time slot has to be allocated for the uplink.

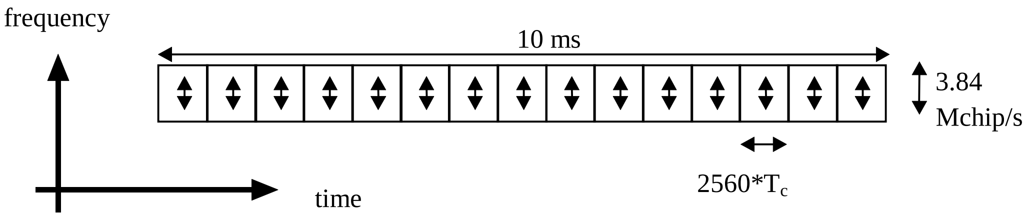
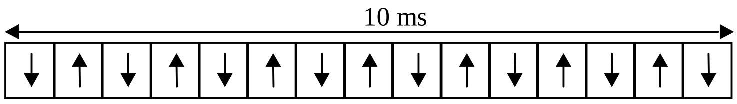
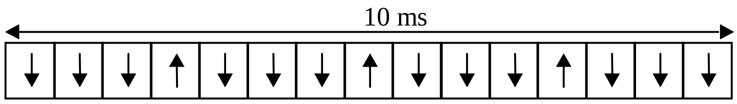



**Figure 2: The TDD frame structure**

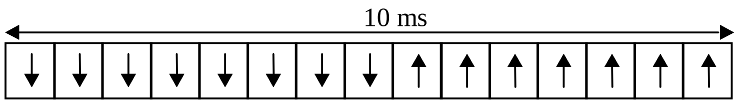
Examples for multiple and single switching point configurations as well as for symmetric and asymmetric UL/DL allocations are given in figure 3.



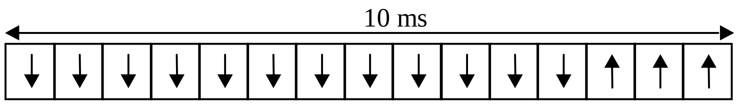

**Multiple-switching-point configuration (symmetric DL/UL allocation)**




**Multiple-switching-point configuration (asymmetric DL/UL allocation)**




**Single-switching-point configuration (symmetric DL/UL allocation)**




**Single-switching-point configuration (asymmetric DL/UL allocation)**

**Figure 3: TDD frame structure examples**

## 5.2 Dedicated physical channel (DPCH)

The DCH as described in subclause 4.1.1 is mapped onto the dedicated physical channel.

### 5.2.1 Spreading

Spreading is applied to the data part of the physical channels and consists of two operations. The first is the channelisation operation, which transforms every data symbol into a number of chips, thus increasing the bandwidth of the signal. The number of chips per data symbol is called the Spreading Factor (SF). The second operation is the scrambling operation, where a scrambling code is applied to the spread signal. Details on channelisation and scrambling operation can be found in [8].

#### 5.2.1.1 Spreading for Downlink Physical Channels

Downlink physical channels shall use SF =16. Multiple parallel physical channels can be used to support higher data rates. These parallel physical channels shall be transmitted using different channelisation codes, see [8]. These codes with SF =16 are generated as described in [8].

Operation with a single code with spreading factor 1 is possible for the downlink physical channels.

#### 5.2.1.2 Spreading for Uplink Physical Channels

The range of spreading factor that may be used for uplink physical channels shall range from 16 down to 1. For each physical channel an individual minimum spreading factor $SF_{min}$ is transmitted by means of the higher layers. There are two options that are indicated by UTRAN:

1. The UE shall use the spreading factor $SF_{min}$, independent of the current TFC.

2. The UE shall autonomously increase the spreading factor depending on the current TFC.

If the UE autonomously changes the SF, it shall always vary the channelisation code along the branch with the higher code numbering of the allowed OVSF sub tree, as depicted in [8].

For multicode transmission a UE shall use a maximum of two physical channels per timeslot simultaneously. These two parallel physical channels shall be transmitted using different channelisation codes, see [8].

### 5.2.2 Burst Types

Three types of bursts for dedicated physical channels are defined. All of them consist of two data symbol fields, a midamble and a guard period, the lengths of which are different for the individual burst types. Thus, the number of data symbols in a burst depends on the SF and the burst type, as depicted in table 1.

**Table 1: Number of data symbols (N) for burst type 1, 2, and 3**

| Spreading factor (SF) | Burst Type 1 | Burst Type 2 | Burst Type 3 |
|---|---|---|---|
| 1 | 1952 | 2208 | 1856 |
| 2 | 976 | 1104 | 928 |
| 4 | 488 | 552 | 464 |
| 8 | 244 | 276 | 232 |
| 16 | 122 | 138 | 116 |

The support of all three burst types is mandatory for the UE. The three different bursts defined here are well suited for different applications, as described in the following sections.

#### 5.2.2.1 Burst Type 1

The burst type 1 can be used for uplink and downlink. Due to its longer midamble field this burst type supports the construction of a larger number of training sequences, see 5.2.3. The maximum number of training sequences depend on the cell configuration, see annex A. For the burst type 1 this number may be 4, 8, or 16.

The data fields of the burst type 1 are 976 chips long. The corresponding number of symbols depends on the spreading factor, as indicated in table 1 above. The midamble of burst type 1 has a length of 512 chips. The guard period for the burst type 1 is 96 chip periods long. The burst type 1 is shown in Figure 4. The contents of the burst fields are described in table 2.

**Table 2: The contents of the burst type 1 fields**

| Chip number (CN) | Length of field in chips | Length of field in symbols | | Contents of field |
|---|---|---|---|---|
| 0-975 | 976 | Cf table 1 | | Data symbols |
| 976-1487 | 512 | - | | Midamble |
| 1488-2463 | 976 | Cf table 1 | | Data symbols |
| 2464-2559 | 96 | - | | Guard period |

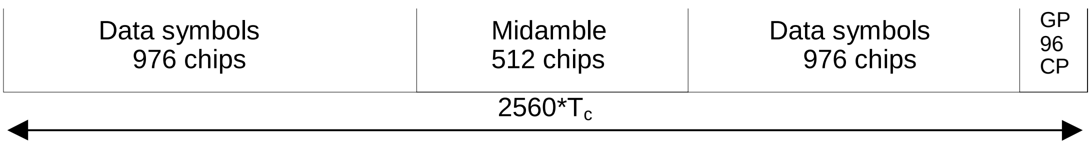



**Figure 4**: **Burst structure of the burst type 1. GP denotes the guard period and CP the chip periods**

#### 5.2.2.2 Burst Type 2

The burst type 2 can be used for uplink and downlink. It offers a longer data field than burst type 1 on the cost of a shorter midamble. Due to the shorter midamble field the burst type 2 supports a maximum number of training sequences of 3 or 6 only, depending on the cell configuration, see annex A.

The data fields of the burst type 2 are 1104 chips long. The corresponding number of symbols depends on the spreading factor, as indicated in table 1 above. The guard period for the burst type 2 is 96 chip periods long.The burst type 2 is shown in Figure 5. The contents of the burst fields are described in table 3.

**Table 3: The contents of the burst type 2 fields**

| Chip number (CN) | Length of field in chips | Length of field in symbols | | Contents of field |
|---|---|---|---|---|
| 0-1103 | 1104 | cf table 1 | | Data symbols |
| 1104-1359 | 256 | - | | Midamble |
| 1360-2463 | 1104 | cf table 1 | | Data symbols |
| 2464-2559 | 96 | - | | Guard period |

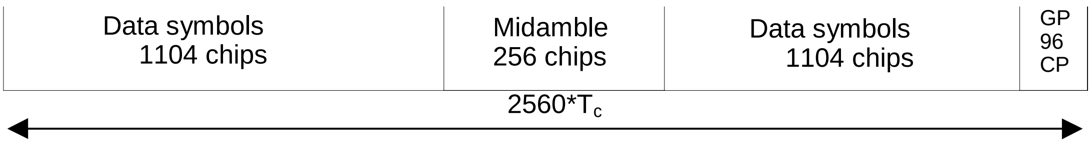



**Figure 5**: **Burst structure of the burst type 2. GP denotes the guard period and CP the chip periods**

#### 5.2.2.3 Burst Type 3

The burst type 3 is used for uplink only. Due to the longer guard period it is suitable for initial access or access to a new cell after handover. It offers the same number of training sequences as burst type 1.

The data fields of the burst type 3 have a length of 976 chips and 880 chips, respectively. The corresponding number of symbols depends on the spreading factor, as indicated in table 1 above. The midamble of burst type 3 has a length of 512 chips. The guard period for the burst type 3 is 192 chip periods long. The burst type 3 is shown in Figure 6. The contents of the burst fields are described in table 4.

**Table 4: The contents of the burst type 3 fields**

| Chip number (CN) | Length of field in chips | Length of field in symbols | | Contents of field |
|---|---|---|---|---|
| 0-975 | 976 | Cf table 1 | | Data symbols |
| 976-1487 | 512 | - | | Midamble |
| 1488-2367 | 880 | Cf table 1 | | Data symbols |
| 2368-2559 | 192 | - | | Guard period |

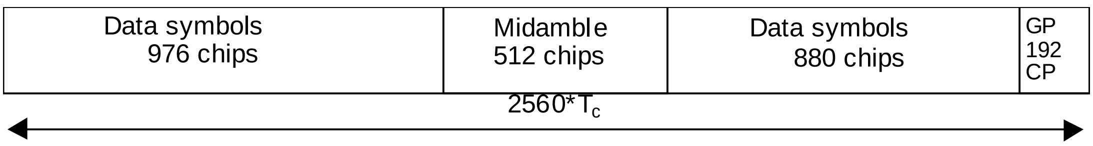



**Figure 6**: **Burst structure of the burst type 3. GP denotes the guard period and CP the chip periods**

#### 5.2.2.4 Transmission of TFCI

All burst types 1, 2 and 3 provide the possibility for transmission of TFCI.

The transmission of TFCI is negotiated at call setup and can be re-negotiated during the call. For each CCTrCH it is indicated by higher layer signalling, which TFCI format is applied. Additionally for each allocated timeslot it is signalled individually whether that timeslot carries the TFCI or not. The TFCI is always present in the first timeslot in a radio frame for each CCTrCH. If a time slot contains the TFCI, then it is always transmitted using the physical channel with the lowest physical channel sequence number (*p*) in that timeslot. Physical channel sequence numbering is determined by the rate matching function and is described in [7].

The transmission of TFCI is done in the data parts of the respective physical channel. In DL the TFCI code word bits and data bits are subject to the same spreading procedure as depicted in [8]. In UL, independent of the SF that is applied to the data symbols in the burst, the data in the TFCI field are always spread with SF=16 using the channelisation code in the branch with the highest code numbering of the allowed OVSF sub tree, as depicted in [8]. Hence the midamble structure and length is not changed. The TFCI code word is to be transmitted directly adjacent to the midamble, possibly after the TPC. Figure 7 shows the position of the TFCI code word in a traffic burst in downlink. Figure 8 shows the position of the TFCI code word in a traffic burst in uplink.

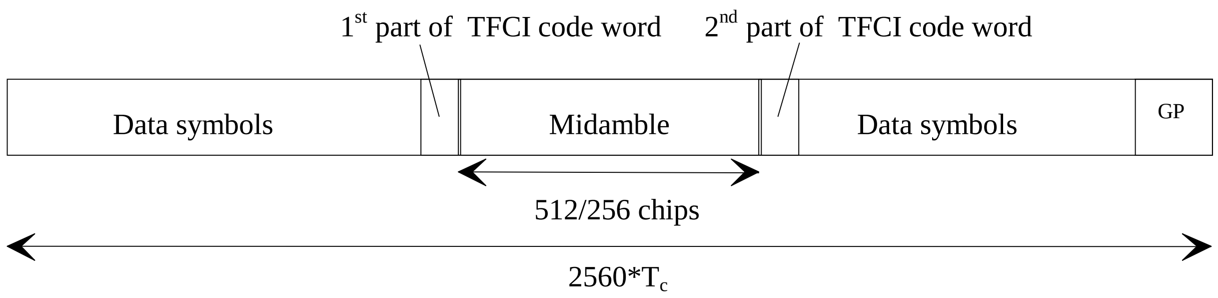



**Figure 7: Position of the TFCI code word in the traffic burst in case of downlink**

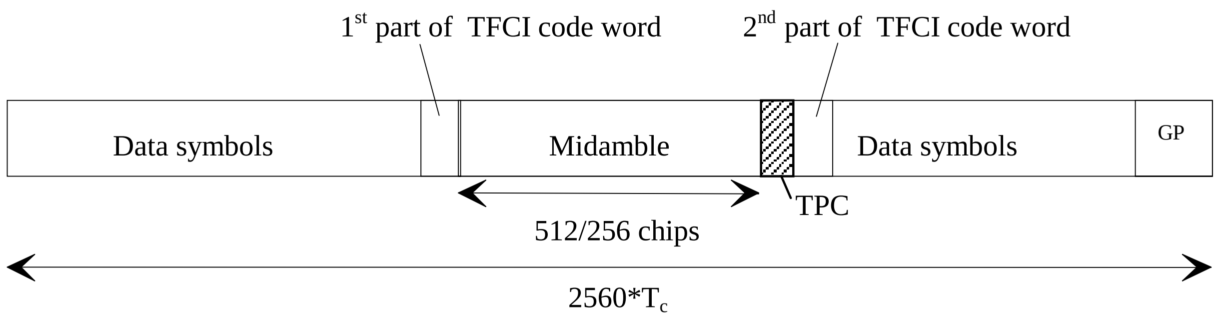



**Figure 8: Position of the TFCI code word in the traffic burst in case of uplink**

Two examples of TFCI transmission in the case of multiple DPCHs used for a connection are given in the Figure 9 and Figure 10 below. Combinations of the two schemes shown are also applicable.

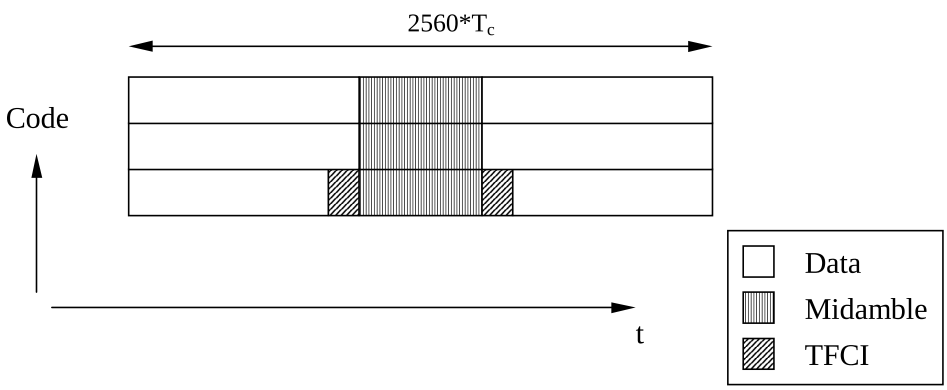



**Figure 9: Example of TFCI transmission with physical channels multiplexed in code domain**

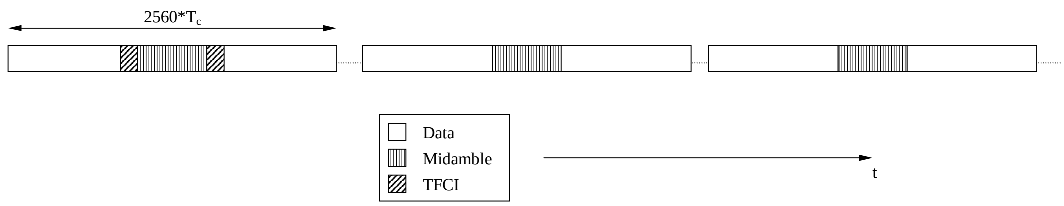



**Figure 10: Example of TFCI transmission with physical channels multiplexed in time domain**

In case the Node B receives an invalid TFI combination on the DCHs mapped to one CCTrCH the procedure described in [16] shall be applied. According to this procedure DTX shall be applied to all DPCHs to which the CCTrCH is mapped to.

#### 5.2.2.5 Transmission of TPC

All burst types 1, 2 and 3 for dedicated channels provide the possibility for transmission of TPC in uplink.

The transmission of TPC is done in the data parts of the traffic burst. Independent of the SF that is applied to the data symbols in the burst, the data in the TPC field are always spread with SF=16 using the channelisation code in the branch with the highest code numbering of the allowed OVSF sub tree, as depicted in [8]. Hence the midamble structure and length is not changed. The TPC information is to be transmitted directly after the midamble. Figure 11 shows the position of the TPC in a traffic burst.

For every user the TPC information shall be transmitted at least once per transmitted frame. If a TFCI is applied for a CCTrCH, TPC shall be transmitted with the same channelization codes and in the same timeslots as the TFCI. If no TFCI is applied for a CCTrCH, TPC shall be transmitted using the physical channel corresponding to physical channel sequence number $p$=1. Physical channel sequence numbering is determined by the rate matching function and is described in [7].

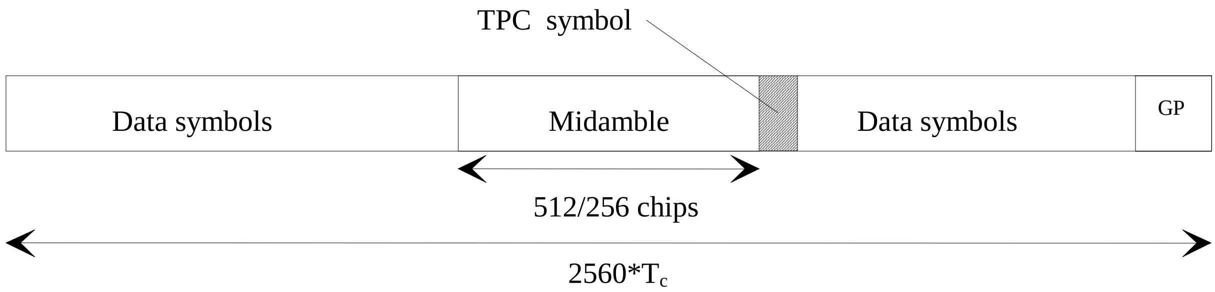



**Figure 11: Position of TPC information in the traffic burst**

The length of the TPC command is one symbol. The relationship between the TPC symbol and the TPC command is shown in table 4a.

**Table 4a: TPC bit pattern**

| TPC Bits | TPC command | Meaning |
|---|---|---|
| 00 | 'Down' | Decrease Tx Power |
| 11 | 'Up' | Increase Tx Power |

#### 5.2.2.6 Timeslot formats

##### 5.2.2.6.1 Downlink timeslot formats

The downlink timeslot format depends on the spreading factor, midamble length and on the number of the TFCI code word bits, as depicted in the table 5a.

**Table 5a: Time slot formats for the Downlink**

| Slot Format # | Spreading Factor | Midamble length (chips) | $N_{TFCI\ code\ word}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data\ field}$ (bits) |
|---|---|---|---|---|---|---|
| 0 | 16 | 512 | 0 | 244 | 244 | 122 |
| 1 | 16 | 512 | 4 | 244 | 240 | 120 |
| 2 | 16 | 512 | 8 | 244 | 236 | 118 |
| 3 | 16 | 512 | 16 | 244 | 228 | 114 |
| 4 | 16 | 512 | 32 | 244 | 212 | 106 |
| 5 | 16 | 256 | 0 | 276 | 276 | 138 |
| 6 | 16 | 256 | 4 | 276 | 272 | 136 |
| 7 | 16 | 256 | 8 | 276 | 268 | 134 |
| 8 | 16 | 256 | 16 | 276 | 260 | 130 |
| 9 | 16 | 256 | 32 | 276 | 244 | 122 |
| 10 | 1 | 512 | 0 | 3904 | 3904 | 1952 |
| 11 | 1 | 512 | 4 | 3904 | 3900 | 1950 |
| 12 | 1 | 512 | 8 | 3904 | 3896 | 1948 |
| 13 | 1 | 512 | 16 | 3904 | 3888 | 1944 |
| 14 | 1 | 512 | 32 | 3904 | 3872 | 1936 |
| 15 | 1 | 256 | 0 | 4416 | 4416 | 2208 |
| 16 | 1 | 256 | 4 | 4416 | 4412 | 2206 |
| 17 | 1 | 256 | 8 | 4416 | 4408 | 2204 |
| 18 | 1 | 256 | 16 | 4416 | 4400 | 2200 |
| 19 | 1 | 256 | 32 | 4416 | 4384 | 2192 |

#### 5.2.2.6.2 Uplink timeslot formats

The uplink timeslot format depends on the spreading factor, midamble length, guard period length and on the number of the TFCI code word bits. Due to TPC, different amount of bits are mapped to the two data fields. The timeslot formats are depicted in the table 5b.

**Table 5b: Timeslot formats for the Uplink**

| Slot Format # | Spreading Factor | Midamble length (chips) | Guard Period (chips) | $N_{TFCI}$ code word (bits) | $N_{TPC}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data field(1)}$ (bits) | $N_{data/data field(2)}$ (bits) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 16 | 512 | 96 | 0 | 0 | 244 | 244 | 122 | 122 |
| 1 | 16 | 512 | 96 | 0 | 2 | 244 | 242 | 122 | 120 |
| 2 | 16 | 512 | 96 | 4 | 2 | 244 | 238 | 120 | 118 |
| 3 | 16 | 512 | 96 | 8 | 2 | 244 | 234 | 118 | 116 |
| 4 | 16 | 512 | 96 | 16 | 2 | 244 | 226 | 114 | 112 |
| 5 | 16 | 512 | 96 | 32 | 2 | 244 | 210 | 106 | 104 |
| 6 | 16 | 256 | 96 | 0 | 0 | 276 | 276 | 138 | 138 |
| 7 | 16 | 256 | 96 | 0 | 2 | 276 | 274 | 138 | 136 |
| 8 | 16 | 256 | 96 | 4 | 2 | 276 | 270 | 136 | 134 |
| 9 | 16 | 256 | 96 | 8 | 2 | 276 | 266 | 134 | 132 |
| 10 | 16 | 256 | 96 | 16 | 2 | 276 | 258 | 130 | 128 |
| 11 | 16 | 256 | 96 | 32 | 2 | 276 | 242 | 122 | 120 |
| 12 | 8 | 512 | 96 | 0 | 0 | 488 | 488 | 244 | 244 |
| 13 | 8 | 512 | 96 | 0 | 2 | 486 | 484 | 244 | 240 |
| 14 | 8 | 512 | 96 | 4 | 2 | 482 | 476 | 240 | 236 |
| 15 | 8 | 512 | 96 | 8 | 2 | 478 | 468 | 236 | 232 |
| 16 | 8 | 512 | 96 | 16 | 2 | 470 | 452 | 228 | 224 |
| 17 | 8 | 512 | 96 | 32 | 2 | 454 | 420 | 212 | 208 |
| 18 | 8 | 256 | 96 | 0 | 0 | 552 | 552 | 276 | 276 |
| 19 | 8 | 256 | 96 | 0 | 2 | 550 | 548 | 276 | 272 |
| 20 | 8 | 256 | 96 | 4 | 2 | 546 | 540 | 272 | 268 |
| 21 | 8 | 256 | 96 | 8 | 2 | 542 | 532 | 268 | 264 |
| 22 | 8 | 256 | 96 | 16 | 2 | 534 | 516 | 260 | 256 |
| 23 | 8 | 256 | 96 | 32 | 2 | 518 | 484 | 244 | 240 |
| 24 | 4 | 512 | 96 | 0 | 0 | 976 | 976 | 488 | 488 |
| 25 | 4 | 512 | 96 | 0 | 2 | 970 | 968 | 488 | 480 |
| 26 | 4 | 512 | 96 | 4 | 2 | 958 | 952 | 480 | 472 |
| 27 | 4 | 512 | 96 | 8 | 2 | 946 | 936 | 472 | 464 |
| 28 | 4 | 512 | 96 | 16 | 2 | 922 | 904 | 456 | 448 |
| 29 | 4 | 512 | 96 | 32 | 2 | 874 | 840 | 424 | 416 |
| 30 | 4 | 256 | 96 | 0 | 0 | 1104 | 1104 | 552 | 552 |
| 31 | 4 | 256 | 96 | 0 | 2 | 1098 | 1096 | 552 | 544 |
| 32 | 4 | 256 | 96 | 4 | 2 | 1086 | 1080 | 544 | 536 |
| 33 | 4 | 256 | 96 | 8 | 2 | 1074 | 1064 | 536 | 528 |
| 34 | 4 | 256 | 96 | 16 | 2 | 1050 | 1032 | 520 | 512 |
| 35 | 4 | 256 | 96 | 32 | 2 | 1002 | 968 | 488 | 480 |
| 36 | 2 | 512 | 96 | 0 | 0 | 1952 | 1952 | 976 | 976 |
| 37 | 2 | 512 | 96 | 0 | 2 | 1938 | 1936 | 976 | 960 |
| 38 | 2 | 512 | 96 | 4 | 2 | 1910 | 1904 | 960 | 944 |
| 39 | 2 | 512 | 96 | 8 | 2 | 1882 | 1872 | 944 | 928 |
| 40 | 2 | 512 | 96 | 16 | 2 | 1826 | 1808 | 912 | 896 |
| 41 | 2 | 512 | 96 | 32 | 2 | 1714 | 1680 | 848 | 832 |
| 42 | 2 | 256 | 96 | 0 | 0 | 2208 | 2208 | 1104 | 1104 |
| 43 | 2 | 256 | 96 | 0 | 2 | 2194 | 2192 | 1104 | 1088 |
| 44 | 2 | 256 | 96 | 4 | 2 | 2166 | 2160 | 1088 | 1072 |
| 45 | 2 | 256 | 96 | 8 | 2 | 2138 | 2128 | 1072 | 1056 |
| 46 | 2 | 256 | 96 | 16 | 2 | 2082 | 2064 | 1040 | 1024 |
| 47 | 2 | 256 | 96 | 32 | 2 | 1970 | 1936 | 976 | 960 |

| Slot Format # | Spreading Factor | Midamble length (chips) | Guard Period (chips) | $N_{TFCI}$ code word (bits) | $N_{TPC}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data\ field(1)}$ (bits) | $N_{data/data\ field(2)}$ (bits) |
|---|---|---|---|---|---|---|---|---|---|
| 48 | 1 | 512 | 96 | 0 | 0 | 3904 | 3904 | 1952 | 1952 |
| 49 | 1 | 512 | 96 | 0 | 2 | 3874 | 3872 | 1952 | 1920 |
| 50 | 1 | 512 | 96 | 4 | 2 | 3814 | 3808 | 1920 | 1888 |
| 51 | 1 | 512 | 96 | 8 | 2 | 3754 | 3744 | 1888 | 1856 |
| 52 | 1 | 512 | 96 | 16 | 2 | 3634 | 3616 | 1824 | 1792 |
| 53 | 1 | 512 | 96 | 32 | 2 | 3394 | 3360 | 1696 | 1664 |
| 54 | 1 | 256 | 96 | 0 | 0 | 4416 | 4416 | 2208 | 2208 |
| 55 | 1 | 256 | 96 | 0 | 2 | 4386 | 4384 | 2208 | 2176 |
| 56 | 1 | 256 | 96 | 4 | 2 | 4326 | 4320 | 2176 | 2144 |
| 57 | 1 | 256 | 96 | 8 | 2 | 4266 | 4256 | 2144 | 2112 |
| 58 | 1 | 256 | 96 | 16 | 2 | 4146 | 4128 | 2080 | 2048 |
| 59 | 1 | 256 | 96 | 32 | 2 | 3906 | 3872 | 1952 | 1920 |
| 60 | 16 | 512 | 192 | 0 | 0 | 232 | 232 | 122 | 110 |
| 61 | 16 | 512 | 192 | 0 | 2 | 232 | 230 | 122 | 108 |
| 62 | 16 | 512 | 192 | 4 | 2 | 232 | 226 | 120 | 106 |
| 63 | 16 | 512 | 192 | 8 | 2 | 232 | 222 | 118 | 104 |
| 64 | 16 | 512 | 192 | 16 | 2 | 232 | 214 | 114 | 100 |
| 65 | 16 | 512 | 192 | 32 | 2 | 232 | 198 | 106 | 92 |
| 66 | 8 | 512 | 192 | 0 | 0 | 464 | 464 | 244 | 220 |
| 67 | 8 | 512 | 192 | 0 | 2 | 462 | 460 | 244 | 216 |
| 68 | 8 | 512 | 192 | 4 | 2 | 458 | 452 | 240 | 212 |
| 69 | 8 | 512 | 192 | 8 | 2 | 454 | 444 | 236 | 208 |
| 70 | 8 | 512 | 192 | 16 | 2 | 446 | 428 | 228 | 200 |
| 71 | 8 | 512 | 192 | 32 | 2 | 430 | 396 | 212 | 184 |
| 72 | 4 | 512 | 192 | 0 | 0 | 928 | 928 | 488 | 440 |
| 73 | 4 | 512 | 192 | 0 | 2 | 922 | 920 | 488 | 432 |
| 74 | 4 | 512 | 192 | 4 | 2 | 910 | 904 | 480 | 424 |
| 75 | 4 | 512 | 192 | 8 | 2 | 898 | 888 | 472 | 416 |
| 76 | 4 | 512 | 192 | 16 | 2 | 874 | 856 | 456 | 400 |
| 77 | 4 | 512 | 192 | 32 | 2 | 826 | 792 | 424 | 368 |
| 78 | 2 | 512 | 192 | 0 | 0 | 1856 | 1856 | 976 | 880 |
| 79 | 2 | 512 | 192 | 0 | 2 | 1842 | 1840 | 976 | 864 |
| 80 | 2 | 512 | 192 | 4 | 2 | 1814 | 1808 | 960 | 848 |
| 81 | 2 | 512 | 192 | 8 | 2 | 1786 | 1776 | 944 | 832 |
| 82 | 2 | 512 | 192 | 16 | 2 | 1730 | 1712 | 912 | 800 |
| 83 | 2 | 512 | 192 | 32 | 2 | 1618 | 1584 | 848 | 736 |
| 84 | 1 | 512 | 192 | 0 | 0 | 3712 | 3712 | 1952 | 1760 |
| 85 | 1 | 512 | 192 | 0 | 2 | 3682 | 3680 | 1952 | 1728 |
| 86 | 1 | 512 | 192 | 4 | 2 | 3622 | 3616 | 1920 | 1696 |
| 87 | 1 | 512 | 192 | 8 | 2 | 3562 | 3552 | 1888 | 1664 |
| 88 | 1 | 512 | 192 | 16 | 2 | 3442 | 3424 | 1824 | 1600 |
| 89 | 1 | 512 | 192 | 32 | 2 | 3202 | 3168 | 1696 | 1472 |

### 5.2.3 Training sequences for spread bursts

In this subclause, the training sequences for usage as midambles in burst type 1, 2 and 3 (see subclause 5.2.2) are defined. The training sequences, i.e. midambles, of different users active in the same cell and same time slot are cyclically shifted versions of one cell-specific single basic midamble code. The applicable basic midamble codes are given in Annex A.1 and A.2. As different basic midamble codes are required for different burst formats, the Annex A.1 shows the basic midamble codes $\mathbf{m}_{PL}$ for burst type 1 and 3, and Annex and A.2 shows $\mathbf{m}_{PS}$ for burst type 2. It should be noted that burst type 2 must not be mixed with burst type 1 or 3 in the same timeslot of one cell.

The basic midamble codes in Annex A.1 and A.2 are listed in hexadecimal notation. The binary form of the basic midamble code shall be derived according to table 6 below.

**Table 6: Mapping of 4 binary elements $m_i$ on a single hexadecimal digit**

| 4 binary elements $m_i$ | Mapped on hexadecimal digit |
|---|---|
| -1 -1 -1 -1 | 0 |
| -1 -1 -1 1 | 1 |
| -1 -1 1 –1 | 2 |
| -1 -1 1 1 | 3 |
| -1 1 -1 –1 | 4 |
| -1 1 -1 1 | 5 |
| -1 1 1 –1 | 6 |
| -1 1 1 1 | 7 |
| 1 -1 -1 –1 | 8 |
| 1 -1 -1 1 | 9 |
| 1 -1 1 –1 | A |
| 1 -1 1 1 | B |
| 1 1 -1 –1 | C |
| 1 1 -1 1 | D |
| 1 1 1 –1 | E |
| 1 1 1 1 | F |

For each particular basic midamble code, its binary representation can be written as a vector $\mathbf{m}_P$ :

$$\mathbf{m}_P = \left(m_1, m_2, ..., m_P\right) \qquad (1)$$

According to Annex A.1, the size of this vector $\mathbf{m}_P$ is P=456 for burst type 1 and 3. Annex A.2 is setting P=192 for burst type 2. As QPSK modulation is used, the training sequences are transformed into a complex form, denoted as the complex vector $\underline{\mathbf{m}}_P$ :

$$\underline{\mathbf{m}}_P = \left(\underline{m}_1, \underline{m}_2, ..., \underline{m}_P\right) \qquad (2)$$

The elements $\underline{m}_i$ of $\underline{\mathbf{m}}_P$ are derived from elements $m_i$ of $\mathbf{m}_P$ using equation (3):

$$\underline{m}_i = (\mathrm{j})^i \cdot m_i \text{ for all } i = 1,...,P \qquad (3)$$

Hence, the elements $\underline{m}_i$ of the complex basic midamble code are alternating real and imaginary.

To derive the required training sequences (different shifts), this vector $\underline{\mathbf{m}}_P$ is periodically extended to the size:

$$i_{\max} = L_m + (K'-1)W + \lfloor P/K \rfloor \qquad (4)$$

Notes on equation (4):

- $L_m$: Midamble length
- K': Maximum number of different midamble shifts in a cell, when no intermediate shifts are used. This value depends on the midamble length.
- K: Maximum number of different midamble shifts in a cell, when intermediate shifts are used, K=2K'. This value depends on the midamble length.
- W: Shift between the midambles, when the number of midambles is K'.

- $\lfloor x \rfloor$ denotes the largest integer smaller or equal to x

Allowed values for $L_m$, K' and W are given in Annex A.1 and A.2.

So we obtain a new vector $\underline{\mathbf{m}}$ containing the periodic basic midamble sequence:

$$\underline{\mathbf{m}} = \left(\underline{m}_1, \underline{m}_2, ..., \underline{m}_{i_{\max}}\right) = \left(\underline{m}_1, \underline{m}_2, ..., \underline{m}_{L_m+(K'-1)W+\lfloor P/K \rfloor}\right) \quad (5)$$

The first P elements of this vector $\underline{\mathbf{m}}$ are the same ones as in vector $\underline{\mathbf{m}}_P$, the following elements repeat the beginning:

$$\underline{m}_i = \underline{m}_{i-P} \text{ for the subset } i = (P+1), ..., i_{\max} \quad (6)$$

Using this periodic basic midamble sequence $\underline{\mathbf{m}}$ for each shift k a midamble $\underline{\mathbf{m}}^{(k)}$ of length $L_m$ is derived, which can be written as a shift specific vector:

$$\underline{\mathbf{m}}^{(k)} = \left(\underline{m}_1^{(k)}, \underline{m}_2^{(k)}, ..., \underline{m}_{L_m}^{(k)}\right) \quad (7)$$

The $L_m$ midamble elements $\underline{m}_i^{(k)}$ are generated for each midamble of the first K' shifts (k = 1,...,K') based on:

$$\underline{m}_i^{(k)} = \underline{m}_{i+(K'-k)W} \text{ with } i = 1, ..., L_m \text{ and } k = 1, ..., K' \quad (8)$$

The elements of midambles for the second K' shifts (k = (K'+1),...,K = (K'+1),...,2K') are generated based on a slight modification of this formula introducing intermediate shifts:

$$\underline{m}_i^{(k)} = \underline{m}_{i+(K-k-1)W+\lfloor P/K \rfloor} \text{ with } i = 1, ..., L_m \text{ and } k = K'+1, ..., K-1 \quad (9)$$

$$\underline{m}_i^{(k)} = \underline{m}_{i+(K'-1)W+\lfloor P/K \rfloor} \text{ with } i = 1, ..., L_m \text{ and } k = K \quad (10)$$

The number $K_{Cell}$ of midambles that is supported in each cell can be smaller than K, depending on the cell size and the possible delay spreads, see annex A. The number $K_{Cell}$ is signalled by higher layers. The midamble sequences derived according to equations (7) to (10) have complex values and are not subject to channelisation or scrambling process, i.e. the elements $\underline{m}_i^{(k)}$ represent complex chips for usage in the pulse shaping process at modulation.

The term 'a midamble code set' or 'a midamble code family' denotes K specific midamble codes $\underline{\mathbf{m}}^{(k)}$; k=1,...,K, based on a single basic midamble code $\mathbf{m}_P$ according to (1).

### 5.2.4 Beamforming

When DL beamforming is used, at least that user to which beamforming is applied and which has a dedicated channel shall get one individual midamble according to subclause 5.2.3, even in DL.

## 5.3 Common physical channels

### 5.3.1 Primary common control physical channel (P-CCPCH)

The BCH as described in subclause 4.1.2 is mapped onto the Primary Common Control Physical Channel (P-CCPCH). The position (time slot / code) of the P-CCPCH is known from the Physical Synchronisation Channel (PSCH), see subclause 5.3.4.

#### 5.3.1.1 P-CCPCH Spreading

The P-CCPCH uses fixed spreading with a spreading factor SF = 16 as described in subclause 5.2.1.1. The P-CCPCH always uses channelisation code $c_{Q=16}^{(k=1)}$.

#### 5.3.1.2 P-CCPCH Burst Types

The burst type 1 as described in subclause 5.2.2 is used for the P-CCPCH. No TFCI is applied for the P-CCPCH.

#### 5.3.1.3 P-CCPCH Training sequences

The training sequences, i.e. midambles, as described in subclause 5.2.3 are used for the P-CCPCH.

### 5.3.2 Secondary common control physical channel (S-CCPCH)

PCH and FACH as described in subclause 4.1.2 are mapped onto one or more secondary common control physical channels (S-CCPCH). In this way the capacity of PCH and FACH can be adapted to the different requirements.

#### 5.3.2.1 S-CCPCH Spreading

The S-CCPCH uses fixed spreading with a spreading factor SF = 16 as described in subclause 5.2.1.1.

#### 5.3.2.2 S-CCPCH Burst Types

The burst types 1 or 2 as described in subclause 5.2.2 are used for the S-CCPCHs. TFCI may be applied for S-CCPCHs.

#### 5.3.2.3 S-CCPCH Training sequences

The training sequences, i.e. midambles, as described in subclause 5.2.3 are used for the S-CCPCH.

### 5.3.3 The physical random access channel (PRACH)

The RACH as described in subclause 4.1.2 is mapped onto one uplink physical random access channel (PRACH).

#### 5.3.3.1 PRACH Spreading

The uplink PRACH uses either spreading factor SF=16 or SF=8 as described in subclause 5.2.1.2. The set of admissible spreading codes for use on the PRACH and the associated spreading factors are broadcast on the BCH (within the RACH configuration parameters on the BCH).

#### 5.3.3.2 PRACH Burst Type

The UEs send uplink access bursts of type 3 randomly in the PRACH. TFCI and TPC are not applied for the PRACH.

#### 5.3.3.3 PRACH Training sequences

The training sequences, i.e. midambles, of different users active in the same time slot are time shifted versions of a single periodic basic code. The basic midamble codes for burst type 3 are shown in Annex A. The necessary time shifts are obtained by choosing either *all* k=1,2,3...,K' (for cells with small radius) or *uneven* k=1,3,5,...≤K' (for cells with large radius). Different cells use different periodic basic codes, i.e. different midamble sets.

For cells with large radius additional midambles may be derived from the time-inverted Basic Midamble Sequence. Thus, the second Basic Midamble Code $m_2$ is the time inverted version of Basic Midamble Code $m_1$.

In this way, a joint channel estimation for the channel impulse responses of all active users within one time slot can be performed by a maximum of two cyclic correlations (in cells with small radius, a single cyclic correlator suffices). The different user specific channel impulse response estimates are obtained sequentially in time at the output of the cyclic correlators.

#### 5.3.3.4 PRACH timeslot formats

For the PRACH the timeslot format is only spreading factor dependent. The timeslot formats 60 and 66 of table 5b are applicable for the PRACH.

#### 5.3.3.5 Association between Training Sequences and Channelisation Codes

For the PRACH there exists a fixed association between the training sequence and the channelisation code. The generic rule to define this association is based on the order of the channelisation codes $\mathbf{c}_Q^{(k)}$ given by *k* and the order of the midambles $\mathbf{m}_j^{(k)}$ given by *k*, firstly, and *j*, secondly, with the constraint that the midamble for a spreading factor *Q* is the same as in the upper branch for the spreading factor 2*Q*. The index *j=1 or 2* indicates whether the original Basic Midamble Sequence (j=1) or the time-inverted Basic Midamble Sequence is used (j=2).

- For the case that all *k* are allowed and only one periodic basic code $m_1$ is available for the RACH, the association depicted in figure 12 is straightforward.
- For the case that only odd *k* are allowed the principle of the association is shown in figure 13. This association is applied for one and two basic periodic codes.

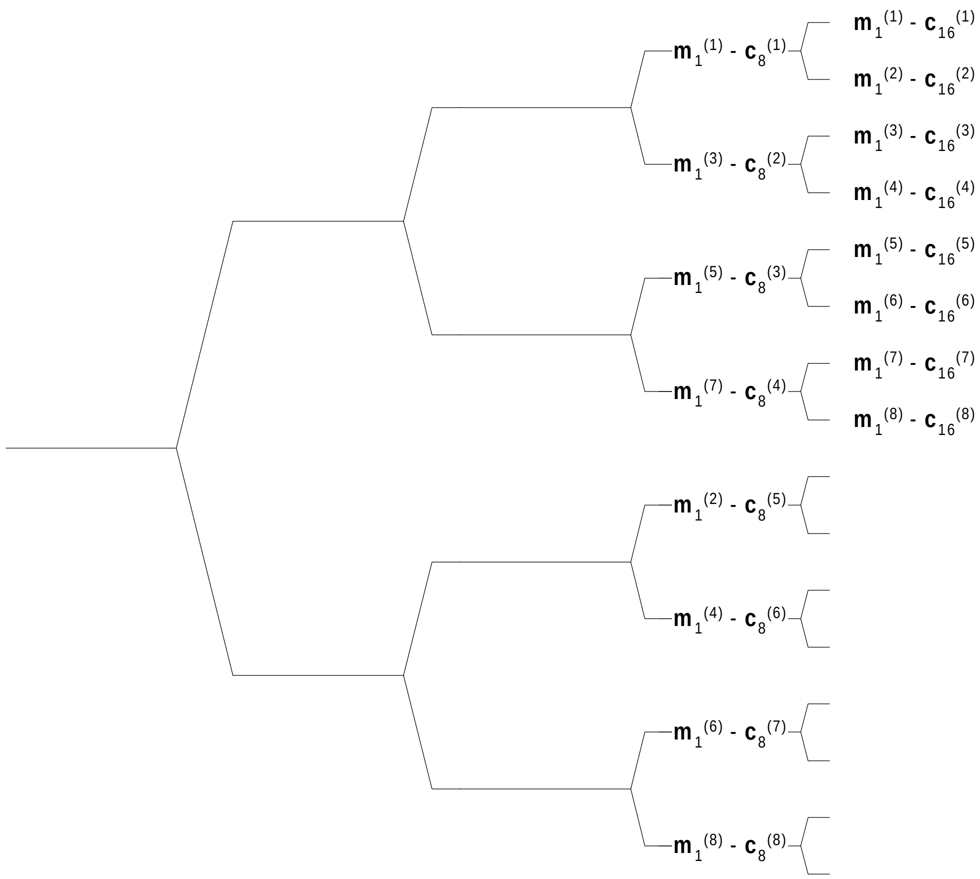



**Figure 12: Association of Midambles to Channelisation Codes in the OVSF tree for all *k***

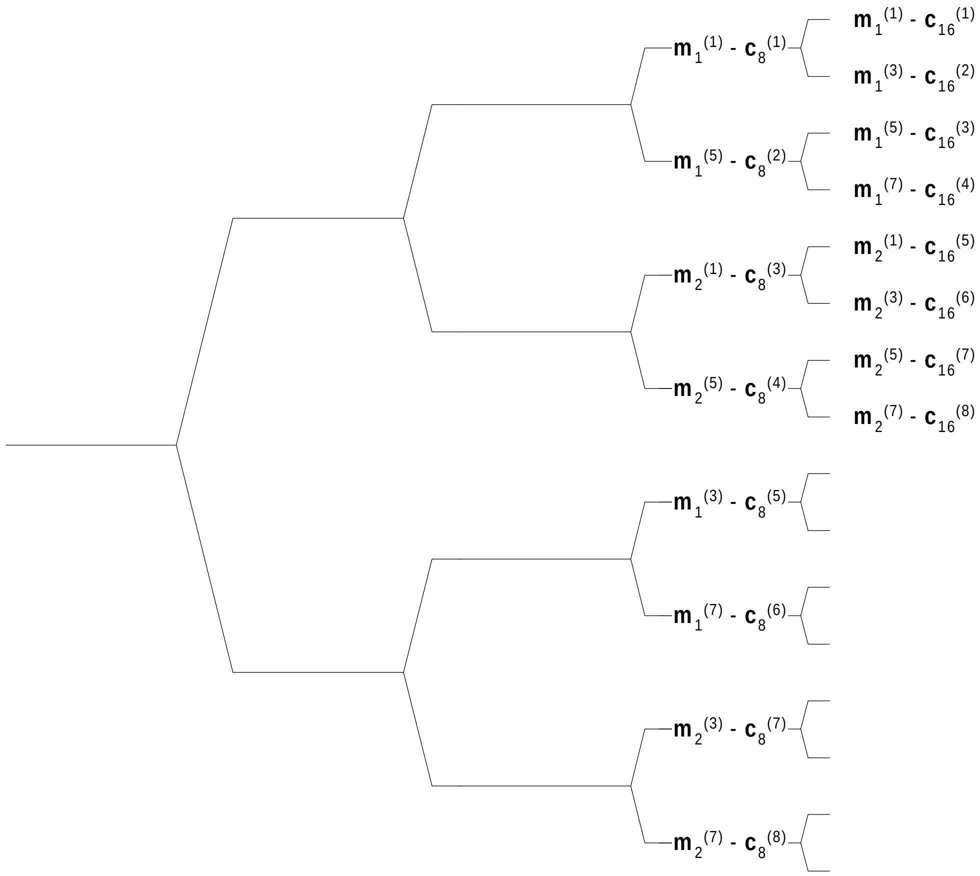



**Figure 13: Association of Midambles to Channelisation Codes in the OVSF tree for odd *k***

## 5.3.4 The synchronisation channel (SCH)

In TDD mode code group of a cell can be derived from the synchronisation channel. In order not to limit the uplink/downlink asymmetry the SCH is mapped on one or two downlink slots per frame only.

There are two cases of SCH and P-CCPCH allocation as follows:

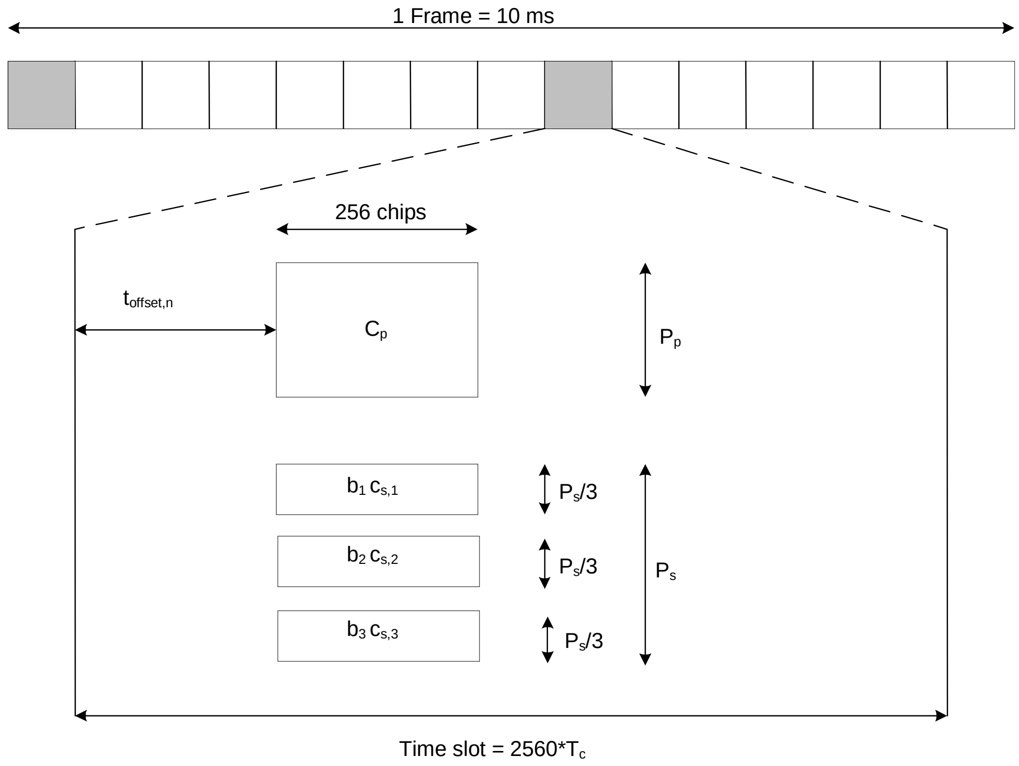
Case 1) SCH and P-CCPCH allocated in TS#k, k=0….14

Case 2) SCH allocated in two TS: TS#k and TS#k+8, k=0…6; P-CCPCH allocated in TS#k.

The position of SCH (value of k) in frame can change on a long term basis in any case.

Due to this SCH scheme, the position of P-CCPCH is known from the SCH.

Figure 14 is an example for transmission of SCH, k=0, of Case 2.




$b_i \in \{\pm 1, \pm j\}$, $C_{s,i} \in \{C_0, C_1, C_3, C_4, C_5, C_6, C_8, C_{10}, C_{12}, C_{13}, C_{14}, C_{15}\}$, i=1,2,3; see [8]

**Figure 14: Scheme for Synchronisation channel SCH consisting of one primary sequence $C_p$ and 3 parallel secondary sequences $C_{s,i}$ in slot k and k+8 (example for k=0 in Case 2)**

As depicted in figure 14, the SCH consists of a primary and three secondary code sequences each 256 chips long. The primary and secondary code sequences are defined in [8] clause 8 'Synchronisation codes for the 3.84 Mcps option'.

Due to mobile to mobile interference, it is mandatory for public TDD systems to keep synchronisation between base stations. As a consequence of this, a capture effect concerning SCH can arise. The time offset $t_{offset,n}$ enables the system to overcome the capture effect.

The time offset $t_{offset,n}$ is one of 32 values, depending on the code group of the cell, n, cf. 'table 6 Mapping scheme for Cell Parameters, Code Groups, Scrambling Codes, Midambles and $t_{offset}$' in [8]. Note that the cell parameter will change from frame to frame, cf. 'Table 7 Alignment of cell parameter cycling and system frame number' in [8], but the cell will belong to only one code group and thus have one time offset $t_{offset,n}$. The exact value for $t_{offset,n}$, regarding column 'Associated $t_{offset}$' in table 6 in [8] is given by:

$$t_{offset,n} = \begin{cases} n \cdot 48 \cdot T_c & n < 16 \\ (720 + n \cdot 48) T_c & n \geq 16 \end{cases}; \quad n = 0, ...., 31$$

## 5.3.5 Physical Uplink Shared Channel (PUSCH)

The USCH as desribed in subclause 4.1.2 is mapped onto one or more physical uplink shared channels (PUSCH). Timing advance, as described in [9], subclause 4.3, is applied to the PUSCH.

### 5.3.5.1 PUSCH Spreading

The spreading factors that can be applied to the PUSCH are SF = 1, 2, 4, 8, 16 as described in subclause 5.2.1.2.

#### 5.3.5.2 PUSCH Burst Types

Burst types 1, 2 or 3 as described in subclause 5.2.2 can be used for PUSCH. TFCI and TPC can be transmitted on the PUSCH.

#### 5.3.5.3 PUSCH Training Sequences

The training sequences as desribed in subclause 5.2.3 are used for the PUSCH.

#### 5.3.5.4 UE Selection

The UE that shall transmit on the PUSCH is selected by higher layer signalling.

### 5.3.6 Physical Downlink Shared Channel (PDSCH)

The DSCH as desribed in subclause 4.1.2 is mapped onto one or more physical downlink shared channels (PDSCH).

#### 5.3.6.1 PDSCH Spreading

The PDSCH uses either spreading factor SF = 16 or SF = 1 as described in subclause 5.2.1.1.

#### 5.3.6.2 PDSCH Burst Types

Burst types 1 or 2 as described in subclause 5.2.2 can be used for PDSCH. TFCI can be transmitted on the PDSCH.

#### 5.3.6.3 PDSCH Training Sequences

The training sequences as described in subclause 5.2.3 are used for the PDSCH.

#### 5.3.6.4 UE Selection

To indicate to the UE that there is data to decode on the DSCH, three signalling methods are available:

1) using the TFCI field of the associated channel or PDSCH;
2) using on the DSCH user specific midamble derived from the set of midambles used for that cell;
3) using higher layer signalling.

When the midamble based method is used, the UE specific midamble allocation method shall be employed (see subclause 5.6), and the UE shall decode the PDSCH if the PDSCH was transmitted with the midamble assigned to the UE by UTRAN. For this method no other physical channels may use the same time slot as the PDSCH and only one UE may share the PDSCH time slot within one TTI.

Note: From the above mentioned signalling methods, only the higher layer signalling method is supported by higher layers in Release 4.

### 5.3.7 The Paging Indicator Channel (PICH)

The Paging Indicator Channel (PICH) is a physical channel used to carry the paging indicators.

#### 5.3.7.1 Mapping of Paging Indicators to the PICH bits

Figure 15 depicts the structure of a PICH burst and the numbering of the bits within the burst. The same burst type is used for the PICH in every cell. $N_{PIB}$ bits in a normal burst of type 1 or 2 are used to carry the paging indicators, where $N_{PIB}$ depends on the burst type: $N_{PIB}$=240 for burst type 1 and $N_{PIB}$=272 for burst type 2. The bits $s_{NPIB+1}$,..., $s_{NPIB+4}$ adjacent to the midamble are reserved for possible future use.

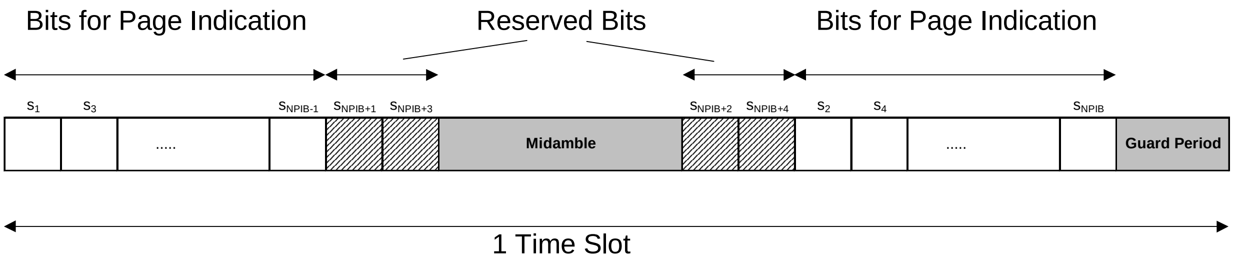



**Figure 15: Transmission and numbering of paging indicator carrying bits in a PICH burst**

Each paging indicator $P_q$ in one time slot is mapped to the bits $\{s_{2Lpi*q+1},...,s_{2Lpi*(q+1)}\}$ within this time slot. Thus, due to the interleaved transmission of the bits half of the symbols used for each paging indicator are transmitted in the first data part, and the other half of the symbols are transmitted in the second data part, as exemplary shown in figure 16 for a paging indicator length $L_{PI}$ of 4 symbols.

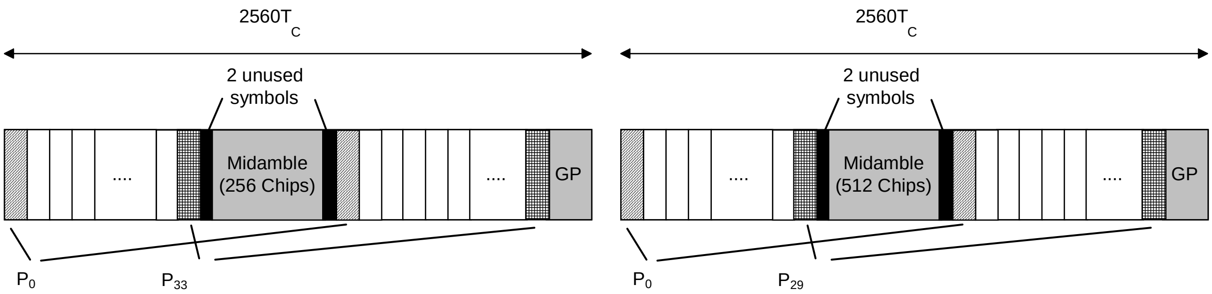



**Figure 16: Example of mapping of paging indicators on PICH bits for $L_{PI}$=4**

The setting of the paging indicators and the corresponding PICH bits (including the reserved ones) is described in [7].

$N_{PI}$ paging indicators of length $L_{PI}$=2, $L_{PI}$=4 or $L_{PI}$=8 symbols are transmitted in each radio frame that contains the PICH. The number of paging indicators $N_{PI}$ per radio frame is given by the paging indicator length and the burst type, which are both known by higher layer signalling. In table 7 this number is shown for the different possibilities of burst types and paging indicator lengths.

**Table 7: Number $N_{PI}$ of paging indicators per time slot for the different burst types and paging indicator lengths $L_{PI}$**

| | $L_{PI}$=2 | $L_{PI}$=4 | $L_{PI}$=8 |
|---|---|---|---|
| Burst Type 1 | $N_{PI}$=60 | $N_{PI}$=30 | $N_{PI}$=15 |
| Burst Type 2 | $N_{PI}$=68 | $N_{PI}$=34 | $N_{PI}$=17 |

### 5.3.7.2 Structure of the PICH over multiple radio frames

As shown in figure 17, the paging indicators of $N_{PICH}$ consecutive frames form a PICH block, $N_{PICH}$ is configured by higher layers. Thus, $N_P=N_{PICH}*N_{PI}$ paging indicators are transmitted in each PICH block.

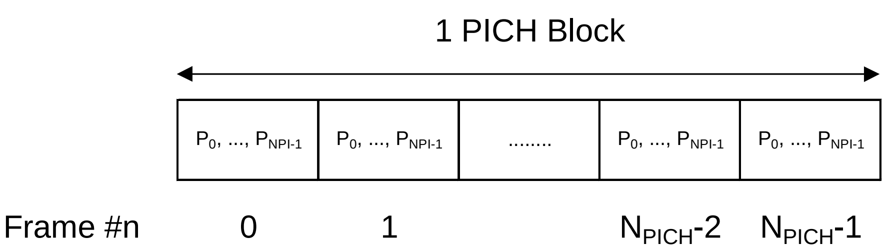



**Figure 17: Structure of a PICH block**

The value PI (PI = 0, ..., $N_P$-1) calculated by higher layers for use for a certain UE, see [15], is associated to the paging indicator $P_q$ in the nth frame of one PICH block, where q is given by

$$q = PI \bmod N_{PI}$$

and n is given by

$$n = PI \text{ div } N_{PI}.$$

The PI bitmap in the PCH data frames over Iub contains indication values for all possible higher layer PI values, see [17]. Each bit in the bitmap indicates if the paging indicator $P_q$ associated with that particular PI shall be set to 0 or 1. Hence, the calculation in the formulas above is to be performed in Node B to make the association between PI and $P_q$.

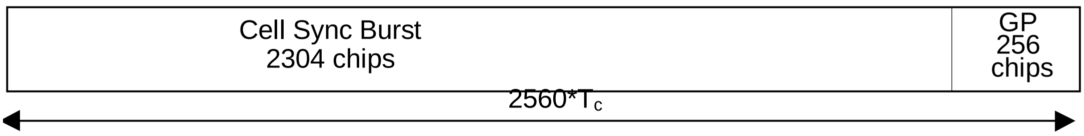
#### 5.3.7.3 PICH Training sequences

The training sequences, i.e. midambles for the PICH.are generated as described in subclause 5.2.3. The allocation of midambles depends on whether SCTD is applied to the PICH.

- If no antenna diversity is applied the PICH the midambles can be allocated as described in subclause 5.6.
- If SCTD antenna diversity is applied to the PICH the allocation of midambles shall be as described in [9].

### 5.3.8 The physical node B synchronisation channel (PNBSCH)

In case cell sync bursts are used for Node B synchronisation the PNBSCH shall be used for the transmission of the cell sync burst [8]. The PNBSCH shall be mapped on the same timeslot as the PRACH acc. to a higher layer schedule. The cell sync burst shall be transmitted at the beginning of a timeslot. In case of Node B synchronisation via the air interface the transmission of a RACH may be prohibited on higher layer command in specified frames and timeslots.




## 5.4 Transmit Diversity for DL Physical Channels

Table 8 summarizes the different transmit diversity schemes for different downlink physical channel types that are described in [9].

**Table 8: Application of Tx diversity schemes on downlink physical channel types "X" – can be applied, "–" – must not be applied**

| Physical channel type | Open loop TxDiversity | | Closed loop TxDiversity |
|---|---|---|---|
| | TSTD | SCTD(*) | |
| P-CCPCH | – | X | – |
| S-CCPCH | -- | X | -- |
| SCH | X | – | – |
| DPCH | – | – | X |
| PDSCH | – | X | X |
| PICH | – | X | – |

(*) Note: SCTD may only be applied to physical channels when they are allocated to beacon locations.

## 5.5 Beacon characteristics of physical channels

For the purpose of measurements, common physical channels that are allocated to particular locations (time slot, code) shall have particular physical characteristics, called beacon characteristics. Physical channels with beacon characteristics are called beacon channels. The locations of the beacon channels are called beacon locations. The ensemble of beacon channels shall provide the beacon function, i.e. a reference power level at the beacon locations, regularly existing in each radio frame. Thus, beacon channels must be present in each radio frame, the only exception is when idle periods are used to support time difference measurements for location services [9]. Then it may be possible that the beacon channels occur in the same frame and time slot as the idle periods. In this case, the beacon channels will not be transmitted in that particular frame and time slot.

### 5.5.1 Location of beacon channels

The beacon locations are determined by the SCH and depend on the SCH allocation case, see subclause 5.3.4:

Case 1) The beacon function shall be provided by the physical channels that are allocated to channelisation code $c_{Q=16}^{(k=1)}$ and to TS#k, k=0,…,14.

Case 2) The beacon function shall be provided by the physical channels that are allocated to channelisation code $c_{Q=16}^{(k=1)}$ and to TS#k and TS#k+8, k=0,…,6.

Note that by this definition the P-CCPCH always has beacon characteristics.

### 5.5.2 Physical characteristics of beacon channels

The beacon channels shall have the following physical characteristics. They:

- are transmitted with reference power;
- are transmitted without beamforming;
- use burst type 1;
- use midamble $m^{(1)}$ and $m^{(2)}$ exclusively in this time slot; and
- midambles $m^{(9)}$ and $m^{(10)}$ are always left unused in this time slot, if 16 midambles are allowed in that cell.

Note that in the time slot where the P-CCPCH is transmitted only the midambles $m^{(1)}$ to $m^{(8)}$ shall be used, see 5.6.1. Thus, midambles $m^{(9)}$ and $m^{(10)}$ are always left unused in this time slot.

The reference power corresponds to the sum of the power allocated to both midambles $m^{(1)}$ and $m^{(2)}$. Two possibilities exist:

- If SCTD antenna diversity is not applied to beacon channels all the reference power of any beacon channel is allocated to $m^{(1)}$.
- If SCTD antenna diversity is applied to beacon channels, for any beacon channel midambles $m^{(1)}$ and $m^{(2)}$ are each allocated half of the reference power.

## 5.6 Midamble Allocation for Physical Channels

Midambles are part of the physical channel configuration which is performed by higher layers. Three different midamble allocation schemes exist:

- UE specific midamble allocation: A UE specific midamble for DL or UL is explicitly assigned by higher layers.
- Default midamble allocation: The midamble for DL or UL is allocated by layer 1 depending on the associated channelisation code.
- Common midamble allocation: The midamble for the DL is allocated by layer 1 depending on the number of channelisation codes currently being present in the DL time slot.

If a midamble is not explicitly assigned and the use of the common midamble allocation scheme is not signalled by higher layers, the midamble shall be allocated by layer 1, based on the default midamble allocation scheme. This default midamble allocation scheme is given by a fixed association between midambles and channelisation codes, see clause A.3, and shall be applied individually to all channelisation codes within one time slot. Different associations apply for different burst types and cell configurations with respect to the maximum number of midambles.

### 5.6.1 Midamble Allocation for DL Physical Channels

Beacon channels shall always use the reserved midambles $m^{(1)}$ and $m^{(2)}$, see 5.5. For DL physical channels that are located in the same time slot as the P-CCPCH, midambles shall be allocated based on the default midamble allocation scheme, using the association for burst type 1 and $K_{Cell}$ =8 midambles. For all other DL physical channels, the midamble is explicitly assigned by higher layers or allocated by layer 1.

#### 5.6.1.1 Midamble Allocation by signalling from higher layers

UE specific midambles may be signalled by higher layers to UE's as a part of the physical channel configuration, if:

- multiple UEs use the physical channels in one DL time slot; and
- beamforming is applied to all of these DL physical channels; and
- no closed loop TxDiversity is applied to any of these DL physical channels;

or

- PDSCH physical layer signalling based on the midamble is used.

#### 5.6.1.2 Midamble Allocation by layer 1

##### 5.6.1.2.1 Default midamble

If a midamble is not explicitly assigned and the use of the common midamble allocation scheme is not signalled by higher layers, the UE shall derive the midambles from the allocated channelisation codes and shall use an individual midamble for each channelisation code group containing one primary and a set of secondary channelisation codes. The association between midambles and channelisation code groups is given in annex A.3. All the secondary channelisation codes within a set use the same midamble as the primary channelisation code to which they are associated.

Higher layers shall allocate the channelisation codes in a particular order. Secondary codes shall only be allocated if the associated primary code is also allocated. If midambles are reserved for the beacon channels, all primary and secondary channelisation codes that are associated with the reserved midambles shall not be used.

Channelisation codes of one channelisation code group shall not be allocated to different UE’s.

In the case that secondary channelisation codes are used, secondary channelisation codes of one channelisation code group shall be allocated in ascending order, with respect to their numbering, and beginning with the lowest code index in this channelisation code group.

The UE shall assume different channel estimates for each of the individual midambles.

The default midamble allocation shall not apply for those downlink channels that are intended for a UE which will be the only UE assigned to a given time slot or slots for the duration of the assigned channel's existence (as in the case of high rate services).

##### 5.6.1.2.2 Common Midamble

The use of the common midamble allocation scheme is signalled to the UE by higher layers as a part of the physical channel configuration. A common midamble may be assigned by layer 1 to all physical channels in one DL time slot, if:

- a single UE uses all physical channels in one DL time slot (as in the case of high rate service);

or

- multiple UEs use the physical channels in one DL time slot; and
- no beamforming is applied to any of these DL physical channels; and
- no closed loop TxDiversity is applied to any of these DL physical channels; and
- midambles are not used for PDSCH physical layer signalling.

The number of channelisation codes currently employed in the DL time slot is associated with the use of a particular common midamble. Different associations apply for different burst types and cell configurations with respect to the maximum number of midambles, see annex BC.

### 5.6.2 Midamble Allocation for UL Physical Channels

If the midamble is explicitly assigned by higher layers, an individual midamble shall be assigned to all UE's in one UL time slot.

If no midamble is explicitly assigned by higher layers, the UE shall derive the midamble from the channelisation code that is used for the data part (except for TFCI/TPC) of the burst. The associations between midamble and channelisation code are the same as for DL physical channels.

## 5.7 Midamble Transmit Power

There shall be no offset between the sum of the powers allocated to all midambles in a timeslot and the sum of the powers allocated to the data symbol fields. The transmit power within a timeslot is hence constant.

The midamble transmit power of beacon channels is equal to the reference power. If SCTD is used for beacon channels, the reference power is equally divided between the midambles $m^{(1)}$ and $m^{(2)}$.

The midamble transmit power of all other physical channels depends on the midamble allocation scheme used. The following rules apply

- In case of Default Midamble Allocation, every midamble is transmitted with the same power as the associated codes.
- In case of Common Midamble Allocation in the downlink, the transmit power of this common midamble is such that there is no power offset between the data parts and the midamble part of the overall transmit signal within one time slot.
- In case of UE Specific Midamble Allocation, the transmit power of the UE specific midamble is such that there is no power offset between the data parts and the midamble part of every user within one time slot.

The following figure 18 depicts the midamble powers for the different channel types and midamble allocation schemes.

Note 1: In figure 18, the codes c(1) to c(16) represent the set of usable codes and not the set of used codes.

Note 2: The common midamble allocation and the midamble allocation by higher layers are not applicable in those beacon time slots, in which the P-CCPCH is located, see section 5.6.1.

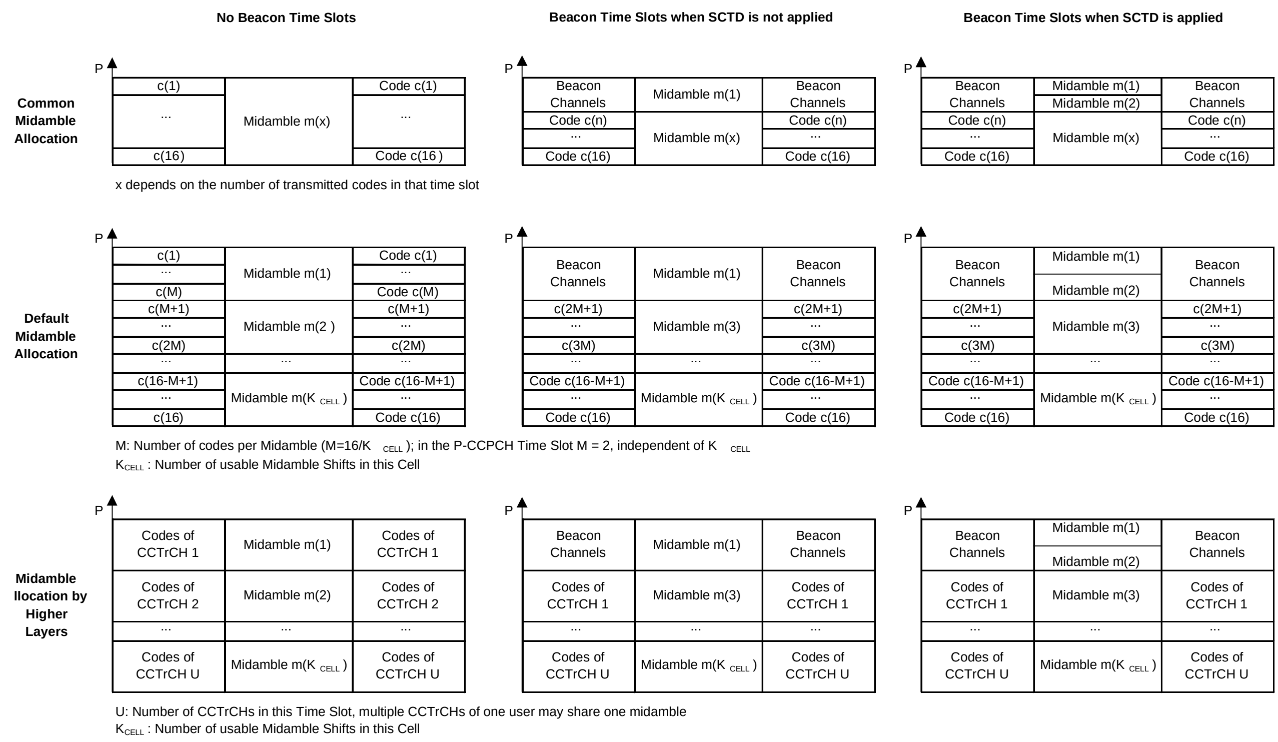



**Figure 18: Midamble powers for the different midamble allocation schemes**

# ~~6~~5A Physical channels for the 1.28 Mcps option

All physical channels take three-layer structure with respect to timeslots, radio frames and system frame numbering (SFN), see [14]. Depending on the resource allocation, the configuration of radio frames or timeslots becomes different. All physical channels need guard symbols in every timeslot. The time slots are used in the sense of a TDMA component to separate different user signals in the time and the code domain. The physical channel signal format for 1.28Mcps TDD is presented in figure ~~19~~18A.

A physical channel in TDD is a burst, which is transmitted in a particular timeslot within allocated Radio Frames. The allocation can be continuous, i.e. the time slot in every frame is allocated to the physical channel or discontinuous, i.e. the time slot in a subset of all frames is allocated only. A burst is the combination of a data part, a midamble and a guard period. The duration of a burst is one time slot. Several bursts can be transmitted at the same time from one transmitter. In this case, the data part must use different OVSF channelisation codes, but the same scrambling code. The midamble part has to use the same basic midamble code, but can use different midambles.

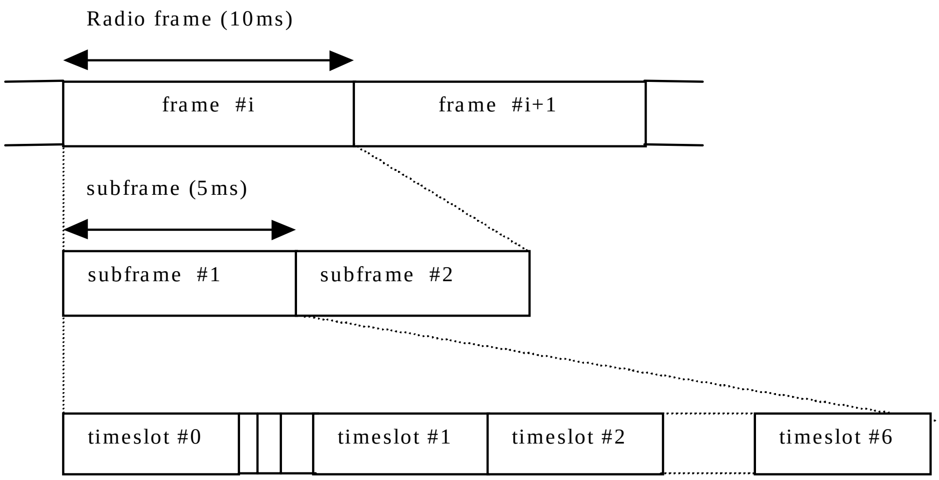



**Figure ~~19~~18A: Physical channel signal format for 1.28Mcps TDD option**

The data part of the burst is spread with a combination of channelisation code and scrambling code. The channelisation code is a OVSF code, that can have a spreading factor of 1, 2, 4, 8, or 16. The data rate of the physical channel is depending on the used spreading factor of the used OVSF code.

So a physical channel is defined by frequency, timeslot, channelisation code, burst type and Radio Frame allocation The scrambling code and the basic midamble code are broadcast and may be constant within a cell. When a physical channel is established, a start frame is given. The physical channels can either be of infinite duration, or a duration for the allocation can be defined.

## ~~6~~5A.1 Frame structure

The TDMA frame has a duration of 10 ms and is divided into 2 sub-frames of 5ms. The frame structure for each sub-frame in the 10ms frame length is the same.

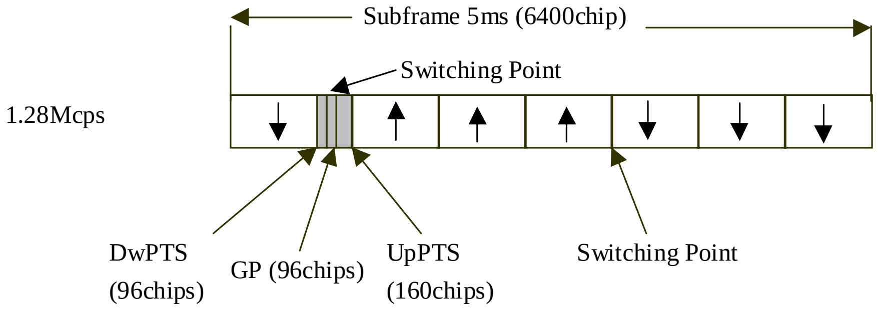



**Figure ~~20~~18B: Structure of the sub-frame for 1.28Mcps TDD option**

Time slot#n (n from 0 to 6): the n$^{th}$ traffic time slot, 864 chips duration;

DwPTS: downlink pilot time slot, 96 chips duration;

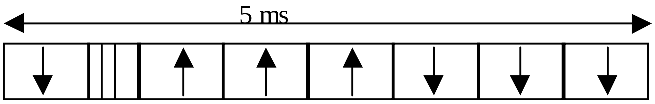
UpPTS: uplink pilot time slot, 160 chips duration;

GP: main guard period for TDD operation, 96 chips duration;

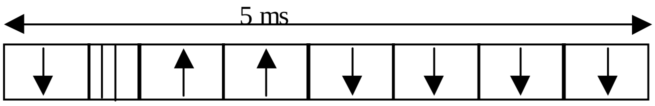
In Figure ~~20~~18B, the total number of traffic time slots for uplink and downlink is 7, and the length for each traffic time slot is 864 chips duration. Among the 7 traffic time slots, time slot#0 is always allocated as downlink while time slot#1 is always allocated as uplink. The time slots for the uplink and the downlink are separated by switching points. Between the downlink time slots and uplink time slots, the special period is the switching point to separate the uplink and downlink. In each sub-frame of 5ms for 1.28Mcps option, there are two switching points (uplink to downlink and vice versa).

Using the above frame structure, the 1.28Mcps TDD option can operate on both symmetric and asymmetric mode by properly configuring the number of downlink and uplink time slots. In any configuration at least one time slot (time slot#0) has to be allocated for the downlink and at least one time slot has to be allocated for the uplink (time slot#1).

Examples for symmetric and asymmetric UL/DL allocations are given in figure ~~21~~18C.




**symmetric DL/UL allocation**




**asymmetric DL/UL allocation**

**Figure 2118C: 1.28Mcps TDD sub-frame structure examples**

## 65A.2 Dedicated physical channel (DPCH)

The DCH as described in subclause 4.1 'Dedicated transport channels' is mapped onto the dedicated physical channel.

### 65A.2.1 Spreading

The spreading of physical channels is the same as in 3.84 Mcps TDD (cf. 5.2.1 'Spreading').

### 65A.2.2 Burst Format

A traffic burst consists of two data symbol fields, a midamble of 144 chips and a guard period. The data fields of the burst are 352 chips long. The corresponding number of symbols depends on the spreading factor, as indicated in table 98A below. The guard period is 16 chip periods long.

The burst format is shown in Figure 2218D. The contents of the traffic burst fields is described in table 108B.

**Table 8A9: number of symbols per data field in a traffic burst**

| Spreading factor (Q) | Number of symbols (N) per data field in Burst |
|---|---|
| 1 | 352 |
| 2 | 176 |
| 4 | 88 |
| 8 | 44 |
| 16 | 22 |

**Table 8B10: The contents of the traffic burst format fields**

| Chip number (CN) | Length of field in chips | Length of field in symbols | Contents of field |
|---|---|---|---|
| 0-351 | 352 | cf table 98A | Data symbols |
| 352-495 | 144 | - | Midamble |
| 496-847 | 352 | cf table 98A | Data symbols |
| 848-863 | 16 | - | Guard period |

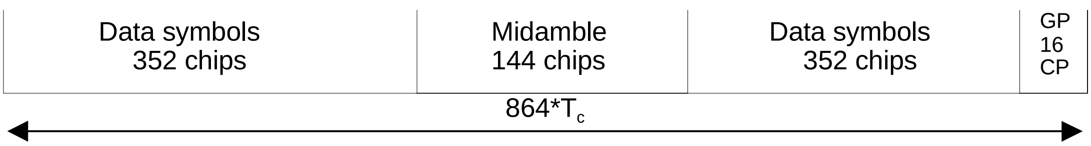



**Figure 2218D: Burst structure of the traffic burst format (GP denotes the guard period and CP the chip periods)**

### ~~6~~5A.2.2.1 Transmission of TFCI

The traffic burst format provides the possibility for transmission of TFCI in uplink and downlink.

The transmission of TFCI is configured by higher Layers. For each CCTrCH it is indicated by higher layer signalling, which TFCI format is applied. Additionally for each allocated timeslot it is signalled individually whether that timeslot carries the TFCI or not. The TFCI is always present in the first timeslot in a radio frame for each CCTrCH. If a time slot contains the TFCI, then it is always transmitted using the physical channel with the lowest physical channel sequence number (*p*) in that timeslot. Physical channel sequence numbering is determined by the rate matching function and is described in [7].

The transmission of TFCI is done in the data parts of the respective physical channel, this means that TFCI code word bits and data bits are subject to the same spreading procedure as depicted in [8]. Hence the midamble structure and length is not changed.

The TFCI code word bits are equally distributed between the two subframes and the respective data fields. The TFCI code word is to be transmitted possibly either directly adjacent to the midamble or after the SS and TPC symbols. Figure ~~23~~18E shows the position of the TFCI code word in a traffic burst, if neither SS nor TPC are transmitted. Figure ~~24~~18F shows the position of the TFCI code word in a traffic burst , if SS and TPC are transmitted.

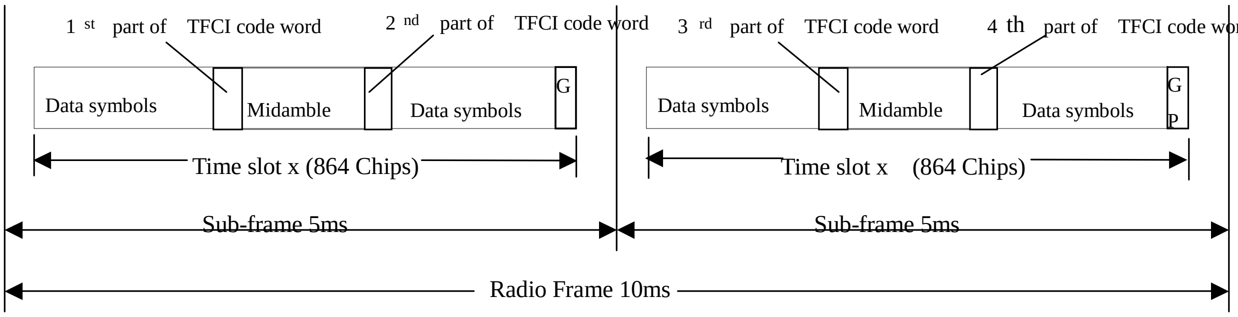



**Figure ~~23~~18E: Position of the TFCI code word in the traffic burst in case of no TPC and SS in 1.28 Mcps TDD**

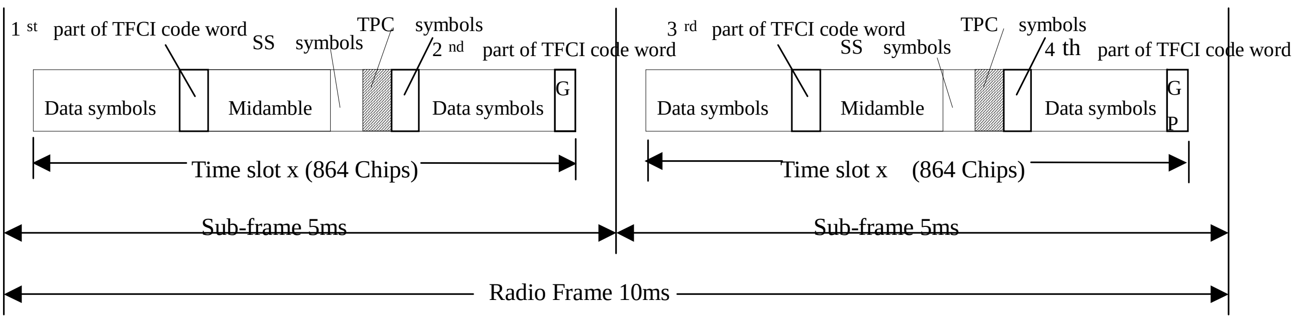



**Figure ~~24~~18F:Position of the TFCI code word in the traffic burst in case of TPC and SS in 1.28 Mcps TDD**

### ~~6~~5A.2.2.2 Transmission of TPC

The burst type for dedicated channels provides the possibility for transmission of TPC in uplink and downlink.

The transmission of TPC is done in the data parts of the traffic burst. Hence the midamble structure and length is not changed. The TPC information is to be transmitted directly after the SS information, which is transmitted after the midamble. Figure ~~25~~18G shows the position of the TPC command in a traffic burst.

For every user the TPC information is to be transmitted at least once per 5ms sub-frame. For each allocated timeslot it is signalled individually whether that timeslot carries TPC information or not. If applied in a timeslot, transmission of TPC symbols is done in the data parts of the traffic burst and they are transmitted using the physical channel with the lowest physical channel sequence number (*p*) in that timeslot. Physical channel sequence numbering is determined by the rate matching function and is described in [7].

TPC symbols may also be transmitted on more than one physical channel in a time slot. For this purpose, higher layers allocate an additional number of $N_{TPC}$ physical channels, individually for each time slot. The TPC symbols shall then be transmitted using the physical channels with the $N_{TPC}+1$ lowest physical channel sequence numbers (*p*) in that time slot. Physical channel sequence numbering is determined by the rate matching function and is described in [7]. If the rate matching function results in $N_{RM} < N_{TPC}+1$ remaining physical channels in this time slot, TPC symbols shall be transmitted only on the $N_{RM}$ remaining physical channels.

The TPC symbols are spread with the same spreading factor (SF) and spreading code as the data parts of the respective physical channel.

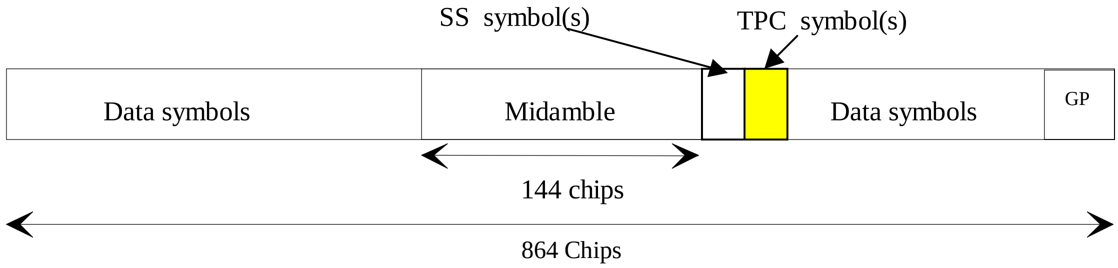



**Figure ~~25~~18G: Position of TPC information in the traffic burst in downlink and uplink**

For the number of TPC symbols per time slot there are 3 possibilities, that can be configured by higher layers individually for each timeslot:

1) one TPC symbol
2) no TPC symbols
3) 16/SF TPC symbols

So, in case 3), when SF=1, there are 16 TPC symbols which correspond to 32 bits (for QPSK) and 48 bits (for 8PSK).

In the following the uplink is described only. For the description of the downlink, downlink (DL) and uplink (UL) have to be interchanged.

Each of the TPC symbols for uplink power control in the DL will be associated with an UL time slot and an UL CCTrCH pair. This association varies with

- the number of allocated UL time slots and UL CCTrCHs on these time slots (time slot and CCTrCH pair) and
- the allocated TPC symbols in the DL.

In case a UE has

- more than one channelisation code

and/or

- channelisation codes being of lower spreading factor than 16 and using 16/SF SS and 16/SF TPC symbols,

the TPC commands for each ULtime slot CCTrCH pair (all channelisation codes on that time slot belonging to the same time slot and CCTrCH pair have the same TPC command) will be distributed to the following rules:

1. The ULtime slots and CCTrCH pairs the TPC commands are intended for will be numbered from the first to the last ULtime slot and CCTrCH pair allocated to the regarded UE (starting with 0). The number of a time slot and CCTrCH pair is smaller then the number of another time slot and CCTrCH pair within the same time slot if its spreading code with the lowest SC number according to the following table has a lower SC number then the spreading code with the lowest SC number of the other time slot and CCTrCH pair.
2. The commanding TPC symbols on all DL CCTrCHs allocated to one UE are numbered consecutively starting with zero according to the following rules:

   a) The numbers of the TPC commands of a regarded DL time slot are lower than those of DL time slots being transmitted after that time slot

b) Within a DL time slot the numbers of the TPC commands of a regarded channelisation code are lower than those of channelisation codes having a higher spreading code number

The spreading code number is defined by the following table (see[8]):

| SC number | SF (Q) | Walsh code number (k) |
|---|---|---|
| 0 | 16 | $\mathbf{c}_{Q=16}^{(k=1)}$ |
| | … | |
| 15 | 16 | $\mathbf{c}_{Q=16}^{(k=16)}$ |
| 16 | 8 | $\mathbf{c}_{Q=8}^{(k=1)}$ |
| | … | |
| 23 | 8 | $\mathbf{c}_{Q=8}^{(k=8)}$ |
| 24 | 4 | $\mathbf{c}_{Q=4}^{(k=1)}$ |
| | … | |
| 27 | 4 | $\mathbf{c}_{Q=4}^{(k=4)}$ |
| 28 | 2 | $\mathbf{c}_{Q=2}^{(k=1)}$ |
| 29 | 2 | $\mathbf{c}_{Q=2}^{(k=2)}$ |
| 30 | 1 | $\mathbf{c}_{Q=1}^{(k=1)}$ |

Note: Spreading factors 2-8 are not used in DL

c) Within a channelisation code numbers of the TPC commands are lower than those of TPC commands being transmitted after that time

The following equation is used to determine the UL time slot which is controlled by the regarded TPC symbol in the DL:

,

$$UL_{pos} = \left(SFN' \cdot N_{UL\_TPCsymbols} + TPC_{DLpos} + \left(\left(SFN' \cdot N_{UL\_TPCsymbols} + TPC_{DLpos}\right) \operatorname{div}\left(N_{ULslot}\right)\right)\right) \bmod \left(N_{ULslot}\right)$$

where

$UL_{pos}$ is the number of the controlled uplink time slot and CCTrCH pairs.

SFN' is the system frame number counting the sub-frames. The system frame number of the radio frames (SFN) can be derived from SFN' by

SFN=SFN' div 2, where div is the remainder free division operation.

$N_{UL\_PCsymbols}$ is the number of UL TPC symbols in a sub-frame.

$TPC_{DLpos}$ is the number of the regarded UL TPC symbol in the DL within the sub-frame.

$N_{ULslot}$ is the number of UL slots and CCTrCH pairs in a frame.

When one of the above parameters is changed due to higher layer reconfiguration, the new relationship between TPC symbols and controlled UL time slots shall be valid, beginning with the radio frame, for which the new parameters are set.

In Annex CBG two examples of the association of TPC commands to time slots and CCTrCH pairs are shown.

Coding of TPC:

The relationship between the TPC Bits and the transmitter power control command for QPSK is the same as in the 3.84Mcps TDD cf. [5.2.2.5 ‘Transmission of TPC’].

The relationship between the TPC Bits and the transmitter power control command for 8PSK is given in table ~~11~~8C

**Table 8C~~11~~: TPC Bit Pattern for 8PSK**

| TPC Bits | TPC command | Meaning |
|---|---|---|
| 000 | 'Down' | Decrease Tx Power |
| 110 | 'Up' | Increase Tx Power |

### ~~6~~5A.2.2.3 Transmission of SS

The burst type for dedicated channels provides the possibility for transmission of uplink synchronisation control (ULSC).

The transmission of ULSC is done in the data parts of the traffic burst. Hence the midamble structure and length is not changed. The ULSC information is to be transmitted directly after the midamble. Figure ~~26~~18H shows the position of the SS command in a traffic burst.

For every user the ULSC information shall be transmitted at least once per transmitted sub-frame.

For each allocated timeslot it is signalled individually whether that timeslot carries ULSC information or not. If applied in a time slot, transmission of SS symbols is done in the data parts of the traffic burst and they are transmitted using the physical channel with the lowest physical channel sequence number (*p*) in that timeslot. Physical channel sequence numbering is determined by the rate matching function and is described in [7].

SS symbols may also be transmitted on more than one physical channel in a time slot. For this purpose, higher layers allocate an additional number of $N_{SS}$ physical channels, individually for each time slot. The SS symbols shall then be transmitted using the physical channels with the $N_{SS}+1$ lowest physical channel sequence numbers (*p*) in that time slot. Physical channel sequence numbering is determined by the rate matching function and is described in [7]. If the rate matching function results in $N_{RM} < N_{SS}+1$ remaining physical channels in this time slot, SS symbols shall be transmitted only on the $N_{RM}$ remaining physical channels.

The SS symbols are spread with the same spreading factor (SF) and spreading code as the data parts of the respective physical channel.

The SS is utilised to command a timing adjustment by (k/8) Tc each M sub-frames, where Tc is the chip period. The k and M values are signalled by the network. The SS, as one of L1 signals, is to be transmitted once per 5ms sub-frame.

M (1-8) and k (1-8) can be adjusted during call setup or readjusted during the call.

Note: The smallest step for the SS signalled by the UTRAN is 1/8 Tc. For the UE capabilities regarding the SS adjustment of the UE it is suggested to set the tolerance for the executed command to be [1/9;1/7] Tc.

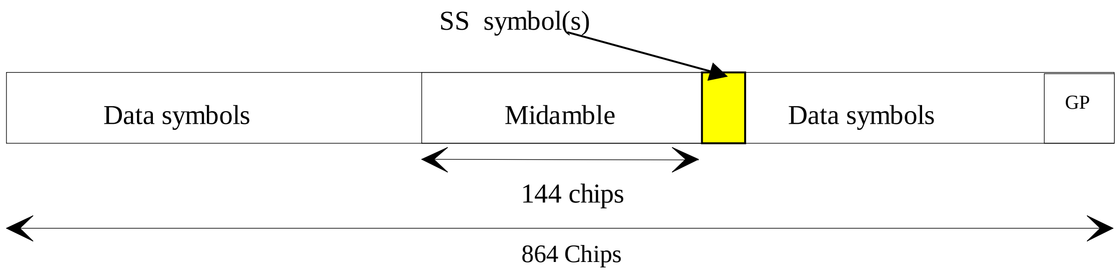



**Figure ~~26~~18H: Position of ULSC information in the traffic burst (downlink and uplink)**

Note that for the uplink where there is no SS symbol used, the SS symbol space is reserved for future use. This can keep UL and DL slots the same structure.

For the number of SS symbols per time slot there are 3 possibilities, that can be configured by higher layers individually for each time slot:

- one SS symbol
- no SS symbol
- 16/SF SS symbols

So, in case 3, when SF=1, there are 16 SS symbols which correspond to 32 bits (for QPSK) and 48 bits (for 8PSK).

Each of the SS symbols in the DL will be associated with an UL time slot depending on the allocated UL time slots and the allocated SS symbols in the DL.

Note: Even though the different time slots of the UE are controlled with independent SS commands, the UE is not in need to execute SS commands leading to a deviation of more than [3] chip with respect to the average timing advance applied by the UE.

The synchronisation shift commands for each UL time slot (all channelisation codes on that time slot have the same SS command) will be distributed to the following rules:

1. The UL time slots the SS commands are intended for will be numbered from the first to the last UL time slot occupied by the regarded UE (starting with 0) considering all CCTrCHs allocated to that UE.
2. The commanding SS symbols on all downlink CCTrCHs allocated to one UE are numbered consecutively starting with zero according to the following rules:
   a) The numbers of the SS commands of a regarded DL time slot are lower than those of DL time slots being transmitted after that time slot
   b) Within a DL time slot the numbers of the SS commands of a regarded channelisation code are lower than those of channelisation codes having a bigger spreading code number

   The spreading code number is defined by the following table: (see TS 25.223)

| Spreading code number | SF (Q) | Walsh code number (k) |
|---|---|---|
| 0 | 16 | $\mathbf{c}_{Q=16}^{(k=1)}$ |
| | ... | |
| 15 | 16 | $\mathbf{c}_{Q=16}^{(k=16)}$ |
| | Spreading factors 2-8 are nor used in DL | |
| 30 | 1 | $\mathbf{c}_{Q=1}^{(k=1)}$ |

   c) Within a channelisation code numbers of the SS commands are lower than those of SS commands being transmitted after that time

The following equation is used to determine the UL time slot which is controlled by the regarded SS symbol:

$$UL_{pos} = \left(SFN' \cdot N_{SSsymbols} + SS_{pos} + \left(\left(SFN' \cdot N_{SSsymbols} + SS_{pos}\right)\mathrm{div}\left(N_{ULslot}\right)\right)\right)\mathrm{mod}\left(N_{ULslot}\right),$$

where

$UL_{pos}$ is the number of the controlled uplink time slot.

SFN' is the system frame number counting the sub-frames. The system frame number of the radio frames (SFN) can be derived from SFN' by

SFN=SFN' div 2, where div is the remainder free division operation.

$N_{SSsymbols}$ is the number of SS symbols in a frame.

$SS_{pos}$ is the number of the regarded SS symbol within the sub-frame.

$N_{ULslot}$ is the number of UL slots in a frame.

When one of the above parameters is changed due to higher layer reconfiguration, the new relationship between SS symbols and controlled UL time slots shall be valid, beginning with the radio frame, for which the new parameters are set.

The relationship between the SS Bits and the SS command for QPSK is the given in table 128D:

**Table 8D12: Coding of the SS for QPSK**

| SS Bits | SS command | Meaning |
|---|---|---|
| 00 | 'Down' | Decrease synchronisation shift by k/8 Tc |
| 11 | 'Up' | Increase synchronisation shift by k/8 Tc |
| 01 | 'Do nothing' | No change |

The relationship between the SS Bits and the SS command for 8PSK is given in table 138E:

**Table 8E13: Coding of the SS for 8PSK**

| SS Bits | SS command | Meaning |
|---|---|---|
| 000 | 'Down' | Decrease synchronisation shift by k/8 Tc |
| 110 | 'Up' | Increase synchronisation shift by k/8 Tc |
| 011 | 'Do nothing' | No change |

### 65A.2.2.4 Timeslot formats

The timeslot format depends on the spreading factor, the number of the TFCI code word bits, the number of SS and TPC symbols and the applied modulation scheme (QPSK/8PSK) as depicted in the following tables.

#### 65A.2.2.4.1 Timeslot formats for QPSK

##### 65A.2.2.4.1.1 Downlink timeslot formats

**Table 8F14 : Time slot formats for the Downlink**

| Slot Format # | Spreading Factor | Midamble length (chips) | $N_{TFCI}$ code word (bits) | $N_{SS}$ & $N_{TPC}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data\ field(1)}$ (bits) | $N_{data/data\ field(2)}$ (bits) |
|---|---|---|---|---|---|---|---|---|
| 0 | 16 | 144 | 0 | 0 & 0 | 88 | 88 | 44 | 44 |
| 1 | 16 | 144 | 4 | 0 & 0 | 88 | 86 | 42 | 44 |
| 2 | 16 | 144 | 8 | 0 & 0 | 88 | 84 | 42 | 42 |
| 3 | 16 | 144 | 16 | 0 & 0 | 88 | 80 | 40 | 40 |
| 4 | 16 | 144 | 32 | 0 & 0 | 88 | 72 | 36 | 36 |
| 5 | 16 | 144 | 0 | 2 & 2 | 88 | 84 | 44 | 40 |
| 6 | 16 | 144 | 4 | 2 & 2 | 88 | 82 | 42 | 40 |
| 7 | 16 | 144 | 8 | 2 & 2 | 88 | 80 | 42 | 38 |
| 8 | 16 | 144 | 16 | 2 & 2 | 88 | 76 | 40 | 36 |
| 9 | 16 | 144 | 32 | 2 & 2 | 88 | 68 | 36 | 32 |
| 10 | 1 | 144 | 0 | 0 & 0 | 1408 | 1408 | 704 | 704 |
| 11 | 1 | 144 | 4 | 0 & 0 | 1408 | 1406 | 702 | 704 |
| 12 | 1 | 144 | 8 | 0 & 0 | 1408 | 1404 | 702 | 702 |
| 13 | 1 | 144 | 16 | 0 & 0 | 1408 | 1400 | 700 | 700 |
| 14 | 1 | 144 | 32 | 0 & 0 | 1408 | 1392 | 696 | 696 |
| 15 | 1 | 144 | 0 | 2 & 2 | 1408 | 1404 | 704 | 700 |
| 16 | 1 | 144 | 4 | 2 & 2 | 1408 | 1402 | 702 | 700 |
| 17 | 1 | 144 | 8 | 2 & 2 | 1408 | 1400 | 702 | 698 |
| 18 | 1 | 144 | 16 | 2 & 2 | 1408 | 1396 | 700 | 696 |
| 19 | 1 | 144 | 32 | 2 & 2 | 1408 | 1388 | 696 | 692 |
| 20 | 1 | 144 | 0 | 32 & 32 | 1408 | 1344 | 704 | 640 |
| 21 | 1 | 144 | 4 | 32 & 32 | 1408 | 1342 | 702 | 640 |
| 22 | 1 | 144 | 8 | 32 & 32 | 1408 | 1340 | 702 | 638 |
| 23 | 1 | 144 | 16 | 32 & 32 | 1408 | 1336 | 700 | 636 |
| 24 | 1 | 144 | 32 | 32 & 32 | 1408 | 1328 | 696 | 632 |

#### ~~6~~5A.2.2.4.1.2 Uplink timeslot formats

**Table 8G~~15~~ : Time slot formats for the Uplink**

| Slot Format # | Spreading Factor | Midamble length (chips) | $N_{TFCI}$ code word (bits) | $N_{SS}$ & $N_{TPC}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data}$ field(1) (bits) | $N_{data/data}$ field(2) (bits) |
|---|---|---|---|---|---|---|---|---|
| 0 | 16 | 144 | 0 | 0 & 0 | 88 | 88 | 44 | 44 |
| 1 | 16 | 144 | 4 | 0 & 0 | 88 | 86 | 42 | 44 |
| 2 | 16 | 144 | 8 | 0 & 0 | 88 | 84 | 42 | 42 |
| 3 | 16 | 144 | 16 | 0 & 0 | 88 | 80 | 40 | 40 |
| 4 | 16 | 144 | 32 | 0 & 0 | 88 | 72 | 36 | 36 |
| 5 | 16 | 144 | 0 | 2 & 2 | 88 | 84 | 44 | 40 |
| 6 | 16 | 144 | 4 | 2 & 2 | 88 | 82 | 42 | 40 |
| 7 | 16 | 144 | 8 | 2 & 2 | 88 | 80 | 42 | 38 |
| 8 | 16 | 144 | 16 | 2 & 2 | 88 | 76 | 40 | 36 |
| 9 | 16 | 144 | 32 | 2 & 2 | 88 | 68 | 36 | 32 |
| 10 | 8 | 144 | 0 | 0 & 0 | 176 | 176 | 88 | 88 |
| 11 | 8 | 144 | 4 | 0 & 0 | 176 | 174 | 86 | 88 |
| 12 | 8 | 144 | 8 | 0 & 0 | 176 | 172 | 86 | 86 |
| 13 | 8 | 144 | 16 | 0 & 0 | 176 | 168 | 84 | 84 |
| 14 | 8 | 144 | 32 | 0 & 0 | 176 | 160 | 80 | 80 |
| 15 | 8 | 144 | 0 | 2 & 2 | 176 | 172 | 88 | 84 |
| 16 | 8 | 144 | 4 | 2 & 2 | 176 | 170 | 86 | 84 |
| 17 | 8 | 144 | 8 | 2 & 2 | 176 | 168 | 86 | 82 |
| 18 | 8 | 144 | 16 | 2 & 2 | 176 | 164 | 84 | 80 |
| 19 | 8 | 144 | 32 | 2 & 2 | 176 | 156 | 80 | 76 |
| 20 | 8 | 144 | 0 | 4 & 4 | 176 | 168 | 88 | 80 |
| 21 | 8 | 144 | 4 | 4 & 4 | 176 | 166 | 86 | 80 |
| 22 | 8 | 144 | 8 | 4 & 4 | 176 | 164 | 86 | 78 |
| 23 | 8 | 144 | 16 | 4 & 4 | 176 | 160 | 84 | 76 |
| 24 | 8 | 144 | 32 | 4 & 4 | 176 | 152 | 80 | 72 |
| 25 | 4 | 144 | 0 | 0 & 0 | 352 | 352 | 176 | 176 |
| 26 | 4 | 144 | 4 | 0 & 0 | 352 | 350 | 174 | 176 |
| 27 | 4 | 144 | 8 | 0 & 0 | 352 | 348 | 174 | 174 |
| 28 | 4 | 144 | 16 | 0 & 0 | 352 | 344 | 172 | 172 |
| 29 | 4 | 144 | 32 | 0 & 0 | 352 | 336 | 168 | 168 |
| 30 | 4 | 144 | 0 | 2 & 2 | 352 | 348 | 176 | 172 |
| 31 | 4 | 144 | 4 | 2 & 2 | 352 | 346 | 174 | 172 |
| 32 | 4 | 144 | 8 | 2 & 2 | 352 | 344 | 174 | 170 |
| 33 | 4 | 144 | 16 | 2 & 2 | 352 | 340 | 172 | 168 |
| 34 | 4 | 144 | 32 | 2 & 2 | 352 | 332 | 168 | 164 |
| 35 | 4 | 144 | 0 | 8 & 8 | 352 | 336 | 176 | 160 |
| 36 | 4 | 144 | 4 | 8 & 8 | 352 | 334 | 174 | 160 |
| 37 | 4 | 144 | 8 | 8 & 8 | 352 | 332 | 174 | 158 |
| 38 | 4 | 144 | 16 | 8 & 8 | 352 | 328 | 172 | 156 |
| 39 | 4 | 144 | 32 | 8 & 8 | 352 | 320 | 168 | 152 |
| 40 | 2 | 144 | 0 | 0 & 0 | 704 | 704 | 352 | 352 |
| 41 | 2 | 144 | 4 | 0 & 0 | 704 | 702 | 350 | 352 |
| 42 | 2 | 144 | 8 | 0 & 0 | 704 | 700 | 350 | 350 |
| 43 | 2 | 144 | 16 | 0 & 0 | 704 | 696 | 348 | 348 |
| 44 | 2 | 144 | 32 | 0 & 0 | 704 | 688 | 344 | 344 |
| 45 | 2 | 144 | 0 | 2 & 2 | 704 | 700 | 352 | 348 |
| 46 | 2 | 144 | 4 | 2 & 2 | 704 | 698 | 350 | 348 |

| Slot Format # | Spreading Factor | Midamble length (chips) | $N_{TFCI}$ code word (bits) | $N_{SS}$ & $N_{TPC}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data\ field(1)}$ (bits) | $N_{data/data\ field(2)}$ (bits) |
|---|---|---|---|---|---|---|---|---|
| 47 | 2 | 144 | 8 | 2 & 2 | 704 | 696 | 350 | 346 |
| 48 | 2 | 144 | 16 | 2 & 2 | 704 | 692 | 348 | 344 |
| 49 | 2 | 144 | 32 | 2 & 2 | 704 | 684 | 344 | 340 |
| 50 | 2 | 144 | 0 | 16 & 16 | 704 | 672 | 352 | 320 |
| 51 | 2 | 144 | 4 | 16 & 16 | 704 | 670 | 350 | 320 |
| 52 | 2 | 144 | 8 | 16 & 16 | 704 | 668 | 350 | 318 |
| 53 | 2 | 144 | 16 | 16 & 16 | 704 | 664 | 348 | 316 |
| 54 | 2 | 144 | 32 | 16 & 16 | 704 | 656 | 344 | 312 |
| 55 | 1 | 144 | 0 | 0 & 0 | 1408 | 1408 | 704 | 704 |
| 56 | 1 | 144 | 4 | 0 & 0 | 1408 | 1406 | 702 | 704 |
| 57 | 1 | 144 | 8 | 0 & 0 | 1408 | 1404 | 702 | 702 |
| 58 | 1 | 144 | 16 | 0 & 0 | 1408 | 1400 | 700 | 700 |
| 59 | 1 | 144 | 32 | 0 & 0 | 1408 | 1392 | 696 | 696 |
| 60 | 1 | 144 | 0 | 2 & 2 | 1408 | 1404 | 704 | 700 |
| 61 | 1 | 144 | 4 | 2 & 2 | 1408 | 1402 | 702 | 700 |
| 62 | 1 | 144 | 8 | 2 & 2 | 1408 | 1400 | 702 | 698 |
| 63 | 1 | 144 | 16 | 2 & 2 | 1408 | 1396 | 700 | 696 |
| 64 | 1 | 144 | 32 | 2 & 2 | 1408 | 1388 | 696 | 692 |
| 65 | 1 | 144 | 0 | 32 & 32 | 1408 | 1344 | 704 | 640 |
| 66 | 1 | 144 | 4 | 32 & 32 | 1408 | 1342 | 702 | 640 |
| 67 | 1 | 144 | 8 | 32 & 32 | 1408 | 1340 | 702 | 638 |
| 68 | 1 | 144 | 16 | 32 & 32 | 1408 | 1336 | 700 | 636 |
| 69 | 1 | 144 | 32 | 32 & 32 | 1408 | 1328 | 696 | 632 |

#### 65A.2.2.4.2 Time slot formats for 8PSK

The Downlink and the Uplink timeslot formats are described together in the following table.

**Table 8H16: Timeslot formats for 8PSK modulation**

| Slot Format # | Spreading Factor | Midamble length (chips) | $N_{TFCI}$ code word (bits) | $N_{SS}$ & $N_{TPC}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data\ field(1)}$ (bits) | $N_{data/data\ field(2)}$ (bits) |
|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 144 | 0 | 0 & 0 | 2112 | 2112 | 1056 | 1056 |
| 1 | 1 | 144 | 6 | 0 & 0 | 2112 | 2109 | 1053 | 1056 |
| 2 | 1 | 144 | 12 | 0 & 0 | 2112 | 2106 | 1053 | 1053 |
| 3 | 1 | 144 | 24 | 0 & 0 | 2112 | 2100 | 1050 | 1050 |
| 4 | 1 | 144 | 48 | 0 & 0 | 2112 | 2088 | 1044 | 1044 |
| 5 | 1 | 144 | 0 | 3 & 3 | 2112 | 2106 | 1056 | 1050 |
| 6 | 1 | 144 | 6 | 3 & 3 | 2112 | 2103 | 1053 | 1050 |
| 7 | 1 | 144 | 12 | 3 & 3 | 2112 | 2100 | 1053 | 1047 |
| 8 | 1 | 144 | 24 | 3 & 3 | 2112 | 2094 | 1050 | 1044 |
| 9 | 1 | 144 | 48 | 3 & 3 | 2112 | 2082 | 1044 | 1038 |
| 10 | 1 | 144 | 0 | 48 & 48 | 2112 | 2016 | 1056 | 960 |
| 11 | 1 | 144 | 6 | 48 & 48 | 2112 | 2013 | 1053 | 960 |
| 12 | 1 | 144 | 12 | 48 & 48 | 2112 | 2010 | 1053 | 957 |
| 13 | 1 | 144 | 24 | 48 & 48 | 2112 | 2004 | 1050 | 954 |
| 14 | 1 | 144 | 48 | 48 & 48 | 2112 | 1992 | 1044 | 948 |
| 15 | 16 | 144 | 0 | 0 & 0 | 132 | 132 | 66 | 66 |
| 16 | 16 | 144 | 6 | 0 & 0 | 132 | 129 | 63 | 66 |
| 17 | 16 | 144 | 12 | 0 & 0 | 132 | 126 | 63 | 63 |
| 18 | 16 | 144 | 24 | 0 & 0 | 132 | 120 | 60 | 60 |
| 19 | 16 | 144 | 48 | 0 & 0 | 132 | 108 | 54 | 54 |
| 20 | 16 | 144 | 0 | 3 & 3 | 132 | 126 | 66 | 60 |
| 21 | 16 | 144 | 6 | 3 & 3 | 132 | 123 | 63 | 60 |
| 22 | 16 | 144 | 12 | 3 & 3 | 132 | 120 | 63 | 57 |
| 23 | 16 | 144 | 24 | 3 & 3 | 132 | 114 | 60 | 54 |
| 24 | 16 | 144 | 48 | 3 & 3 | 132 | 102 | 54 | 48 |

## 65A.2.3 Training sequences for spread bursts

In this subclause, the training sequences for usage as midambles are defined. The training sequences, i.e. midambles, of different users active in the same cell and same time slot are cyclically shifted versions of one single basic midamble code. The applicable basic midamble codes are given in Annex AAB.1.

The basic midamble codes in Annex AAB.1 are listed in hexadecimal notation. The binary form of the basic midamble code shall be derived according to table 178I below.

**Table 8I~~17~~: Mapping of 4 binary elements $m_i$ on a single hexadecimal digit:**

| 4 binary elements $m_i$ | Mapped on hexadecimal digit |
|---|---|
| -1 -1 -1 -1 | 0 |
| -1 -1 -1 1 | 1 |
| -1 -1 1 –1 | 2 |
| -1 -1 1 1 | 3 |
| -1 1 -1 –1 | 4 |
| -1 1 -1 1 | 5 |
| -1 1 1 –1 | 6 |
| -1 1 1 1 | 7 |
| 1 -1 -1 –1 | 8 |
| 1 -1 -1 1 | 9 |
| 1 -1 1 –1 | A |
| 1 -1 1 1 | B |
| 1 1 -1 –1 | C |
| 1 1 -1 1 | D |
| 1 1 1 –1 | E |
| 1 1 1 1 | F |

For each particular basic midamble code, its binary representation can be written as a vector $\mathbf{m}_{\mathrm{P}}$ :

$$\mathbf{m}_{\mathrm{P}} = \left(m_1, m_2, \ldots, m_P\right) \qquad (1)$$

According to Annex AA~~B~~.1, the size of this vector $\mathbf{m}_{\mathrm{P}}$ is P=128. As QPSK modulation is used, the training sequences are transformed into a complex form, denoted as the complex vector $\underline{\mathbf{m}}_{\mathrm{P}}$ :

$$\underline{\mathbf{m}}_{\mathrm{P}} = \left(\underline{m}_1, \underline{m}_2, \ldots, \underline{m}_P\right) \qquad (2)$$

The elements $\underline{m}_i$ of $\underline{\mathbf{m}}_{\mathrm{P}}$ are derived from elements $m_i$ of $\mathbf{m}_{\mathrm{P}}$ using equation (3):

$$\underline{m}_i = (\mathrm{j})^i \cdot m_i \text{ for all } i = 1, \ldots, P \qquad (3)$$

Hence, the elements $\underline{m}_i$ of the complex basic midamble code are alternating real and imaginary.

To derive the required training sequences, this vector $\underline{\mathbf{m}}_{\mathrm{P}}$ is periodically extended to the size:

$$i_{\max} = L_m + (K-1)W \qquad (4)$$

Notes on equation (4):

K and W are taken from Annex AA~~B~~.1

So we obtain a new vector $\underline{\mathbf{m}}$ containing the periodic basic midamble sequence:

$$\underline{\mathbf{m}} = \left(\underline{m}_1, \underline{m}_2, \ldots, \underline{m}_{i_{\max}}\right) = \left(\underline{m}_1, \underline{m}_2, \ldots, \underline{m}_{L_m + (K-1)W}\right) \qquad (5)$$

The first P elements of this vector $\underline{\mathbf{m}}$ are the same ones as in vector $\underline{\mathbf{m}}_{\mathrm{P}}$ , the following elements repeat the beginning:

$$\underline{m}_i = \underline{m}_{i-P} \text{ for the subset } i = (P+1), \ldots, i_{\max} \qquad (6)$$

Using this periodic basic midamble sequence $\underline{\mathbf{m}}$ for each user k a midamble $\underline{\mathbf{m}}^{(k)}$ of length $L_m$ is derived, which can be written as a user specific vector:

$$\underline{\mathbf{m}}^{(k)} = \left(\underline{m}_1^{(k)}, \underline{m}_2^{(k)}, \ldots, \underline{m}_{L_m}^{(k)}\right) \qquad (7)$$

The $L_m$ midamble elements $\underline{m}_i^{(k)}$ are generated for each midamble of the k users (k = 1,...,K) based on:

$$\underline{m}_i^{(k)} = \underline{m}_{i+(K-k)W} \text{ with } i = 1,\ldots,L_m \text{ and } k = 1,\ldots,K \qquad (8)$$

The midamble sequences derived according to equations (7) to (8) have complex values and are not subject to channelisation or scrambling process, i.e. the elements $\underline{m}_i^{(k)}$ represent complex chips for usage in the pulse shaping process at modulation.

The term 'a midamble code set' or 'a midamble code family' denotes K specific midamble codes $\underline{\mathbf{m}}^{(k)}$; k=1,...,K, based on a single basic midamble code $\mathbf{m}_P$ according to (1).

### ~~6~~5A.2.4 Beamforming

Beamforming is same as that of the 3.84Mcps TDD, cf. [ 5.2.4 Beamforming ].

## ~~6~~5A.3 Common physical channels

### ~~6~~5A.3.1 Primary common control physical channel (P-CCPCH)

The BCH as described in section 4.1.2 'Common Transport Channels' is mapped onto the Primary Common Control Physical Channels (P-CCPCH1 and P-CCPCH2). The position (time slot / code) of the P-CCPCHs is fixed in the 1.28Mcps TDD. The P-CCPCHs are mapped onto the first two code channels of timeslot#0 with spreading factor of 16. The P-CCPCH is always transmitted with an antenna pattern configuration that provides whole cell coverage.

#### ~~6~~5A.3.1.1 P-CCPCH Spreading

The P-CCPCH uses fixed spreading with a spreading factor SF = 16. The P-CCPCH1 and P-CCPCH2 always use channelisation code $c_{Q=16}^{(k=1)}$ and $c_{Q=16}^{(k=2)}$ respectively.

#### ~~6~~5A.3.1.2 P-CCPCH Burst Format

The burst format as described in ~~section 6~~section 5A.2.2 is used for the P-CCPCH. No TFCI is applied for the P-CCPCH.

#### ~~6~~5A.3.1.3 P-CCPCH Training sequences

The training sequences, i.e. midambles, as described in subclause ~~6~~5A.2.3 are used for the P-CCPCH.

### ~~6~~5A.3.2 Secondary common control physical channel (S-CCPCH)

PCH and FACH as described in subclause 4.1.2 are mapped onto one or more secondary common control physical channels (S-CCPCH). In this way the capacity of PCH and FACH can be adapted to the different requirements. The time slot and codes used for the S-CCPCH are broadcast on the BCH.

#### ~~6~~5A.3.2.1 S-CCPCH Spreading

The S-CCPCH uses fixed spreading with a spreading factor SF = 16 as described in subclause ~~6~~5A.2.1.

#### ~~6~~5A.3.2.2 S-CCPCH Burst Format

The burst format as described in ~~section 6~~section 5A.2.2 is used for the S-CCPCH. TFCI may be applied for S-CCPCHs.

#### 65A.3.2.3 S-CCPCH Training sequences

The training sequences, i.e. midambles, as described in the subclause 65A.2.3 are also used for the S-CCPCH.

## 65A.3.3 Fast Physical Access CHannel (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. FPACH makes use of one code with spreading factor 16, so that its burst is composed by 44 symbols. The spreading code, training sequence and time slot position are configured by the network and signalled on the BCH.

#### 65A.3.3.1 FPACH burst

The FPACH burst contains 32 information bits. Table 188J reports the content description of the FPACH information bits and their priority order:

**Table 8J18: FPACH information bits description**

| Information field | Length (in bits) |
|---|---|
| Signature Reference Number | 3 (MSB) |
| Relative Sub-Frame Number | 2 |
| Received starting position of the UpPCH ($UpPCH_{POS}$) | 11 |
| Transmit Power Level Command for RACH message | 7 |
| Reserved bits (default value: 0) | 9 (LSB) |

In the use and generation of the information fields is explained in [9].

##### 65A.3.3.1.1 Signature Reference Number

The reported number corresponds to the numbering principle for the cell signatures as described in [8].

The Signature Reference Number value range is 0 – 7 coded in 3 bits such that:

bit sequence(0 0 0) corresponds to the first signature of the cell; …; bit sequence (1 1 1) corresponds to the 8th signature of the cell.

##### 65A.3.3.1.2 Relative Sub-Frame Number

The Relative Sub-Frame Number value range is 0 – 3 coded such that:

bit sequence (0 0) indicates one sub-frame difference; …; bit sequence (1 1) indicates 4 sub-frame difference.

##### 65A.3.3.1.3 Received starting position of the UpPCH ($UpPCH_{POS}$)

The received starting position of the UpPCH value range is 0 – 2047 coded such that:

bit sequence (0 0 … 0 0 0) indicates the received starting position zero chip; …; bit sequence (1 1 … 1 1 1) indicates the received starting position 2047*1/8 chip.

##### 65A.3.3.1.4 Transmit Power Level Command for the RACH message

The transmit power level command is transmitted in 7 bits.

#### 65A.3.3.2 FPACH Spreading

The FPACH uses only spreading factor SF=16 as described in subclause 65A.3.3. The set of admissible spreading codes for use on the FPACH is broadcast on the BCH.

#### ~~6~~5A.3.3.3~~2~~ FPACH Burst Format

The burst format as described in ~~section 6~~section 5A.2.2 is used for the FPACH.

#### ~~6~~5A.3.3.4~~3~~ FPACH Training sequences

The training sequences, i.e. midambles, as described in subclause ~~6~~5A.2.3 are used for FPACH.

#### ~~6~~5A.3.3.5~~4~~ FPACH timeslot formats

The FPACH uses slot format #0 of the DL time slot formats given in subclause ~~6~~5A.2.2.4.1.1.

### ~~6~~5A.3.4 The physical random access channel (PRACH)

The RACH as described in subclause 4.1.2 is mapped onto one or more uplink physical random access channels (PRACH). In such a way the capacity of RACH can be flexibly scaled depending on the operators need.

#### ~~6~~5A.3.4.1 PRACH Spreading

The uplink PRACH uses either spreading factor SF=16, SF=8 or SF=4 as described in subclause ~~6~~5A.2.1. The set of admissible spreading codes for use on the PRACH and the associated spreading factors are broadcast on the BCH (within the RACH configuration parameters on the BCH).

#### ~~6~~5A.3.4.2 PRACH Burst Format

The burst format as described in ~~section 6~~section 5A.2.2 is used for the PRACH.

#### ~~6~~5A.3.4.3 PRACH Training sequences

The training sequences, i.e. midambles, of different users active in the same time slot are time shifted versions of a single periodic basic code. The basic midamble codes as described in subclause ~~6~~5A.2.3 are used for PRACH.

#### ~~6~~5A.3.4.4 PRACH timeslot formats

The PRACH uses the following time slot formats taken from the uplink timeslot formats described in sub-clause ~~6~~5A.2.2.4.1.2:

| Spreading Factor | Slot Format # |
|---|---|
| 16 | 0 |
| 8 | 10 |
| 4 | 25 |

#### ~~6~~5A.3.4.5 Association between Training Sequences and Channelisation Codes

The association between training sequences and channelisation codes of PRACH in the 1.28McpsTDD is same as that of the DPCH.

### ~~6~~5A.3.5 The synchronisation channels (DwPCH, UpPCH)

There are two dedicated physical synchronisation channels —DwPCH and UpPCH in each 5ms sub-frame of the 1.28Mcps TDD. The DwPCH is used for the down link synchronisation and the UpPCH is used for the uplink synchronisation.

The position and the contents of the DwPCH are equal to the DwPTS as described in the subclause ~~6~~5A.1., while the position and the contents of the UpPCH are equal to the UpPTS.

The DwPCH is transmitted at each sub-frame with an antenna pattern configuration which provides whole cell coverage. Furthermore it is transmitted with a constant power level which is signalled by higher layers.

The burst structure of the DwPCH ( DwPTS) is described in the figure ~~27~~18I.

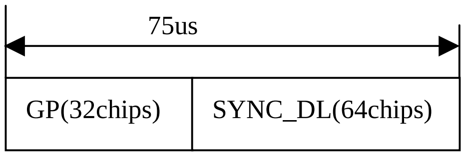



**Figure ~~27~~18I: burst structure of the DwPCH ( DwPTS)**

Note: 'GP' for 'Guard Period'

The burst structure of the UpPCH ( UpPTS) is described in the figure ~~28~~18J.

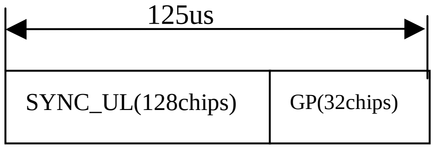



**Figure ~~28~~18J: burst structure of the UpPCH ( UpPTS)**

The SYNC-DL code in DwPCH and the SYNC-UL code in UpPCH are not spreaded. The details about the SYNC-DL and SYNC-UL code are described in the corresponding subclause and annex in [8].

### ~~6~~5A.3.6 Physical Uplink Shared Channel (PUSCH)

For Physical Uplink Shared Channel (PUSCH) the burst structure of DPCH as described in subclause ~~6~~5A.2 and the training sequences as described in subclause ~~6~~5A.2.3 shall be used. PUSCH provides the possibility for transmission of TFCI, SS, and TPC in uplink.

The PUSCH is common with 3.84 Mcps TDD with respect to Spreading and UE selection, cf. [5.3.5 Physical Uplink Shared Channel (PUSCH)].

### ~~6~~5A.3.7 Physical Downlink Shared Channel (PDSCH)

For Physical Downlink Shared Channel (PDSCH) the burst structure of DPCH as described in subclause ~~6~~5A.2 and the training sequences as described in subclause ~~6~~5A.2.3 shall be used. PDSCH provides the possibility for transmission of TFCI, SS, and TPC in downlink.

The PDSCH is common with 3.84 Mcps TDD with respect to Spreading and UE selection, cf. [5.3.6 Physical Downlink Shared Channel (PDSCH)].

### ~~6~~5A.3.8 The Page Indicator Channel (PICH)

The Paging Indicator Channel (PICH) is a physical channel used to carry the paging indicators.

#### ~~6~~5A.3.8.1 Mapping of Paging Indicators to the PICH bits

Figure ~~29~~18K depicts the structure of a PICH transmission and the numbering of the bits within the bursts. The burst type as described in [~~6~~5A.2.2 ‘Burst Format’] is used for the PICH. $N_{PIB}$ bits are used to carry the paging indicators, where $N_{PIB}$=352.

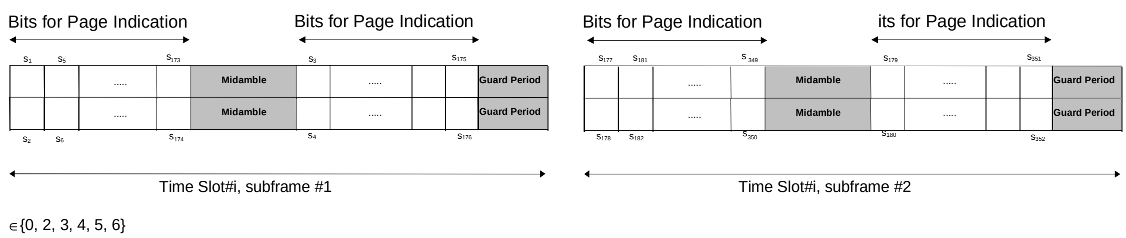



**Figure ~~29~~18K: Transmission and numbering of paging indicator carrying bits in the PICH bursts**

Each paging indicator $P_q$ (where $P_q$, $q = 0, ..., N_{PI}-1$, $P_q \in \{0, 1\}$) in one radio frame is mapped to the bits $\{s_{2L_{PI}*q+1},...,s_{2L_{PI}*(q+1)}\}$ in subframe #1 or subframe #2.

The setting of the paging indicators and the corresponding PICH bits is described in [7].

$N_{PI}$ paging indicators of length $L_{PI}$=2, $L_{PI}$=4 or $L_{PI}$=8 symbols are transmitted in each radio frame that contains the PICH. The number of paging indicators $N_{PI}$ per radio frame is given by the paging indicator length, which signalled by higher layers. In table ~~19~~8K this number is shown for the different possibilities of paging indicator lengths.

**Table 8K~~19~~: Number $N_{PI}$ of paging indicators per radio frame for different paging indicator lengths $L_{PI}$**

| | $L_{PI}$=2 | $L_{PI}$=4 | $L_{PI}$=8 |
|---|---|---|---|
| $N_{PI}$ per radio frame | 88 | 44 | 22 |

### ~~6~~5A.3.8.2 Structure of the PICH over multiple radio frames

The structure of the PICH over multiple radio frames is common with 3.84 Mcps TDD, cf. [5.3.7.2 Structure of the PICH over multiple radio frames]

## ~~6~~5A.4 Transmit Diversity for DL Physical Channels

Table ~~20~~8L summarizes the different transmit diversity schemes for different downlink physical channel types in 1.28Mcps TDD that are described in [9].

**Table 8L~~20~~: Application of Tx diversity schemes on downlink physical channel types in 1.28Mcps TDD**
**"X" – can be applied, "–" – must not be applied**

| Physical channel type | Open loop TxDiversity | | Closed loop TxDiversity |
|---|---|---|---|
| | TSTD | SCTD (*) | |
| P-CCPCH | X | X | – |
| S-CCPCH | X | X | – |
| DwPCH | X | – | – |
| DPCH | X | – | X |
| PDSCH | X | X | X |
| PICH | X | X | - |
| | | | |

(*) Note: SCTD may only be applied to physical channels when they are allocated to beacon locations.

## ~~6~~5A.5 Beacon characteristics of physical channels

For the purpose of measurements, common physical channels that are allocated to particular locations (time slot, code) shall have particular physical characteristics, called beacon characteristics. Physical channels with beacon characteristics are called beacon channels. The location of the beacon channels is called beacon location. The beacon channels shall provide the beacon function, i.e. a reference power level at the beacon location, regularly existing in each subframe. Thus, beacon channels must be present in each subframe.

### ~~6~~5A.5.1 Location of beacon channels

The beacon location is described as follows :

The beacon function shall be provided by the physical channels that are allocated to channelisation code $c_{Q=16}^{(k=1)}$ and $c_{Q=16}^{(k=2)}$ in Timeslot#0.

Note that by this definition the P-CCPCH always has beacon characteristics.

### ~~6~~5A.5.2 Physical characteristics of the beacon function

The beacon channels shall have the following physical characteristics.

They:

- are transmitted with reference power;
- are transmitted without beamforming;
- use midamble $m^{(1)}$ and $m^{(2)}$ exclusively in this time slot

The reference power corresponds to the sum of the power allocated to both midambles $m^{(1)}$ and $m^{(2)}$. Two possibilities exist:

- If SCTD antenna diversity is not applied to beacon channels, all the reference power of any beacon channel is allocated to $m^{(1)}$.
- If SCTD antenna diversity is applied to beacon channels, for any beacon channel midambles $m^{(1)}$ and $m^{(2)}$ are each allocated half of the reference power.

## ~~6~~5A.6 Midamble Allocation for Physical Channels

The midamble allocation schemes for physical channels are the same as in the 3.84Mcps TDD option. The associations between channelisation codes and midambles for the default and common midamble allocation differ from the 3.84 Mcps TDD option. The associations are given in Annex AA~~B~~.2 [Association between Midambles and channelisation Codes] and D [Signalling of the number of channelisation codes for the DL common midamble case for 1.28Mcps TDD] respectively

### ~~6~~5A.6.1 Midamble Allocation for DL Physical Channels

Beacon channels shall always use the reserved midambles $m^{(1)}$ and $m^{(2)}$, see ~~6~~5A.5. For the other DL physical channels that are located in timeslot #0, midambles shall be allocated based on the default midamble allocation scheme, using the association for K=8 midambles. For all other DL physical channels, the midamble is explicitly assigned by higher layers or allocated by layer 1.

#### ~~6~~5A.6.1.1 Midamble Allocation by signalling from higher layers

The midamble allocation by signalling is the same like in the 3.84 Mcps TDD cf. [5.6.1.1 Midamble allocation by signalling from higher layers]

#### ~~6~~5A.6.1.2 Midamble Allocation by layer 1

##### ~~6~~5A.6.1.2.1 Default midamble

The default midamble allocation by layer 1 is the same like in the 3.84 Mcps TDD cf. [5.6.1.2.1 Default midamble]. The associations between midambles and channelisation codes are given in Annex AA~~B~~.2 [Association between Midambles and channelisation Codes].

##### ~~6~~5A.6.1.2.2 Common Midamble

The common midamble allocation by layer 1 is the same like in the 3.84 Mcps TDD cf. [5.6.1.2.2 Common midamble]. The respective associations are given in Annex BA~~D~~ [Signalling of the number of channelisation codes for the DL common midamble case for 1.28 Mcps TDD].

### ~~6~~5A.6.2 Midamble Allocation for UL Physical Channels

The midamble allocation for UL Physical Channels is the same as in the 3.84 Mcps TDD cf. [5.6.2 Midamble allocation for UL Physical Channels]

## ~~6~~5A.7 Midamble Transmit Power

The setting of the midamble transmit power is done as in the 3.84 Mcps TDD option cf. 5.7 'Midamble Transmit Power'

# ~~7~~6 Mapping of transport channels to physical channels for the 3.84 Mcps option

This clause describes the way in which transport channels are mapped onto physical resources, see figure 19~~30~~.

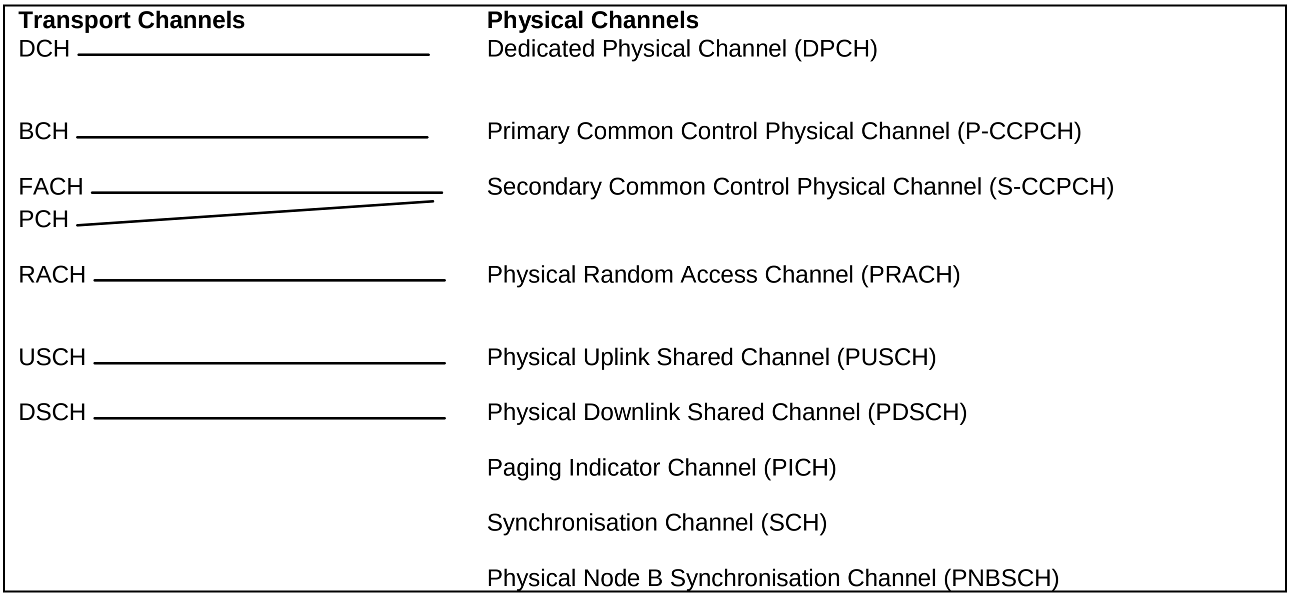



**Figure 19~~30~~: Transport channel to physical channel mapping**

## ~~7~~6.1 Dedicated Transport Channels

A dedicated transport channel is mapped onto one or more physical channels. An interleaving period is associated with each allocation. The frame is subdivided into slots that are available for uplink and downlink information transfer. The mapping of transport blocks on physical channels is described in TS 25.222 ("multiplexing and channel coding").

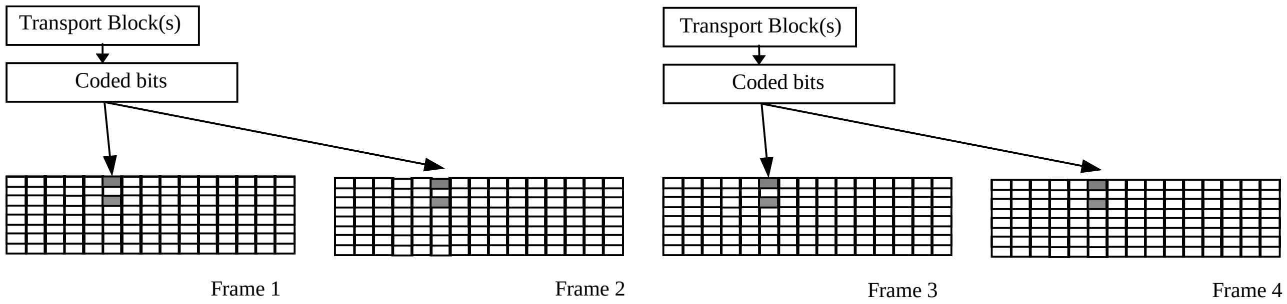



**Figure 20~~31~~: Mapping of Transport Blocks onto the physical bearer**

For NRT packet data services, shared channels (USCH and DSCH) can be used to allow efficient allocations for a short period of time.

# ~~7~~6.2 Common Transport Channels

## ~~7~~6.2.1 The Broadcast Channel (BCH)

The BCH is mapped onto the P-CCPCH. The secondary SCH codes indicate in which timeslot a mobile can find the P-CCPCH containing BCH.

## ~~7~~6.2.2 The Paging Channel (PCH)

The PCH is mapped onto one or several S-CCPCHs so that capacity can be matched to requirements. The location of the PCH is indicated on the BCH. It is always transmitted at a reference power level.

To allow an efficient DRX, the PCH is divided into PCH blocks, each of which comprising $N_{PCH}$ paging sub-channels. $N_{PCH}$ is configured by higher layers. Each paging sub-channel is mapped onto 2 consecutive PCH frames within one PCH block. Layer 3 information to a particular UE is transmitted only in the paging sub-channel, that is assigned to the UE by higher layers, see [15]. The assignment of UEs to paging sub-channels is independent of the assignment of UEs to page indicators.

### ~~7~~6.2.2.1 PCH/PICH Association

As depicted in figure 21~~32~~, a paging block consists of one PICH block and one PCH block. If a paging indicator in a certain PICH block is set to '1' it is an indication that UEs associated with this paging indicator shall read their corresponding paging sub-channel within the same paging block. The value $N_{GAP}$>0 of frames between the end of the PICH block and the beginning of the PCH block is configured by higher layers.

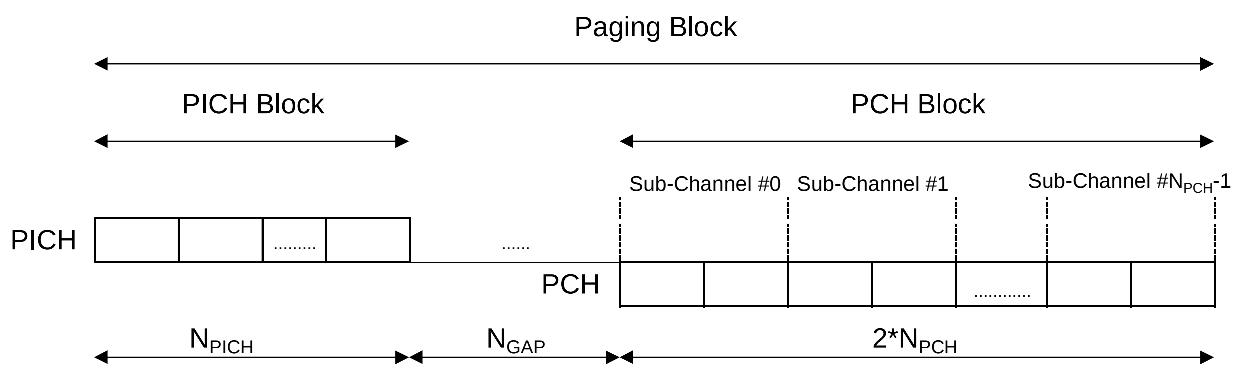



**Figure 21~~32~~: Paging Sub-Channels and Association of PICH and PCH blocks**

### ~~7~~6.2.3 The Forward Channel (FACH)

The FACH is mapped onto one or several S-CCPCHs. The location of the FACH is indicated on the BCH and both, capacity and location can be changed, if required. FACH may or may not be power controlled.

### ~~7~~6.2.4 The Random Access Channel (RACH)

The RACH has intraslot interleaving only and is mapped onto PRACH. The same slot may be used for PRACH by more than one cell. Multiple transmissions using different spreading codes may be received in parallel. More than one slot per frame may be administered for the PRACH. The location of slots allocated to PRACH is broadcast on the BCH. The PRACH uses open loop power control. The details of the employed open loop power control algorithm may be different from the corresponding algorithm on other channels.

### ~~7~~6.2.5 The Uplink Shared Channel (USCH)

The uplink shared channel is mapped on one or several PUSCH, see subclause 5.5.

### ~~7~~6.2.6 The Downlink Shared Channel (DSCH)

The downlink shared channel is mapped on one or several PDSCH, see subclause 5.6.

# ~~8~~7 Mapping of transport channels to physical channels for the 1.28 Mcps option

This clause describes the way in which the transport channels are mapped onto physical resources, see figure ~~33~~22.

| Transport channels | Physical channels |
|---|---|
| DCH | Dedicated Physical Channel (DPCH) |
| BCH | Primary Common Control Physical Channels (P-CCPCH) |
| PCH | Secondary Common Control Physical Channels(S-CCPCH) |
| FACH | Secondary Common Control Physical Channels(S-CCPCH) |
| | PICH |
| RACH | Physical Random Access Channel (PRACH) |
| USCH | Physical Uplink Shared Channel (PUSCH) |
| DSCH | Physical Downlink Shared Channel (PDSCH) |
| | Down link Pilot Channel (DwPCH) |
| | Up link Pilot Channel (UpPCH) |
| | FPACH |

**Figure 22~~33~~: Transport channel to physical channel mapping for 1.28Mcps TDD**

## ~~8~~7.1 Dedicated Transport Channels

The mapping of transport blocks to physical bearers is in principle the same as in 3.84 Mcps TDD but due to the subframe structure the coded bits are mapped onto each of the subframes within the given TTI.

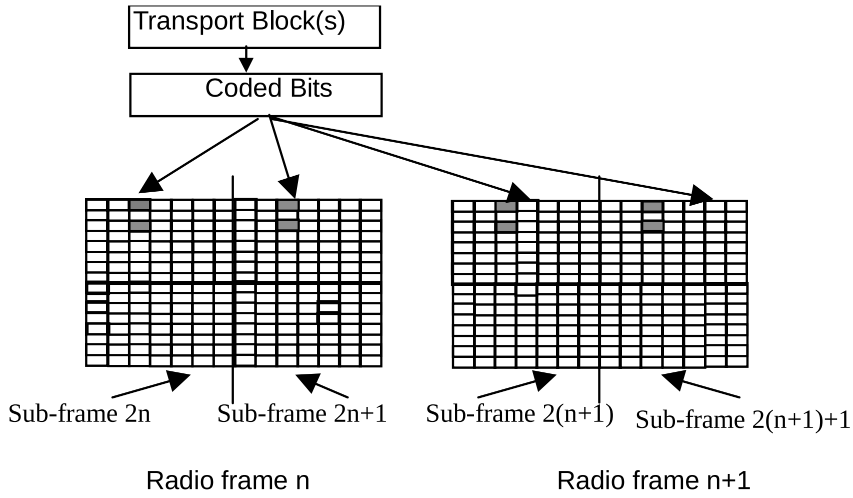



**Figure 23~~34~~ : Mapping of Transport Blocks onto the physical bearer ( TTI= 20ms )**

## ~~8~~7.2 Common Transport Channels

### ~~8~~7.2.1 The Broadcast Channel (BCH)

There are two P-CCPCHs, P-CCPCH 1 and P-CCPCH 2 which are mapped onto timeslot#0 using the channelisation codes $c_{Q=16}^{(k=1)}$ and $c_{Q=16}^{(k=2)}$ with spreading factor 16. The BCH is mapped onto the P-CCPCH1+P-CCPCH2.

The position of the P-CCPCHs is indicated by the relative phases of the bursts in the DwPTS with respect to the P-CCPCHs midamble sequences, see [8]. One special combination of the phase differences of the burst in the DwPTS with respect to the P-CCPCH midamble indicates the position of the P-CCPCH in the multi-frame and the start position of the interleaving period.

### ~~8~~7.2.2 The Paging Channel (PCH)

The mapping of Paging Channels onto S-CCPCHs and the association between PCHs and Paging Indicator Channels is the same as in the 3.84 Mcps TDD option, cf. ~~7~~6.2.2 'The paging Channel' and ~~7~~6.2.2.1 'PCH/PICH Association' respectively.

### ~~8~~7.2.3 The Forward Channel (FACH)

The FACH is mapped onto one or several S-CCPCHs. The location of the FACH is indicated on the BCH and both, capacity and location can be changed, if required. FACH may or may not be power controlled.

### ~~8~~7.2.4 The Random Access Channel (RACH)

The RACH is mapped onto PRACH. More than one slot per frame may be administered for the PRACH. The location of slots allocated to PRACH is broadcast on the BCH. The uplink sync codes (SYNC-UL sequences) used by the UEs for UL synchronisation have a well known association with the P-RACHs, as broadcast on the BCH. On the PRACH, both power control and uplink synchronisation control are used.

### ~~8~~7.2.5 The Uplink Shared Channel (USCH)

The uplink shared channel is mapped onto one or several PUSCH, see subclause ~~6~~5A.3.6 ‘Physical Uplink Shared Channel (PUSCH)’

### ~~8~~7.2.6 The Downlink Shared Channel (DSCH)

The downlink shared channel is mapped onto one or several PDSCH, see subclause ~~6~~5A.3.7 'Physical Downlink Shared Channel (PDSCH)'

# Annex A (normative): Basic Midamble Codes for the 3.84 Mcps option

## A.1 Basic Midamble Codes for Burst Type 1 and 3

In the case of burst type 1 or 3 (see subclause 5.2.2) the midamble has a length of Lm=512, which is corresponding to:

K'=8; W=57; P=456.

Depending on the possible delay spread cells are configured to use $K_{Cell}$ midambles which are generated from the Basic Midamble Codes (see table ~~A-1~~A.1)

- for all k=1,2,...,K; K=2K' or
- for k=1,2,...,K', only, or
- for odd k=1,3,5,...,≤ K', only.

Depending on the cell size midambles for PRACH are generated from the Basic Midamble Codes (see table A.-1)

- for k=1,2,...,K' or
- for odd k=1,3,5,...,≤ K', only.

The cell configuration is broadcast on BCH.

The mapping of these Basic Midamble Codes to Cell Parameters is shown in TS 25.223.

**Table A.-1: Basic Midamble Codes $\mathbf{m}_P$ according to equation (5) from subclause 5.2.3 for case of burst type 1 and 3**

| Code ID | Basic Midamble Codes $m_{PL}$ of length *P*=456 |
|---|---|
| $m_{PL0}$ | 8DF65B01E4650910A4BF89992E48F43860B07FE55FA0028E454EDCD1F0A09A6F029668F55427253FB8A71E5EF2EF360E539C489584413C6DC4 |
| $m_{PL1}$ | 4C63F9BC3FD7B655D5401653BE75E1018DC26D271AADA1CF13FD348386759506270F2F953E93A44468E0A76605EAE8526225903B1201077602 |
| $m_{PL2}$ | 8522611FFCAEB55A5F07D966036C852E7B15B893B3ABA9672C327380283D168564B8E1200F0E2205AF1BB23A58679899785CFA2A6C131CFDC4 |
| $m_{PL3}$ | F58107E6B777C221999BDE9340E192DC6C31AB8AE85E70AA9BBEB39727435412A5A27C0EF73AB453ED0D28E5B032B94306EC1304736C91E922 |
| $m_{PL4}$ | 89670985013DFD2223164B68A63BD58C7867E97316742D3ABD6CBDA4FC4E08C0B0CBE44451575C72F887507956BD1F27C466681800B4B016EE |
| $m_{PL5}$ | FCDEF63500D6745CDB962594AF171740241E982E9210FC238C4DD85541F08C1A010F7B3161A7F4DF19BAD916FD308AB1CED2A32538C184E92C |
| $m_{PL6}$ | DB04CE77A5BA7C0E09B6D3551072B11A7A43B6A355C1D6FDCF725D587874999895748DD09832ABC35CEC3008338249612E6FE5005E13B03103 |
| $m_{PL7}$ | D2F61A622D0BA9E448CD29587D398EF8CDC3B6582B6CDD50E9E20BF5FE2B3258041E14D60821DC6725132C22D787CD5D497780D4241E3B420D |
| $m_{PL8}$ | 7318524E62D806FA149ECC5435058A2B74111524B84727FE9A7923B4A1F0D8FCD89208F34BEE5CADEB90130F9954BB30605A98C11045FF173D |
| $m_{PL9}$ | 8E832B4FA1A11E0BF318E84F54725C8052E0D099EF0AF54BC342BEE44976C9F38DE701623C7BF6474DF90D2E2222A4915C8080E7CD3EC84DAC |
| $m_{PL10}$ | CFA5BAC90780876C417933C43103B55699A8AD51164E590AF9DA6AF0C18804E1F74862F00CE7ECC899C85B6ABB0CAD5E50836AD7A39878FE2F |
| $m_{PL11}$ | AD539094A19858A75458F1B98E286A4F7DC3A117083D04724CBE83F34102817C5531329CDB437FFF712241B644BDF0C1FEC8598A63C2F21BD7 |
| $m_{PL12}$ | BEB8483139529BDE23E42DA6AB8170DD0BFBB30CE28A4502FAF3C8EDA219B9A6D5B849D9C9E4451F74E2408EA046061201E0C1D69CF48F3A94 |
| $m_{PL13}$ | C482462CA7846266060D21688BA00B72E1EC84A3D5B7194C8DA39E21A3CE12BF512C8AAB6A7079F73C0D3E4F40AC555A4BCC453F1DFE3F6C82 |

| Code ID | Basic Midamble Codes $m_{PL}$ of length $P$=456 |
|---|---|
| $m_{PL14}$ | 9663373935FD5C213AC58C0670206683D579D2526C05B0A81030DDF61A221D8A68EAD8D6F7A<br>A0D662C07C6DCD0115A54D39F03F7122B0675AC |
| $m_{PL15}$ | 387397AE5CD3F2B3912C26B8F87CE82CEFEC55507DB08FB0C4CF2FD6858896201ACA726428<br>1D0298440DD3481E5E9DDB24C16F30EB7A22948A |
| $m_{PL16}$ | AFE9266843C892571B6230D808788C63B9065EA3BDFF687B92B8734A8D7099559FEA22C94165<br>76D0C087EB4503E87E356471B330182A24A3E6 |
| $m_{PL17}$ | 6E6C550A4CB74010F6C3E0328651DF421C456D9A5E8AE9D3946C10189D72B579184552EE3E7<br>99970969C870FE8A37B6C4BA890992103486DC0 |
| $m_{PL18}$ | D803CA71B6F99CFB3105D40F4695D61EB0B62E803F79302EE3D2A6BF12EA70D304B181E8B3<br>8B3B74F5022B67EB8109808C62532688C563D4BE |
| $m_{PL19}$ | E599ED48D01772055DBE9D343A4EA5EABE643DA38F06904FC7523B08C4101F021B199AF759A<br>00D9AC298881D79413A77470992A75C771492D0 |
| $m_{PL20}$ | 9F30AC4162CE5D185953705F3D45F026F38E9B5721AEFE07370214D526A2C4B344B508B57BF<br>B2492320C05903C79CBEE08C6E7F218B57E14D6 |
| $m_{PL21}$ | B5971060DA84685B4D042ED0189FAF13C961B2EF61CC164E363B22AAB14AC8AF607906C1C6<br>E04F2054C687AA6741A9E70639857DA02B6FFFFA |
| $m_{PL22}$ | 97135FC2226C4B4A5CBA5FCA3732763B87455F73A1148006F3DF214BD4C936D061E04045160<br>E2CE33B9CD09D08FDE2A37F4E998322B4401D27 |
| $m_{PL23}$ | 4D256D57C861B9791151A78D5299C56D116B6178B2A2D04BB95FB76540AF28341DC6EC4E7E<br>D3BF9E508478D9C8F44914805DA82429E1CF320E |
| $m_{PL24}$ | 858EF5C84CE32D18D9ABA110EEA7474CF0CD70254D2928C3F4DFF6BB3A518587CADA190290<br>78AC90A8336C8178203BE3289E601F07D089CB64 |
| $m_{PL25}$ | 920A8796A511650AEF32F93DD3C39C624E07AE03CE8C96139973F54DCB9803C5164ADB502D<br>4FF561564D607037FCD172921F1982B102C3312C |
| $m_{PL26}$ | 485C5DAE76B360A9C56E20B8422EA3E6ACF07CB093B5587CB0E6A5498A4714081EA98DBCD<br>B0482B26E0D097C03444473D233BEF3C8E440DEBF |
| $m_{PL27}$ | 565A9D54EA789892B024F97E728E8EE112411942C48BD0C5BC8AA457D8DC9941F0F7424B386<br>43FFE6521CD306FBC56FE10F1428D4C245B5606 |
| $m_{PL28}$ | 5AEF2C0C2C378179A1AC36242E6B3EDB72C42D3624437674F8D51260C0898C201837CBA14E9<br>E23D1EF6451C4ACF27AB031F457A8A1BFD148AE |
| $m_{PL29}$ | 87D8FE685417822A23D925307E6C11081ADAC4702BCCD9BE448E78984D109B50DEF5B7C58B<br>C71EA1F0A6826BA8AD1978843E7697F3E416AADA |

| Code ID | Basic Midamble Codes $m_{PL}$ of length $P$=456 |
|---|---|
| $m_{PL30}$ | 84802B72AF27B5BE724D1FB629E0E627BDB0D9061292562F98350C1D0C9D4B9D8E2BF71123C82EBB161003AE9829E07244D78F19926F8847A2 |
| $m_{PL31}$ | 8CCB5128238BCB088E30972D62792AEF02B9BBDDCAD68C9916C00BF91CBE788B0F03851FAAF88605534FD73436C259D270B1013CB14226F658 |
| $m_{PL32}$ | 62F4E6FAC2BF1979CE6854AA2D33534BFB2F946519101A6589131C3640707D40E67ED804AF8736AD213CAF593574190006 1967E8285C27E34C |
| $m_{PL33}$ | 4095E5B4EEAFCDF68A34B267EEA28D8444FA533900F41499E260D2E65C256A52E1DD5861F5227C98E00687D107233F51A1167BCF72FB184654 |
| $m_{PL34}$ | 5630E9A79FCAD303404D9E5A802299162657AAC734761C6E90DA8BCE4F61A763E0BB48D3FEB3F78468C828ABA4828DAD06E0F904CFD40421DC |
| $m_{PL35}$ | CD12B24C0BCA8AAC1FCBF0500A3BC684A180E863D888F2506B48C68ECF17F76CB285991FBA18EB6397211FAD002F482D57A258CD45DE3FF1A6 |
| $m_{PL36}$ | AFCF2A50877286CD3405442730C45514F082D9EC296B367C0F64F04C4E0007DCA9E50BEED5C102126E319ACBC64F1729272F2F72C9397029FE |
| $m_{PL37}$ | 18F89EE8589D20882A72A44DCCDF0050F0A3D88DBA6531614973D26905FDF41E3F779FF0648E8AF1540928511BCF4C25D9C64AF34AC31B8965 |
| $m_{PL38}$ | F890D550F33F032ECDA3A51FED427D634F64EB29AF1332A23CD961258E4BAED040E7B336918E250EC272A12816B9EBFFA1E0AE401185F08C10 |
| $m_{PL39}$ | ACE5DD61506047E80FB7D41BD3992DF4D7F18EB46CC145C0E9105428C2F8F299141F5D66691904A7DC2513A3B83994ACB1292246B32818FE9D |
| $m_{PL40}$ | 150680FF900C9B46E1E24D54BE2238CB950A934E5CCDE9BC3939EB51CB0AE202B7D339EEC2018B33A0AB9B63DA5D512D64FB58C0E51A1C82C2 |
| $m_{PL41}$ | 51A579EED2663A002D32D10A0753173612F4D5BA167D1807C61F25C4D42C063682E8E9DD019F79D446A046EB3F75E50FEB228DC52F08E694B6 |
| $m_{PL42}$ | CDC644FE4C0C6897604F9D14D714123BF16FFF0E49F35F674908CA60653702FE27BCCA2A47098453AF8661055C8C549EB6A951A8396AD4B94D |
| $m_{PL43}$ | 750A10366C595373C5001CA3E4239764B1409D602CF6052B39BC6A3255A15FE06C782C4C5F847026A7E79838A2933A61C77BB6CBF5915B2DA5 |
| $m_{PL44}$ | B7490686D78E409082C4C48FE18D4C35429C20AADF96076B92FC4E85490664753DB0891A0B27FD849BB7FCA99E3B38F22F8C662852C0D35AA6 |
| $m_{PL45}$ | D86E1B575B47D23DA811806A54C231281F03317830E7BD305D3CAA7D6382A5233104CFD54D22DF9F34535E5B390D9040CF1375FEA44CEC29E2 |
| $m_{PL46}$ | 828655960C026EC67B683480992AC2ED2C43ABC606F5220C2945F373470BE7ED5BCCF7C1AA0986BBCCC84F11F1658AA568FAA0A60C5F0B5BFA |
| $m_{PL47}$ | D76230E02C8533653AAB99B288AA2ADE25A1C1BF28516C04239240EAF1EFC0B98974B51F886861D8A1E9F5D62CFFEC309F071A9716B325101B |
| $m_{PL48}$ | EA207662865B8A07D69648964DED818EE474A90B94473408871880E63EF0596B9FCFEC3C06B86EA6AD2B06C91672EFB33C70241A5450B59B8A |
| $m_{PL49}$ | 9CB5459549909835FAB22F0D99298C120ACF479F814CCE749079D40688F28101037762F125C776DA9C5FA1FCE0E76E452F8185354FDCDE94E2 |
| $m_{PL50}$ | 227506304AEC1D6F93569B51FDC3405A0F38194F65BE17163A3CB9827A35AECEA757D020FE249377ECD561428A38FEED004EC859C272563185 |
| $m_{PL51}$ | 96B9AEC9938910F0E533422A3977519B05CD4AD3909BC15A7502D48D49C124FA192A8E57027CFEB11DF542010603CE5C9FDF8E626D4FBF8CF4 |
| $m_{PL52}$ | A6AAD06E095A9BE0BD9F8A2ED40C3CBDBAE91C700CBB778C8696CC06F3A675C16BDB2918E5F2111005A8727206DC6A9684E05655185C398EEB |
| $m_{PL53}$ | CD168D384A78DA172991AD333EE2A9880905AFE59E2A2A4AC4414C40F82874F98A3CBE7B44F4C7F4710B35FD88AFC0399FAEB070EB9CA4D30A |
| $m_{PL54}$ | 22016CA87AD1549174A8699DD65599697871091457E83E0912E7E77A06531C209394D283D18A38662B73681DD9C5BF330FED978BDA7D487CA8 |
| $m_{PL55}$ | B9401B0843AA6F7827A13BD66C922287E8886C31EB5B90B82B472CCD6DA3D8D4FBF78B8F8496DFA8252B06429D5DD17142F1C908ACCD70EA0C |
| $m_{PL56}$ | E42B9EFDC5D09AC27B3C7DA28D02493A70521223B9D7A76A9D13E9C171017964D16A70C08EAD02C3DC948889C23E365AFCF01BF20B89B0BF5C |
| $m_{PL57}$ | 9DA0180168DB915E9F3597B59312198E1B5CC00D743C2ECB0DBAADA3E35A2465ED1EAA9D74734D49A313CE4DFF020D0760E3153DC485603943 |
| $m_{PL58}$ | B6C966619ECB98191D719C187C07BD503425650CAA3A2D1F2DF5212B1441D7A0C1D36A4C9C2550240AD17CA43BB3943DFFFBF1E283D81299CC |
| $m_{PL59}$ | DB0E8C41F08A03D477C1AA548799274C4BF3EB68F2636166FDC8D4B1E7132539930297E228BA232BB5C279FA5ECA3AC10E24361AF050A453B8 |
| $m_{PL60}$ | 89BCE2DE2974EEBA833CF32F224C85A2891484478527DB48FA6ECEA84C5E288CC3914CB54ADA0476278750187F68FBEA41017E1E58DF1A5A3D |
| $m_{PL61}$ | 70A457D1314A278625443EEB52520815EC92CEF17417B97440DCB531BC1CE83212F63270418D0FBDE71F6DB9E0EA88772E1E4535B6633E4425 |

| Code ID | Basic Midamble Codes $m_{PL}$ of length $P$=456 |
|---|---|
| $m_{PL62}$ | C388460AD54B36C4452CF0433BD347100ACCC24C79C535AD3E1F23FE0425E93A044C553BFA116E09AA4BB32F13CFA76FBA1BC17520F45EFD44 |
| $m_{PL63}$ | 0BAFCADCDF9AA2846681782CD3B90CA036A863C78EE1507620BC394D0C6804B4C97A15BC9C0D7B79E6892EA1BFF1A0DD9573A9213AB140D0D2 |
| $m_{PL64}$ | 833B0226789A62882FCD27A30885E67872B1A1C2FA484AD498011599DD57E8E2A07A560B47167AA5F60EF47177DBB1632D5387A2896348640B |
| $m_{PL65}$ | 8F52820323ABA5E6C6B465821B621600B980E59F53A599DA5646BA103214336836CF17E3386CE4FB2BC5F25CCB30CF7F500546828EC8786B8E |
| $m_{PL66}$ | E2E9A29C3C8207B9A4508FD2F667A159F068EEE8D00686F46EA904C3692C1D79DFF1B32E5103720D47B4B58AC35384A26087027E141B3126A8 |
| $m_{PL67}$ | 70E7C39FD2D3AE1DCE341699A544D801A8688A6EE47C5CB3630022147DDC06241FC5337A348A462B2472DEC5E104DD520ADA5114DB065D4B0D |
| $m_{PL68}$ | 9E3483CAB164BD053C4971D4D87494CC689033D589EF80E5453376E4A8DCC02183B98C36B0FF7DDC0AD07FCE8B4D5164371BD03A2110AD1247 |
| $m_{PL69}$ | 04DA1C649B0608938DAADD3FE920A4F681690C54505429DBDCDCF10067AB5714BCDDFE1F28692710F794765781C1D233344E119BEE8A8416DC |
| $m_{PL70}$ | 7A18D6D30BDF44410714C3DCA27D8F9EA8A542D87122205640B98313C91AD9A0B993A5A7BC3E035F93B88BBE6D4204BC82A9FA8D4C1A7618CF |
| $m_{PL71}$ | EB9525E10265A48733C8E0E77E459310112A71DCA680F68AC044B64BC0A31D02EEA0F7ACAAAB7F1E574E94FEA2D1301CB14B03263DA8122B76 |
| $m_{PL72}$ | E706C6ED2D6F89153835079BE0C6D45310845EF2F9F6C6AE91B7419810508BA501C0148BF09955BAD90D6391BA8EBA5CEFBD23221CC75143D7 |
| $m_{PL73}$ | DF071A10AC4120CD1431590BEDCFF9483CA7047B19590D035D309240BDB4264E9A3A2761402EC97FD8BC51B4AF32E37FBC47162A2357D18751 |
| $m_{PL74}$ | F0F952B2238139F46D8254D1A2C1C22A16BA71EC0C0C900ED1442452D7F44C798BC65FF40671B88074BA0B74C6510996EEAC495C5B49C37DEB |
| $m_{PL75}$ | 1C86BD82EDA81FD65418D3837B5552A853791456D93B06C62C650D86CFBEC269AFFD772763064062C03751B9428C6DA2E60383025F9E404B70 |
| $m_{PL76}$ | B390978DD2552C88AABA7838489A6F5A8E9C41E95FFA2215819BF8A5BFE39C8A706CC658E549E966611B843A1468406C41C09D1560BEDA4F1B |
| $m_{PL77}$ | 1A69EC9D053C7E84BAE7A48CCC71857D0C6B06D1065E3EA4633B133AA022B8104F6EE7C69B6184B746C8822958B0A16686F27C8A0E3B4EFEAD |
| $m_{PL78}$ | C95B2070816DC97C6D8DD2583263E73F9AAAFD13F0548D2EBD835824418F11E54111005FB713AB234BE412347358281C7DE331EDD21B8BEA52 |
| $m_{PL79}$ | 56D6408399F23C2ED85EE0F68111D69A91A3AD9A732AC57CA08F86CC28B3CF4E4B02EBBA0BCE5CAE5BACC4D52004070797C04093A84BB18DBA |
| $m_{PL80}$ | E662E7043867BE250764DA0596D34A582A619B408B505E6211DD6286E93A37F95B1EA680C0C5F3E777E3F71E8D75495D59043217FC0E222E16 |
| $m_{PL81}$ | 27D5E681C222297AD478A079EF12F1A98F744B66335303322EF8880B931FEBF8322F4302944E80BED468A0A516D410B183D863795992DA7DDB |
| $m_{PL82}$ | 5100336C05F9E5BF35201906C1C588858E0DAF56130DF5554B9AB21CA15311A90290624CD63E03F5EDA49DB7A0C32AB5F1CA427A2D5635FDA5 |
| $m_{PL83}$ | C696DC993BFAEA9A61B781B9C5C3F5CFAA4C8339D8B03A9B0387883D0482A41AC78D6522425959846E561D26A30FF79A205C801A85889736B2 |
| $m_{PL84}$ | D562297561AFF42D3168296C1153E4E39BE7B2EB0348BC704625AA08391235075EE0DE0A79AB03222FEDB27218C56F96EAC2F91CC8FCE64B12 |
| $m_{PL85}$ | DD0B6768FC01CC0A551F8ACC36907129623E975AB8B3FF58037F1859E2FA8C62C2D9D1E8506916029A2C3F8CAD9A26AE2CC652F48800859F5C |
| $m_{PL86}$ | 923920696EB3AB413786C41854822282BB83F6900D33A232D470BE198BBF086067B72613300C593B74251E2F079857ADBBCD86583A9DCAA6DC |
| $m_{PL87}$ | B8EF30C797D8D2C4EF11244F137D806E556A436626D0115A621C92C34D166A68BCEDFA0040DA8FD6F987B1CD5C2AA1C1B045E64475F0F8DABD |
| $m_{PL88}$ | E1887001D414405ED6419E9EE1D1D346D924ED57ADF04B31B7948099976B2D1501A60DFFB287AD44C8783DF0C1EA5AA5D273D1389C8EA22DCC |
| $m_{PL89}$ | 8C2E379A58AA96748141CA84C35987905F984A49D3AD9BFF7807AC244C16C1DF74343C2E1F25514F5A0954CFBB3C92E25EF783136844998AC5 |
| $m_{PL90}$ | 78F8A99E0A54E27F51C0726FE7A11EB26B1E29FE65F55AC8AC58011465900B958488A90F6DF614A58431DC8B6C6B9A6F032EE0E0B1306EC4B4 |
| $m_{PL91}$ | 88F7A31B7B20E0F05CA26E729B4F8A1933962D7BD7BE3E1EB130B28C794C0B4D01CADE09006FF97E80117509733F3A9DC225413A0AE08CA662 |
| $m_{PL92}$ | BE4DFCEAC18905AC8D5DA27A794F88A4D3058D2EFA3B075A819DEAE688EAF8940A653ED7104E7B403D490F0A9030264E1F12B8922C75775E61 |
| $m_{PL93}$ | 5BA4B79FC4550234D8922963BF3537485E3C8745A5DB90D3E2E454B30FF61112F508155B7C2B3C4C628AF846240C2021ACDE547E5A41F666B8 |

| Code ID | Basic Midamble Codes $m_{PL}$ of length $P$=456 |
|---|---|
| $m_{PL94}$ | 00556D35649F7610AB24A43C4F16D6AC0571FD126F11880C5CD72100D730E4E4D6BB73C33F8<br>37FAF1072743B249ADA2E09598B1EB23F1180A7 |
| $m_{PL95}$ | 7A0CC9F21BD69CF3023E944545C2176EF0D4F450B765C28359FB8A32137D043D0E5713E67B3<br>F61320985D2C6106605081F87D2296321468A2F |
| $m_{PL96}$ | DA669880995B0671201172BABFF141D5854A245E211879EF3038A7C84170DADBD368455F2465<br>3161E7886E15B253F93E3A3C568EFB17CDEB1A |
| $m_{PL97}$ | 4E294E53D1661C1F6F748302A7723DA951C00FDB8BEBBF67A68710BA0F1A255DFB1627059D4<br>1A23D3961726DE6FEB10E5D209CC4505B209812 |
| $m_{PL98}$ | 73385DF701414E144768A67EF72924B1653479E962FB1554B7E54BC5284D9B3E41C0C133F878<br>972230721918AA425501B920B204FECE0C7F8A |
| $m_{PL99}$ | F4492160805F258CE592DF4D1200566F81D173458D78EA3ABED79A14AF88170DB1D4A9A5931<br>D2B80C58C27FE17D806E3E6A66CDAAD09F118D4 |
| $m_{PL100}$ | 44D562D9012D8B07B8F44596467C11A163982BB7EAEAC184078B6B8CE46B5D7E17C39CEF57<br>6A025491183017FA09931D070B307B86524B03FF |
| $m_{PL101}$ | FCAEEFCC49A13B4FFA12C0CC6A2B90CF4F57D78B1E98294B04675C2F0991661FDC61A452A2<br>47F8C29E0284AA21026F368307375AA2C3F1E12C |
| $m_{PL102}$ | C486DF0510DCAD5AB86E178A686D398E11A0ECFAC5A326C10129257E5456B22FB8E147E919<br>0D9929A5DFFE44715FA47D62F04CFC9B1C201414 |
| $m_{PL103}$ | C10AF383DC708E257E15A8AB337BCE684A2F4AC7A22DC2C25C277F8E8D0858E79317CDDD9<br>AA2EA6CBE604D24AC0945026103E7B4126FD361A4 |
| $m_{PL104}$ | A5C60A181148D9A931B2DDDB9D169648BA54F366B4EFAE88F6861909EE0F07C037EE349D0E<br>C59A823286E366CA3943589EEA7F828C3728085F |
| $m_{PL105}$ | 96136AEBD5E28462B0421DF292BA899FFA660D80EA01620D2C7490E5347127884AA3C3D1FF4<br>4BCEEF6C29EC589CDEF200C5742C5964F8B2B52 |
| $m_{PL106}$ | 40F63C04ACAD986255D1E16B769A6D4C11A1D075E804BDC0AC61923E9A67F5D741775632807<br>2455F6E22B1C64E06F367D1B0808295C2D90E22 |
| $m_{PL107}$ | F4B82D413578C4888C5F002CF6D0E03778134A860436551FD57537E4CED334B3C9CEBACE615<br>238271717AA762448B86FA53D2074BCE35658A7 |
| $m_{PL108}$ | BCCC92D72C920E685530591FC351743D1E23DE044BF81D32650406113E23ECC757FDE4E386<br>B6E2E7195EE4969717A7BD0812AC312B33A54308 |
| $m_{PL109}$ | 6ED59DE0D44370A861CE2B42CF5E578E764A682AB5777905EE027D7160490EDC6C28989B238<br>05AA697FCD215CB401BC5E4D430624C01B16192 |
| $m_{PL110}$ | DE80C0E273B92CC3C5034F7A20DB3914643C430B425C8B9249EAF73ACE8C3BCF17957242CF<br>534D87A67D4DC0252275262E737F4095450CFA14 |
| $m_{PL111}$ | 9505C4FEF2A397D5059F4729D013292A8321FFFA929ACB0A210D0A13E13061227C44A68FBD8<br>CE6B66CE3D783363CD039AB35EE52603E09B758 |
| $m_{PL112}$ | E8BE90D7F954B14D8002A4CAC20765ABEED80634498C836D79B0F9338DBC17B28F05CF4E79<br>136779E1C55AA30B6215F890882887B3B53C23E2 |
| $m_{PL113}$ | 9F4B622C1358AE5468DC31E4B2CA320E5E20458C1DE5405BF4F9AD7D45A5BCAA39EC0626FF<br>FC698C16A009CCCB7A18A64E85E70BA71731BA24 |
| $m_{PL114}$ | B91B2624843CF48299AFC2B1442570B41F28F578530D1E322E0B54282372131C71ACB924E707<br>68A243EEC3200E7A5EBFA77111D9FB07FEA8AE |
| $m_{PL115}$ | 965F42DDA3A4650FE2F5103932B68F166FA424B9F0F7045311D962C2A9F66B9BC6C66FB480F<br>9800354E0C54A72251071422CF1DFC44F94C00C |
| $m_{PL116}$ | 08ADCE48699FC30FA0788073BDAADB9177BBB4C1CED41F93085218364B8BAD8488561EF0FE<br>1B0DDAA403C602494CB35697D62AA0A2B93A64CF |
| $m_{PL117}$ | 9A313BED80B1220D77C8ADA4B2E0B3D284A5120A94B741380923C78D3AD32BC3E71EC6EEA<br>520E9D447D8727697598BB987F17506F482003ABD |
| $m_{PL118}$ | 24C9AD4C14EFEC002A3473FCAB04E492F2E269161A2960BA8AF09FD710B444A40C4E8B1384<br>18E62301E91FBA97AFDC58759A76D00F676736C7 |
| $m_{PL119}$ | 6514C7733711CE4942CD2123AB37186EB7FECB7E78ABB28744864942FCF4C0F810054AF55B1<br>042EB53064F0857C61D85B2CF0D2DC5826AF22F |
| $m_{PL120}$ | B2C80CDC83E48C36BC6FDAB8661208EAD392F3A0571BE41DFAD765E744932ADEA50061E66<br>C05498A5381B2A1F1B446587089DC4E4A2DF03D82 |
| $m_{PL121}$ | 639368BA75CC709A3D9F28EDA237E32C2017A9BF1E382045B9426AEE0A4049DCB4E1D7EBE4<br>647B855212824557497CFA039885A3BA42F98F63 |
| $m_{PL122}$ | 6A70DDC17D0C8024B1C853F0C1948561EF32510151BE0C63BCA9171F20217891D1021EE7258<br>6CAFF557F8973336913A94A2A699B8740B054B8 |
| $m_{PL123}$ | 2E32E3A35CCD001172CE310B63B4E406126045A0FA3795BE3E3D9B56F72405FC94FD8994681<br>8BAECD24A61BABBBE2D23052AB01EF73CA0CF4A |
| $m_{PL124}$ | 829395C35205A480AC1351C25E234BF52D384A3DE1C5138A650A6F82F739757D812D9C38231<br>AB9FD81AA0648B11F6F6113F9312C57624FC746 |
| $m_{PL125}$ | D98FFE19C0AAAAB0571A9075ECDFD3E7373F5255DC669116A8C6913F0123E598F930934C5F6<br>A601C37C529C371A0C391B59AC5A9E286D04011 |

| Code ID | Basic Midamble Codes $m_{PL}$ of length *P*=456 |
|---|---|
| $m_{PL126}$ | C1A108192BCE96C2430A63C189BB33856BE6B8B524703FCB205DAEF37EF544CD43CA09B618<br>1B417398083FF2F781BA4AE89A5CA291DB928D71 |
| $m_{PL127}$ | 42568DF9F61849BF9E7DEE750604BE2E0BC16CC464B1CDE15015E01D6498E9F3E6D6950E58<br>24651F212BA0057CE9529B9CCAB88D8136B8545E |

# A.2 Basic Midamble Codes for Burst Type 2

In the case of burst type 2 (see subclause 5.2.2) the midamble has a length of Lm=256, which is corresponding to:

K'=3; W=64; P=192.

Depending on the possible delay spread cells are configured to use $K_{Cell}$ midambles which are generated from the Basic Midamble Codes (see table ~~A-2~~A.2)

- for all k=1,2,...,K; K=2K' or
- for k=1,2,...,K', only.

The cell configuration is broadcast on BCH.

The mapping of these Basic Midamble Codes to Cell Parameters is shown in TS 25.223.

**Table ~~A-2~~A.2: Basic Midamble Codes $\mathbf{m}_P$ according to equation (5) from subclause ~~6~~5A.2.3 for case of burst type 2**

| Code ID | Basic Midamble Codes $m_{PS}$ of length *P*=192 |
|---|---|
| $m_{PS0}$ | 5D253744435A24EF0ECC21F43AA5B8144FBDB348C746080C |
| $m_{PS1}$ | 9D7174187201B5CE0136B7A6D85D39A9DD8D4B00E23835E4 |
| $m_{PS2}$ | AE90B477C294E55D28467476C6011029CDE29B7325DF0683 |
| $m_{PS3}$ | BC8A44125F823E51E568641EC12A6C68EAFDFA2350E3233C |
| $m_{PS4}$ | 898B7317B830D207C9BC7B521D5715680824DC08347B2943 |
| $m_{PS5}$ | 466C7482C8827655BC13F479C7C1417290679A9841297C4A |
| $m_{PS6}$ | AC0734C27C7DC1B818A8492744290DFE866B0EBA62B0B56E |
| $m_{PS7}$ | 0A92106325B15A8C15FC3764724CE67A5056D50A77F9360E |
| $m_{PS8}$ | AE69F62E23035083E6094B89493D33E06FDB6532D473A280 |
| $m_{PS9}$ | B485D4E3614C9C373EA1365FA6FA890E9844084EBA90EB0C |
| $m_{PS10}$ | 66182885E2D28360D2FEAB842C65304FFC956CE8DC8A90C7 |
| $m_{PS11}$ | CC30A9B0A742FCC1E9A408415368391F1299AEA3CB6509FE |
| $m_{PS12}$ | 673928915886947F464FDDAAD29A07D182328EBC5839089A |
| $m_{PS13}$ | 4418861C14D62B46EE6D70D4BF05A3ED801A01BD6CDC5235 |
| $m_{PS14}$ | DAD62DC88F52F2D140062C2330BE6540E6F86192322AFB04 |
| $m_{PS15}$ | A2122BAF24529CEA9855FB43CE40923E7CA7B30D92E40702 |
| $m_{PS16}$ | 6C44AB41E11F54B0929DF65673BD231F92A380132D9F1712 |
| $m_{PS17}$ | 1DC2742E756CDA6421340D0087DD087A615E4B8688CB2F75 |
| $m_{PS18}$ | 2E0105328B56E9E07D9B5A62F38B08AF8D8C2817B54F3302 |
| $m_{PS19}$ | 88315EC30A94CA4EDB2C77079D9BD810A2E280B50DABB213 |
| $m_{PS20}$ | 440E0093D28CB2B2B0A95D18CEB4AB934C33FA45C1CFC7B0 |
| $m_{PS21}$ | CC9BF85D41A96A6EC314F9611D5E1C0672556C8850801BB4 |
| $m_{PS22}$ | 1ABEA04C99BC26972715F01957C0B6B959CC71CD88120817 |
| $m_{PS23}$ | EC5A33DA0BA4470442C5CB324A8E47B0A9F7968FC8108EE8 |
| $m_{PS24}$ | F82086290271DB446B5B1DC15D9BE96414B19B3D5E0F540C |
| $m_{PS25}$ | 11A1A790D6958FD3A9157DF1E05D1378248CA201EBCC7592 |
| $m_{PS26}$ | AA8564882231907BCE78092DC6C9DD4F5A0E4A34AFCFB809 |
| $m_{PS27}$ | 912EE2238212F87BC7CDA7F30441ED184A6AA954EC4D20C8 |
| $m_{PS28}$ | 2D200D8B8891B804673E380A1AF5AB875986E29D37D3FDC9 |
| $m_{PS29}$ | 75E086B6C818423491BF9D6365C52FD1C5E42A576E268170 |
| $m_{PS30}$ | 50ADBF27DA2A3701470186B699118E16DDB0D10F705607B1 |
| $m_{PS31}$ | 656C0692B4E22023590A906D2A74DFD471C883A7B1E0B3A2 |
| $m_{PS32}$ | C21FDACD09A3CDCE74C4794010A3E45769B142505C56A0E6 |
| $m_{PS33}$ | CD9392A87C2D4D7CE5801CDDA8A76339B6F900F008B290E2 |

| Code ID | Basic Midamble Codes $m_{PS}$ of length *P*=192 |
|---|---|
| $m_{PS34}$ | 956426FEFD8B8D52073E87984E10C4D255064E1372C04A24 |
| $m_{PS35}$ | C4F4D6DF1B754AD6063FD10C331C1428ABB27B0700134B94 |
| $m_{PS36}$ | B65548082B34E9FAF43F33C4070F79099758CFD41B491A11 |
| $m_{PS37}$ | C8317EA111A82B04E78B88B864B1EF5D711BBEB4A0527036 |
| $m_{PS38}$ | 8FB7AD1188E8D1A5219845013672560FD38904E70537403B |
| $m_{PS39}$ | B41A324E0D80AA0598A8D391C1D7FFC82B4A075218E98EC3 |
| $m_{PS40}$ | 49A6350A62E208B011E86528B9A481A0E76D723F6675FF82 |
| $m_{PS41}$ | C344C8C23C42A7B7442E6022E95AE4B08A4BFA786F35F911 |
| $m_{PS42}$ | 28F430CF67D69C9DF60E25656413BC5F932A022DB1406C44 |
| $m_{PS43}$ | 2FA5D70CF0FED4213F32116051450391C2A627D9B670C428 |
| $m_{PS44}$ | 959537D988FDD4F1360B4E84701AE5409229C30EDF8BC404 |
| $m_{PS45}$ | CDD2E0450F9EC12F81391AD4633CB29F315B4A0A890A9A22 |
| $m_{PS46}$ | 158776A20B4B82C563EC08F086830EA66DBD2DCCB4DF6026 |
| $m_{PS47}$ | 431FCACBE48208975950342709D11F19AD5FB047F3B440C9 |
| $m_{PS48}$ | 86B141AC571BA6B42653B12FF04D4F0E6C81F3EB608660A2 |
| $m_{PS49}$ | 86D297ABD34E8510F6CDB0EA617F1F1051C8799117B02211 |
| $m_{PS50}$ | 80B2D9530B34E781311D95CFA3857F277CC07014D324AF5A |
| $m_{PS51}$ | 2B607B93FD8B45601C1E574E14CFC6912C22AEC1045ADC49 |
| $m_{PS52}$ | D234C5C45E105A837E6DD74BC4E534523A20317BA0625A29 |
| $m_{PS53}$ | 768CCDB3E2A7A2B863128382590946B25472BE2BFFC40641 |
| $m_{PS54}$ | 3DA38212E0A987EE1F665D4E13C2AA4446E00A76C948A073 |
| $m_{PS55}$ | 09173135E4A2CFC8F2678750AB5257110906F013587BDE82 |
| $m_{PS56}$ | 522E070B266F35E99C1F3C42D2017F8E415550492B72F086 |
| $m_{PS57}$ | D63E4BD805262A3DEF05C7D86C422E5048921E5531784132 |
| $m_{PS58}$ | 564AF806E28131611E5F884229265D446A50E1E488EAFBBA |
| $m_{PS59}$ | A2603E009D3D30147727B750C35C62299AF754D3E4A54E1C |
| $m_{PS60}$ | 938504B02599D33E28246E4271C375AE81A3BBE8D3F8A920 |
| $m_{PS61}$ | 461516B2CAC6FC42A4B707CC6073BBE573C014892C811776 |
| $m_{PS62}$ | 29186DE4CCAAB2CD0100BB19EA595879D63F0F0CFA881AA5 |
| $m_{PS63}$ | A064B449CB784A91B803369CDC5EF61A670AAAC044BA3E68 |
| $m_{PS64}$ | 8719C454D88FF5149DB943CB6CADA01D0B9664B357A18203 |
| $m_{PS65}$ | A27EC68720F00A714AA2C45A7EF232286984D7B193F5C916 |
| $m_{PS66}$ | AC8361676AB424E48F0789082B0CD2EFB8D2E627D041DD66 |
| $m_{PS67}$ | ABA1BEB0064733A0620906BF2B29C95883F069D7E4C35D39 |
| $m_{PS68}$ | 9E22EEDED47D92CA1D0B7530EC6062287BD83A04874AE00C |
| $m_{PS69}$ | 0BADEF288B20F5686C5DE3A71219AC2172054326BE831696 |
| $m_{PS70}$ | 953801EB2AF58C2F80E49A6CC46085CB554243E3B3BBEC8C |
| $m_{PS71}$ | 333A504C51C8FAC5025994565C3F600F154F64FAEF4EA484 |
| $m_{PS72}$ | A6583E19647662005474153A6F8DD88A473853E94B720CE7 |
| $m_{PS73}$ | 90ACAF707D18AF34F5848C58166830AF620ACDC1B2DFDDA8 |
| $m_{PS74}$ | 39C5C598A374EA82F3F83378258248DAD3808812DD0E74BB |
| $m_{PS75}$ | F79525DE694629346D73F6256CC0F140F82603197AAA1844 |
| $m_{PS76}$ | B8C2A8F139097699A693022E78588D4058DB0A65FF52F813 |
| $m_{PS77}$ | 449B50C2A52996FA5A828A907F30F9F460EE3D99930DF890 |
| $m_{PS78}$ | 62CEC9574D30184BCB4F94EECF0CC23D2D2A8D0003F0AA33 |
| $m_{PS79}$ | B56D258889703F76A0738EE3A7D355994159A4851833E198 |
| $m_{PS80}$ | 65894AA54C0F6C9A206521C9FC379A8AAF6E621C03CF849C |
| $m_{PS81}$ | 2D47F3414E30CC02C6835D95C9BA204488F0FFCB4852677D |
| $m_{PS82}$ | 12BE4DD8B906B584010F8A330AB67B278E8642FA33D51B68 |
| $m_{PS83}$ | BC928A90A4B10906CAEE638BF768E08542F48F1676006DF0 |
| $m_{PS84}$ | 30C544E437C8ADA143566CD1BC4E9E7BA84139A08505C2F4 |
| $m_{PS85}$ | 84FD5B05506192B753FBA2C719B584E0EDA01814999867D2 |
| $m_{PS86}$ | 191F14DD00034E03AB5BB4342F1138B2CD33784E60CFD75A |
| $m_{PS87}$ | B8ACE7990B6A98A80A61162C4D2D5F88F24E8F7DE4207590 |
| $m_{PS88}$ | EC1DBE72E8EED0C61054FC2695422AC0AD2D888265B21AB0 |
| $m_{PS89}$ | 9A1B4CA467AB7E082AF4278E44D177EA78424508C23E8B08 |
| $m_{PS90}$ | 999EE541C608164AC975214F3A37A677FC2CA03E2C2A4B20 |
| $m_{PS91}$ | 1BDCC20265031432917A2EB828FB356A22DF9CB609C0F8F3 |
| $m_{PS92}$ | EB4A81859C93338B8A1B87C02C815AE09D765F6F2249B958 |
| $m_{PS93}$ | E6A5D1629F4CF09A1F280DE0C480D4C73B26ADE321A50AEE |
| $m_{PS94}$ | BAAB7286DD24C80B15A7958039B904F1CA83C310C8C7AFF2 |
| $m_{PS95}$ | 12220F72619E983717C68FFE1C4148F2354B7B1955B65620 |
| $m_{PS96}$ | A198706E24FAA08BD09EE392414816038E667BB34307D6B2 |

| Code ID | Basic Midamble Codes $m_{PS}$ of length $P$=192 |
|---|---|
| $m_{PS97}$ | 30B3493B4C035881A7A722E4546527AAE787FA2C0893AC46 |
| $m_{PS98}$ | 5A7318126522843DCB7F00A2D9F9BA8F88963E4152BC923C |
| $m_{PS99}$ | 844844B0CACAB702C332CE2692B4166F4B0C63E62BF151BF |
| $m_{PS100}$ | B8297389526410313692F861DC60DA86A23607F7DDE24755 |
| $m_{PS101}$ | 6C1144CF8BC01538D655D29ED62DE6E74A3180EC905BF1E0 |
| $m_{PS102}$ | E9DB3221FACFC5C88691A7013EF09672A130D52C3413AAE2 |
| $m_{PS103}$ | 2FD0508615EC4CD4BF18ADD46D777078869130C8921A4F0E |
| $m_{PS104}$ | 40911B4E0525AC874228F6EF642E59154730CB187C7E417A |
| $m_{PS105}$ | 2034C6A027D4D850F5184AA64C3153231F4651B616BBFCF9 |
| $m_{PS106}$ | 57833235451525A1DFA213FCE0B419B6494BC7B99F488410 |
| $m_{PS107}$ | 6DC3D57F2E39158D036825F8804810D77CA1ECA610ECD894 |
| $m_{PS108}$ | F5C50DE43AA7B731CAB7683524021701F97650499A7070E4 |
| $m_{PS109}$ | F2184D2699785442E09FA22CC2D60A5A13FFF22AE660A470 |
| $m_{PS110}$ | EF0029DE0D79207205458CF4D7328E81A93518D93C9A74BD |
| $m_{PS111}$ | 9D6D8992482FB885AA5E878C3BA2045538B09886C23CDC2D |
| $m_{PS112}$ | C0A5AB67D1CEA126F6476C75443F0A11CBE749412EF03104 |
| $m_{PS113}$ | 1853A5C20CDF968C5A180D8EB5E72BF15517D06680D98412 |
| $m_{PS114}$ | 8CEA1223227ADF37D0DAAB320906E1C79029F480D25181A7 |
| $m_{PS115}$ | 5561038E96A658EF3EC665612FF92B064065D1ACC1F54812 |
| $m_{PS116}$ | C55A6263F08D664A1E53584560DFF5E611640D8281D9A843 |
| $m_{PS117}$ | 4386A8EA59124D043F29056A4598735A4FC7BC11119B90C1 |
| $m_{PS118}$ | D6571B20668BED50BD7C80388C162632BCB069AA67C7FC22 |
| $m_{PS119}$ | 4F9F09ABBC1391EC2CCA5359FB52250E533BF04324154106 |
| $m_{PS120}$ | 662659F42188C9453F6E6DF00C579627045DA1461A3A0EA5 |
| $m_{PS121}$ | 8DCC9274C0C2A9BA6096BF27FACA542CD01CA8653D60A80F |
| $m_{PS122}$ | 5C1210A1E50E505F6B73C90156C9D9F19AE2310BBD820DF0 |
| $m_{PS123}$ | B1E0A7CE26202E223D4FC06D5C9BBA4E5F6D98204D2D5286 |
| $m_{PS124}$ | DB506776958E34552F7E60E4B400D836153218F918E22FA6 |
| $m_{PS125}$ | ECAA60300439B2360B2AC3C43FB6241ACDE5055B295FA71C |
| $m_{PS126}$ | BF1E6D9AA9CA4AC092BE60500C77D0DC7A6A236520F86722 |
| $m_{PS127}$ | 051C5FA122845A30B4EC306B38016B45667C7754F92F13A0 |

# A.3 Association between Midambles and Channelisation Codes

The following mapping schemes apply for the association between midambles and channelisation codes if no midamble is allocated by higher layers. Secondary channelisation codes are marked with a *. These associations apply both for UL and DL.

## A.3.1 Association for Burst Type 1/3 and $K_{Cell}$ =16 Midambles

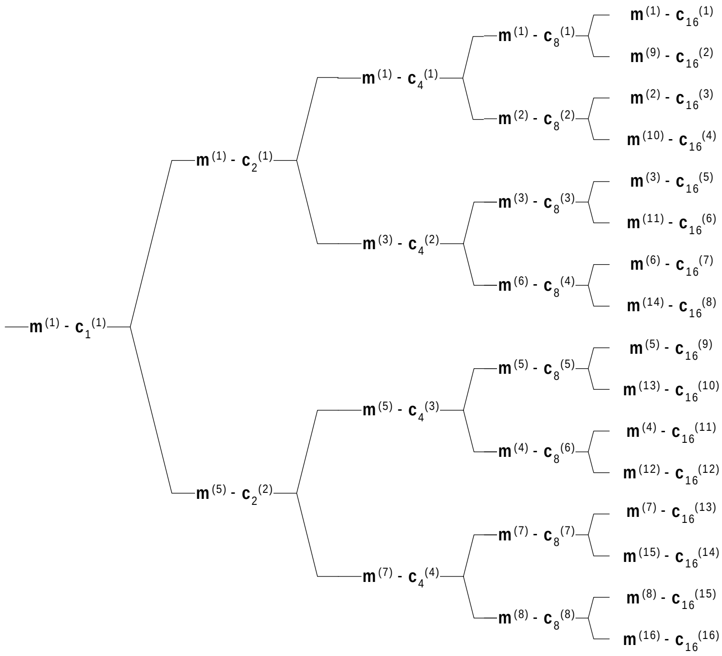



**Figure ~~A-1~~A.1: Association of Midambles to Spreading Codes for Burst Type 1/3 and $K_{Cell}$ =16**

## A.3.2 Association for Burst Type 1/3 and $K_{Cell}$ =8 Midambles

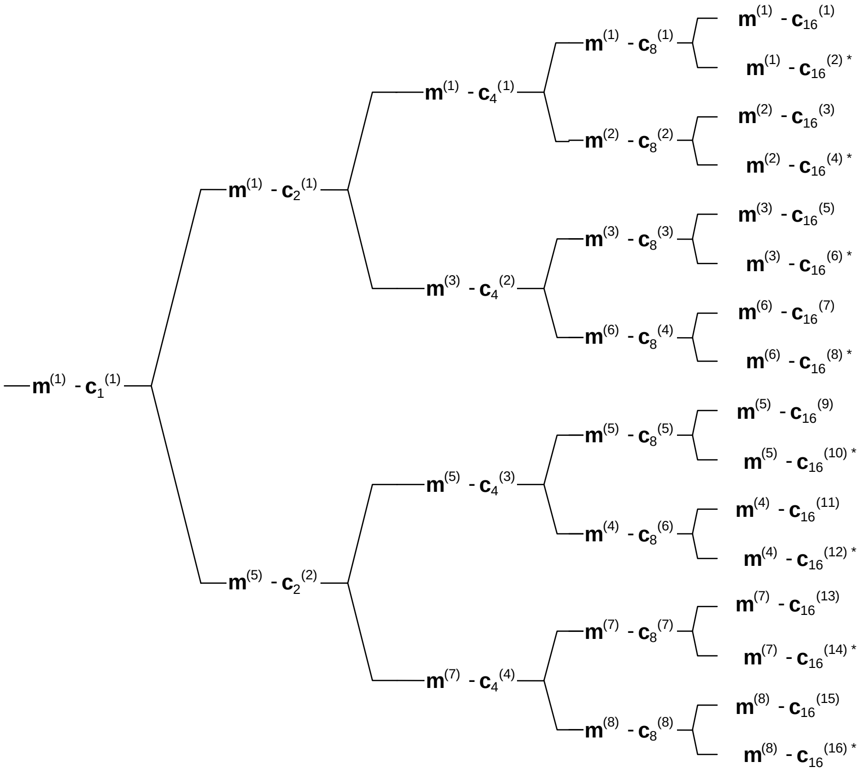



**Figure ~~A-2~~A.2: Association of Midambles to Spreading Codes for Burst Type 1/3 and $K_{Cell}$ =8**

## A.3.3 Association for Burst Type 1/3 and $K_{Cell}$ =4 Midambles

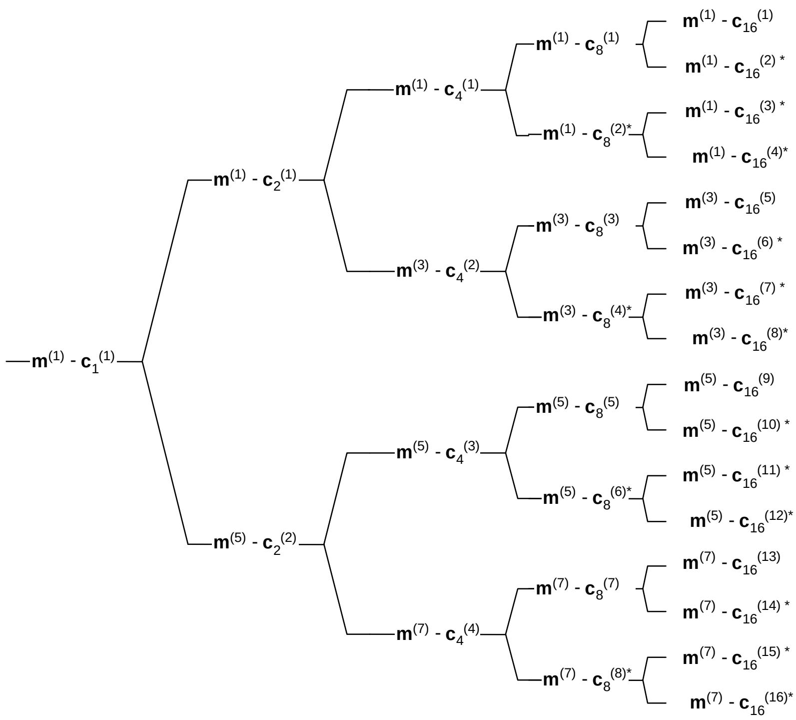



**Figure ~~A-3~~A.3: Association of Midambles to Spreading Codes for Burst Type 1/3 and $K_{Cell}$ =4**

## A.3.4 Association for Burst Type 2 and $K_{Cell}$ =6 Midambles

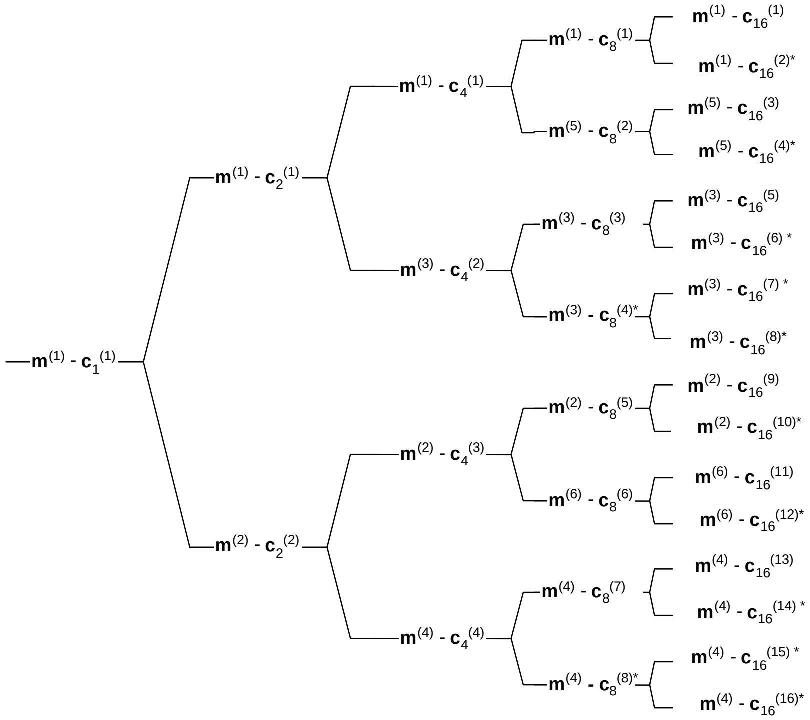



**Figure ~~A-4~~A.4: Association of Midambles to Spreading Codes for Burst Type 2 and $K_{Cell}$ =6**

## A.3.5 Association for Burst Type 2 and $K_{Cell}$ =3 Midambles

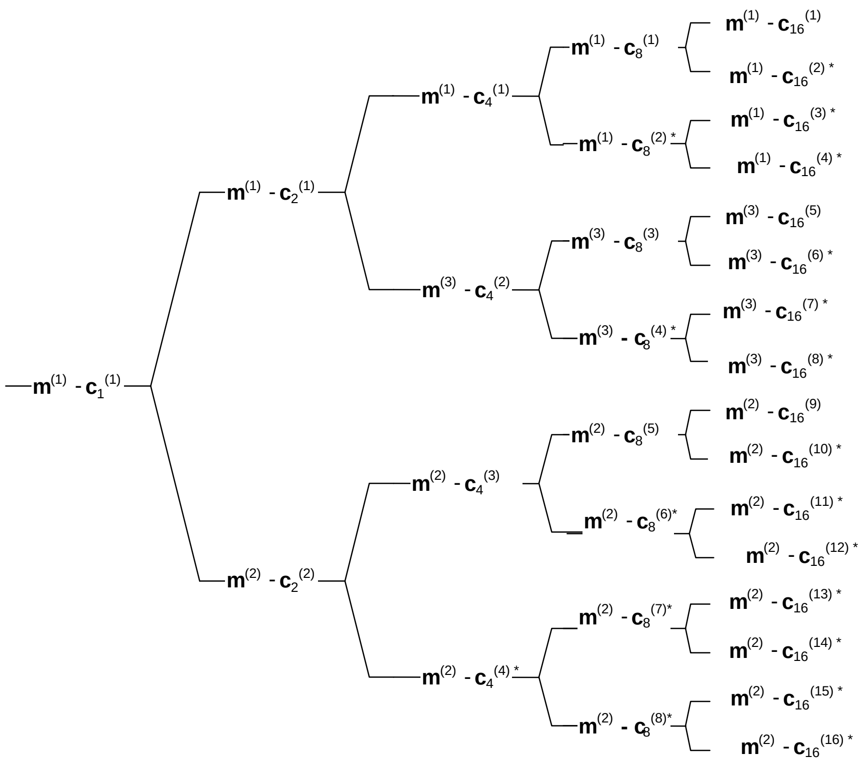



**Figure ~~A-5~~A.5: Association of Midambles to Spreading Codes for Burst Type 2 and $K_{Cell}$ =3**

Note that the association for burst type 2 can be derived from the association for burst type 1 and 3, using the following table:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Burst Type 1/3 | m(1) | m(2) | m(3) | m(4) | m(5) | m(6) | m(7) | m(8) |
| Burst Type 2 | m(1) | m(5) | m(3) | m(6) | m(2) | m(4) | - | - |

# Annex ~~B~~AA (normative): Basic Midamble Codes for the 1.28 Mcps option

## ~~B~~AA.1 Basic Midamble Codes

The midamble has a length of $L_m$=144, which is corresponding to:

K=2, 4, 6, 8, 10, 12, 14, 16, $W = \left\lfloor \frac{P}{K} \right\rfloor$ , P=128

Note: that $\lfloor x \rfloor$ denotes the largest integer number less or equal to $x$.

Depending on the possible delay spread cells are configured to use midambles which are generated from the Basic Midamble Codes (see table ~~B~~AA.1). The cell configuration is broadcast on BCH.

The mapping of these Basic Midamble Codes to Cell Parameters is shown in [8].

**Table AAB.1: Basic Midamble Codes $m_p$ according to equation (5) from subclause 65A.2.3**

| Code ID | Basic Midamble Codes $m_P$ of length P=128 |
|---|---|
| $m_{P0}$ | B2AC420F7C8DEBFA69505981BCD028C3 |
| $m_{P1}$ | 0C2E988E0DBA046643F57B0EA6A435E2 |
| $m_{P2}$ | D5CEC680C36A4454135F86DD37043962 |
| $m_{P3}$ | E150D08CAC2A00FF9B32592A631CF85B |
| $m_{P4}$ | E0A9C3A8F6E40329B2F2943246003D44 |
| $m_{P5}$ | FE22658100A3A683EA759018739BD690 |
| $m_{P6}$ | B46062F89BB2A1139D76A1EF32450DA0 |
| $m_{P7}$ | EE63D75CC099092579400D956A90C3E0 |
| $m_{P8}$ | D9C0E040756D427A2611DAA35E6CD614 |
| $m_{P9}$ | EB56D03A498EC4FEC98AE220BC390450 |
| $m_{P10}$ | F598703DB0838112ED0BABB98642B665 |
| $m_{P11}$ | A0BC26A992D4558B9918986C14861EFF |
| $m_{P12}$ | 541350D109F1DD68099796637B824F88 |
| $m_{P13}$ | 892D344A962314662F01F9455F7BC302 |
| $m_{P14}$ | 49F270E29CCD742A40480DD4215E1632 |
| $m_{P15}$ | 6A5C0410C6C39AA04E77423C355926DE |
| $m_{P16}$ | 797661553820310 3D4DBCC219B16A9E1 |
| $m_{P17}$ | A6C3C3175845400BD2B738C43EE2645F |
| $m_{P18}$ | A0FD56258D228642C6F641851C3751ED |
| $m_{P19}$ | EFA48C3FC84AC625783C6C9510A2269A |
| $m_{P20}$ | 62A8EB1A420334B23396E8D76BC19740 |
| $m_{P21}$ | 9E96235699D5D41C9816C921023BC741 |
| $m_{P22}$ | 4362AE4CAE0DCC32D60A3FED1341A848 |
| $m_{P23}$ | 454C068E6C4F190942E0904B95D61DFB |
| $m_{P24}$ | 607FEEA6E2E99206718A49C0D6A25034 |
| $m_{P25}$ | E1D1BCDA39A09095B5C81645103A077C |
| $m_{P26}$ | 994B445E558344DE211C8286DDD3D1A3 |
| $m_{P27}$ | C1523327358141763890 6ADB61FDCA3C |
| $m_{P28}$ | 8B79A274D542F096FB1388098230F8A1 |
| $m_{P29}$ | DF58AC1C5F44B2A40266385CE1DA5640 |
| $m_{P30}$ | B5949A1CC69962C464401D05FF5C1A7A |
| $m_{P31}$ | 85AC489841ED3EAA2D83BBB0039CC707 |
| $m_{P32}$ | AE371CC144BC95923CA8108D8B49FE82 |
| $m_{P33}$ | 7F188484A649D1C22BDA1F09D49B5117 |
| $m_{P34}$ | ADAA3C657089DEF7C0284903A491C9B0 |
| $m_{P35}$ | C3F96893C7504DC3B51488604AF64F4C |
| $m_{P36}$ | B4002F5AE0CE8623AC979D368E9148C1 |
| $m_{P37}$ | 0EEBCC0C795C02A106C24ABB36D08C6E |
| $m_{P38}$ | 4B0F537E384A893F58971580D9894433 |
| $m_{P39}$ | 08E0035AB29B7ECC53C15DAA0687CC8F |
| $m_{P40}$ | 8611ACBC4C82781D77654EE862506D60 |
| $m_{P41}$ | 63315261A8F1CB02549802DBFD197C07 |
| $m_{P42}$ | 9A2609A434F43E7DCADC0E22B2EF4012 |
| $m_{P43}$ | F4C9F0A127A88461209ABF8C69CE4D00 |
| $m_{P44}$ | C79124EE3FFC28C5C4524D2B01670D42 |
| $m_{P45}$ | C91985C4FED53D09361914354BA80E79 |
| $m_{P46}$ | 82AA517260779ECFF26212C1A10BDC29 |
| $m_{P47}$ | 561DE2040ACB458E0DBD354E43E111D9 |
| $m_{P48}$ | 2E58C7202D17392BC1235782CEFABB09 |
| $m_{P49}$ | C4FAA121C698047650F6503126A577C1 |
| $m_{P50}$ | E7B75206A9B410E44346E0DAE842A23C |
| $m_{P51}$ | 3F8B1C32682B28D098D3805ED130EA7F |
| $m_{P52}$ | 8D5FC2C1C6715F824B401434C8D4BB82 |
| $m_{P53}$ | 0B2A43453ACC028FE6EB6E1CB0740B59 |
| $m_{P54}$ | BC56948FC700BA4883262EE73E12D82A |
| $m_{P55}$ | 558D136710272912FA4F183D1189A7FD |
| $m_{P56}$ | 5709E7F82DC6500B7B12A3072D182645 |
| $m_{P57}$ | 86D4F161C844AE5E20EE39FD5493B044 |
| $m_{P58}$ | 8729B6EDC382B152185885F013DAE222 |
| $m_{P59}$ | 154C45B50720F4C362C14C77FE8335A1 |
| $m_{P60}$ | C6A0962890351F4EB802DE43A7662C9E |

| | |
|---|---|
| $m_{P61}$ | D19D69D6B380B4B22457CB80033519F0 |
| $m_{P62}$ | C7D89509FB0DAE9255998E0A00C2B262 |
| $m_{P63}$ | DFD481C652C0C905D61D66F1732C4AA2 |
| $m_{P64}$ | 06C848619AF1D6C910A8EAC4B622FC06 |
| $m_{P65}$ | 0635E29D4E7AC8ABC189890241F45ECA |
| $m_{P66}$ | B272B020586AAD7B093AC2F459076638 |
| $m_{P67}$ | B608ACE46E1A6BC96181EEDD88B54140 |
| $m_{P68}$ | 0A516092B3ED7849B168AFE223B8670E |
| $m_{P69}$ | D1A658C5009E04D0D7D5E9205EE663E8 |
| $m_{P70}$ | AC316DC39B91EB60B1AABD8280740432 |
| $m_{P71}$ | E3F06825476A026CD287625E514519FC |
| $m_{P72}$ | A56D092080DDE8994F387C175CC56833 |
| $m_{P73}$ | 15EA799DE587C506D0CD99A408217B05 |
| $m_{P74}$ | A59C020BAB9AF6D3F813C391CA244CD2 |
| $m_{P75}$ | 74B0101EB9F3167434B94BABC8378882 |
| $m_{P76}$ | CE752975C8DA9B0100386DB82A8C3D20 |
| $m_{P77}$ | BBB38DCDB1E9118570AC147DC05241A4 |
| $m_{P78}$ | 944ABBF0866098101F6971731AB2E986 |
| $m_{P79}$ | 2BB147B2A30C68B4853F90481A166EB6 |
| $m_{P80}$ | 444840ACCF3F23C45B56D7704BF18283 |
| $m_{P81}$ | 87604F7450D1AD188C452981A5C7FC9B |
| $m_{P82}$ | 8C3842EBC948A65BC4C8B387F11B7090 |
| $m_{P83}$ | 10B4767D071CF5DB2288E4029576135A |
| $m_{P84}$ | 6F07AAB697CD0089572C6B062E2018E4 |
| $m_{P85}$ | D3D65B442057E613A8655060C8D29E27 |
| $m_{P86}$ | 5EDA330514C604BF4E0894E09EC57A74 |
| $m_{P87}$ | B0899CD094060724DED82AE85F18A43A |
| $m_{P88}$ | B2D999B86DF902BC25015CAE3A0823C4 |
| $m_{P89}$ | C23CD40F04242B92D46EED82CD9A9A18 |
| $m_{P90}$ | D22DDCC5CB82960125DD24655F3C8788 |
| $m_{P91}$ | 54987218FBD99AE4340FD4C9458E9850 |
| $m_{P92}$ | BE4341822997A7B11EA1E8A1A2767005 |
| $m_{P93}$ | 255200FBA6EE48E6DE0A82B0461B8D0F |
| $m_{P94}$ | 6FBD58A663932423503690CF9C171701 |
| $m_{P95}$ | D215033A4AA87EC1C232BAC7EDA09370 |
| $m_{P96}$ | CA0959B01AE48E80204F1E4A3F29CE55 |
| $m_{P97}$ | 582043413B9B825903E3A3545ED59463 |
| $m_{P98}$ | 5016541922971C703D16E284CBDF633B |
| $m_{P99}$ | 7347EF160A1733CA98D43608A83A920B |
| $m_{P100}$ | 908B22AD433CCA00B3FD47C691F1A290 |
| $m_{P101}$ | BB22A272FC6923DF1B43BA4118806570 |
| $m_{P102}$ | 0FA75C87474836B47DC7624D61193802 |
| $m_{P103}$ | A22EBA0658A4D0FF1E9CA5030A65CC06 |
| $m_{P104}$ | 6C9C51CA15F1F4981F4C46180A6A6697 |
| $m_{P105}$ | 4C847ACF8BC15359C405322851C9BDE2 |
| $m_{P106}$ | C1D29499C0082C9DE473ED15B14D63E0 |
| $m_{P107}$ | 7E85ECC98AC761005076C5572869A431 |
| $m_{P108}$ | D8F11121595B8F49F78A7039E44126A0 |
| $m_{P109}$ | 1A0BC814445FD71C8E5B1A9163ED2059 |
| $m_{P110}$ | A7591F27F8B0C00C68CC41697954FA04 |
| $m_{P111}$ | 6CA2CE595E7406D79C4840183D41B9D0 |
| $m_{P112}$ | C093D3CC701FC20E66F5AB22516C5460 |
| $m_{P113}$ | D0E0CDE9B595546B96C4F8066B469020 |
| $m_{P114}$ | E99F743A451431C8B427054A4E6F2007 |
| $m_{P115}$ | C0D21A344A2C07DF2A6EBE6250C7B91E |
| $m_{P116}$ | F031223E282CF7A4D8EF174A908668AE |
| $m_{P117}$ | E4BD244AC16C55C7137FB068FD44280C |
| $m_{P118}$ | C44920DE2028F19FC2AAB36A0DCFDAD0 |
| $m_{P119}$ | 3FA7054E77135250699E6C8A11600742 |
| $m_{P120}$ | D5740B4D8870C1C5B5A214C4266FC537 |
| $m_{P12}$1 | F0B7942D43BB6F38446442EB8126AB80 |
| $m_{P122}$ | 83DB9534EAD6238FA8968798CDF04848 |
| $m_{P123}$ | EB9663CDDC2B291690703125BABCB800 |
| $m_{P124}$ | 84D547225D4BBD20DEF1A583240C6E0F |

| | |
|---|---|
| $m_{P125}$ | B51F6A771838BE934724AEA6A2669802 |
| $m_{P126}$ | D92AC05E10496794BBDC115233B1C068 |
| $m_{P127}$ | D3ACF0078EDA9856BBB0AF8651132103 |

# AA~~B~~.2 Association between Midambles and Channelisation Codes

The following mapping schemes apply for the association between midambles and channelisation codes if no midamble is allocated by higher layers. Secondary channelisation codes are marked with *. These associations apply for both UL and DL.

## AA~~B~~.2.1 Association for K=16 Midambles

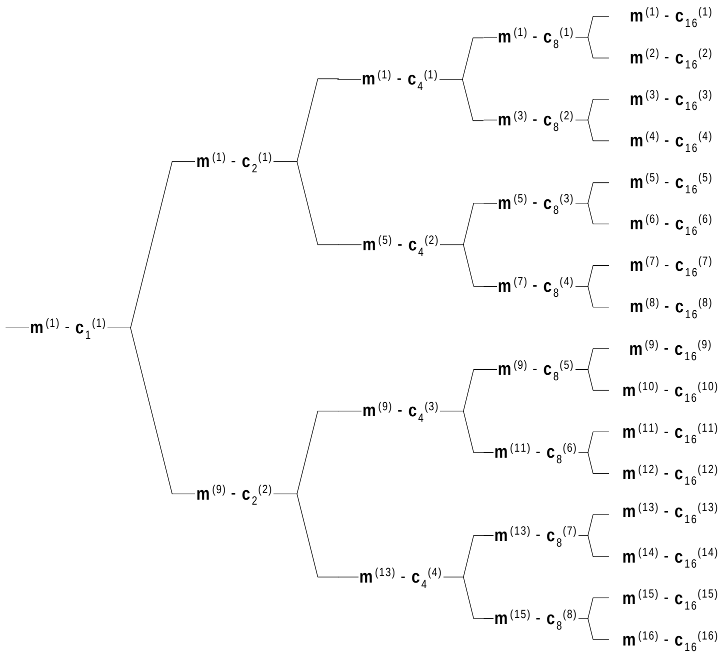



**Figure AA~~B~~.2.1: Association of Midambles to Spreading Codes for K=16**

## AAB.2.2 Association for K=14 Midambles

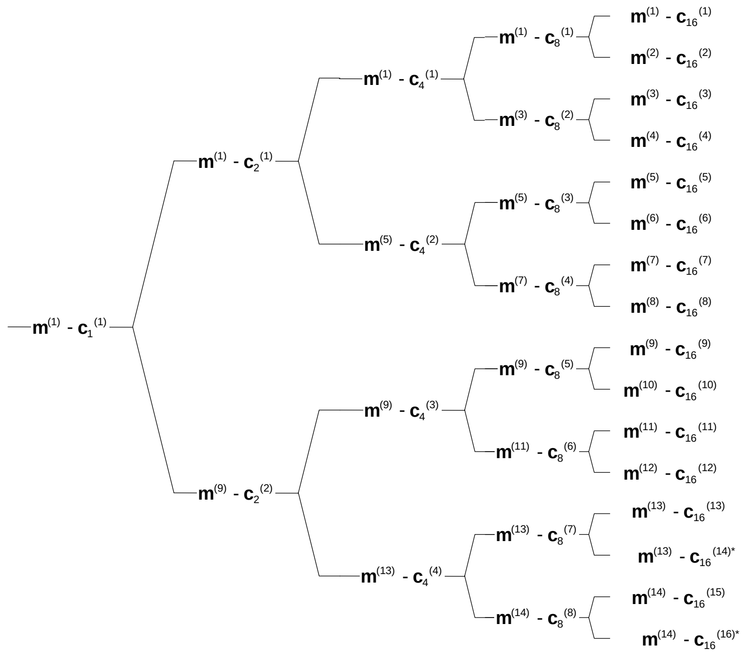



**Figure AAB.2.2: Association of Midambles to Spreading Codes for K=14**

## AAB.2.3 Association for K=12 Midambles

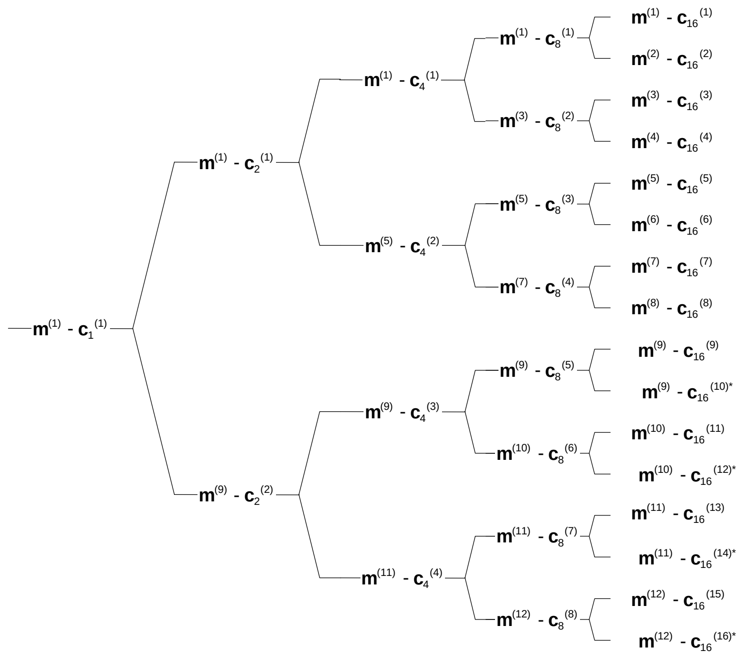



**Figure AAB.2.3: Association of Midambles to Spreading Codes for K=12**

### AA~~B~~.2.4 Association for K=10 Midambles

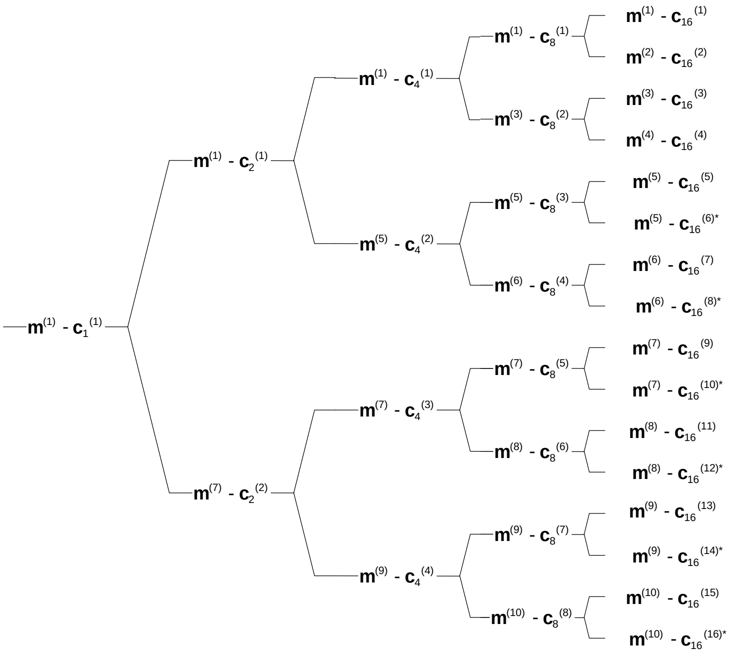



**Figure AA~~B~~.2.4: Association of Midambles to Spreading Codes for K=10**

### AA~~B~~.2.5 Association for K=8 Midambles

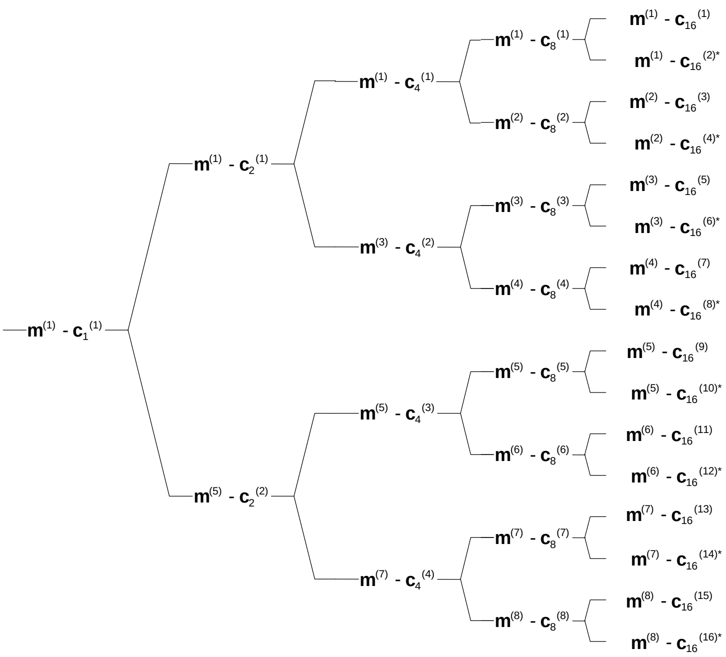



**Figure AA~~B~~.2.5: Association of Midambles to Spreading Codes for K=8**

# AA~~B~~.2.6 Association for K=6 Midambles

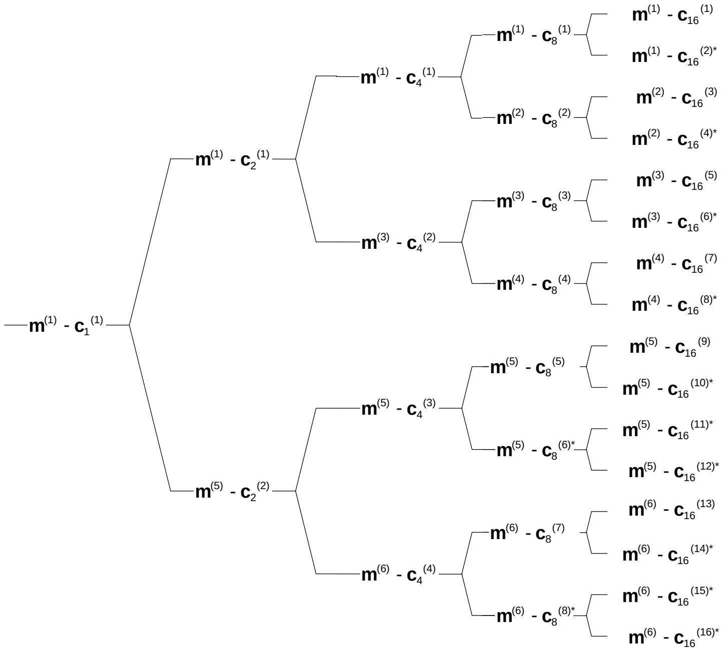



**Figure AA~~B~~.2.6: Association of Midambles to Spreading Codes for K=6**

# AA~~B~~.2.7 Association for K=4 Midambles

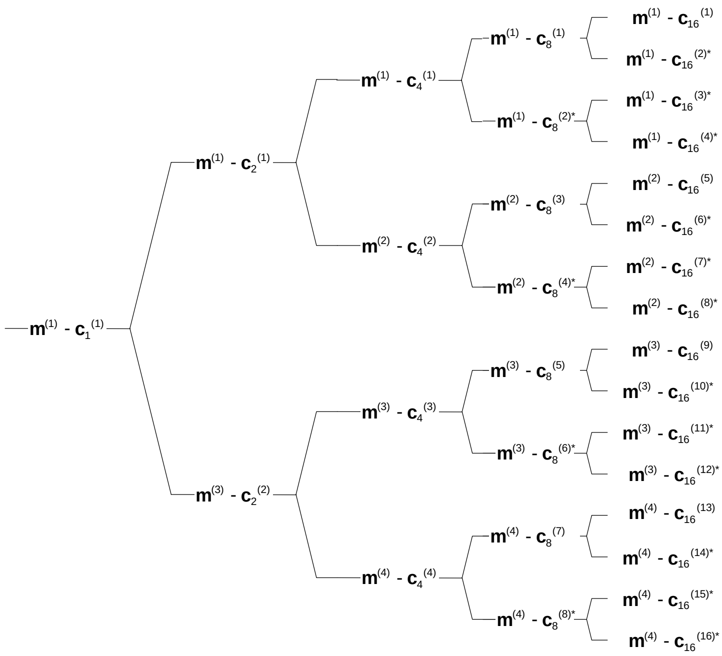



**Figure AA~~B~~.2.7: Association of Midambles to Spreading Codes for K=4**

## AAB.2.8 Association for K=2 Midambles

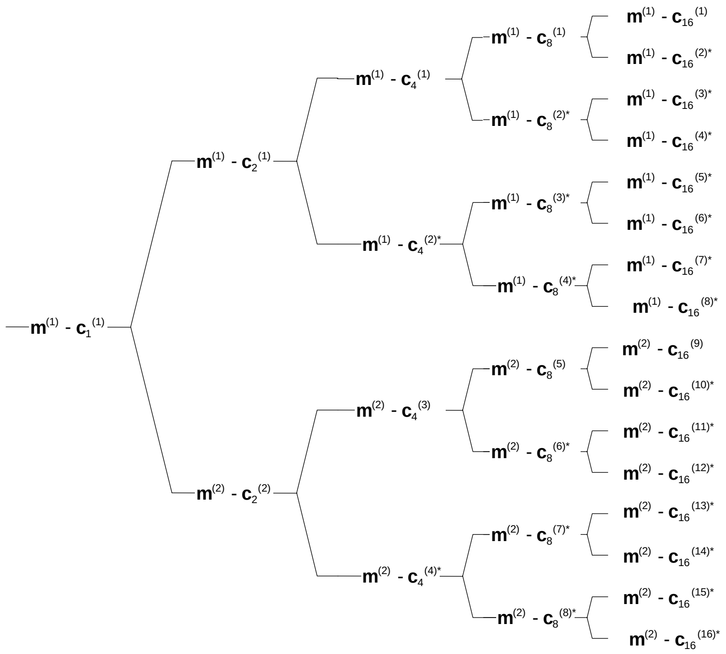



**Figure AAB.2.8: Association of Midambles to Spreading Codes for K=2**

# Annex B~~C~~ (normative): Signalling of the number of channelisation codes for the DL common midamble case for 3.84Mcps TDD

The following mapping schemes shall apply for the association between the number of channelisation codes employed in a timeslot and the use of a particular midamble shift in the DL common midamble case. In the following tables the presence of a particular midamble shift is indicated by ‘1’. Midamble shifts marked with ‘0’ are left unused. Mapping schemes B~~C~~.4, B~~C~~.5 and B~~C~~.6 are not applicable to beacon timeslots where a P-CCPCH is present, because the default midamble allocation scheme is applied to these timeslots. Note that in mapping schemes B~~C~~.4, B~~C~~.5 and B~~C~~.6, the fixed and pre-allocated channelisation code for the beacon channel is included into the number of indicated channelisation codes.

## B~~C~~.1 Mapping scheme for Burst Type 1 and $K_{Cell}$ =16 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | m7 | M8 | m9 | m10 | m11 | m12 | m13 | m14 | m15 | m16 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 code |
| 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 10 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 11 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 12 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 13 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 14 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 15 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 16 codes |

## B~~C~~.2 Mapping scheme for Burst Type 1 and $K_{Cell}$ =8 Midambles

| M1 | m2 | m3 | m4 | m5 | m6 | m7 | m8 | |
|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 code or 9 codes |
| 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 2 codes or 10 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 3 codes or 11 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 4 codes or 12 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 5 codes or 13 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 6 codes or 14 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 7 codes or 15 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 8 codes or 16 codes |

## B~~C~~.3 Mapping scheme for Burst Type 1 and $K_{Cell}$ =4 Midambles

| m1 | m3 | m5 | m7 | |
|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 1 or 5 or 9 or 13 codes |
| 0 | **1** | 0 | 0 | 2 or 6 or 10 or 14 codes |
| 0 | 0 | **1** | 0 | 3 or 7 or 11 or 15 codes |
| 0 | 0 | 0 | **1** | 4 or 8 or 12 or 16 codes |

## B~~C~~.4 Mapping scheme for beacon timeslots and $K_{Cell}$ =16 Midambles

| m1 | m2 | m3 | M4 | m5 | m6 | m7 | M8 | m9 | m10 | m11 | M12 | m13 | m14 | m15 | m16 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 code (see note 1) |
| **1** | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 codes (SCTD applied to beacon in this time slot, see note 2) |
| **1** | x(*) | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 codes |
| **1** | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 codes (SCTD not applied to beacon in this time slot) or 14 codes |
| **1** | x(*) | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 codes or 15 codes |
| **1** | x(*) | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 codes or 16 codes |
| **1** | x(*) | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 codes |
| **1** | x(*) | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 codes |
| **1** | x(*) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 7 codes |
| **1** | x(*) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 8 codes |
| **1** | x(*) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 9 codes |
| **1** | x(*) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 10 codes |
| **1** | x(*) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 11 codes |
| **1** | x(*) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 12 codes |

(*) For the case of SCTD applied to beacon, midamble shift 2 is used by the diversity antenna.

Note 1: If only one code is present in a beacon time slot, this code is a beacon channel and the beacon channel is the only channel in this slot, by default. Therefore, only the beacon midamble(s) shall be used.

Note 2: If SCTD is applied to the beacon and only two codes are present in a beacon time slot, the beacon channel is the only channel in this slot, by default. Therefore, only the beacon midambles shall be used.

## ~~C~~B.5 Mapping scheme for beacon timeslots and $K_{Cell}$ =8 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | m7 | M8 | |
|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 code (see note 1) |
| **1** | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 2 codes (SCTD applied to beacon in this time slot, see note 2) |
| **1** | x(*) | **1** | 0 | 0 | 0 | 0 | 0 | 7 or 13 codes |
| **1** | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 2 (SCTD not applied to beacon in this time slot) or 8 or 14 codes |
| **1** | x(*) | 0 | 0 | **1** | 0 | 0 | 0 | 3 or 9 or 15 codes |
| **1** | x(*) | 0 | 0 | 0 | **1** | 0 | 0 | 4 or 10 or 16 codes |
| **1** | x(*) | 0 | 0 | 0 | 0 | **1** | 0 | 5 codes or 11 codes |
| **1** | x(*) | 0 | 0 | 0 | 0 | 0 | **1** | 6 codes or 12 codes |

(*) For the case of SCTD applied to beacon, midamble shift 2 is used by the diversity antenna.

Note 1: If only one code is present in a beacon time slot, this code is a beacon channel and the beacon channel is the only channel in this slot, by default. Therefore, only the beacon midamble(s) shall be used.

Note 2: If SCTD is applied to beacon and only two codes are present in a beacon time slot, the beacon channel is the only channel in this slot, by default. Therefore, only the beacon midambles shall be used.

## ~~C~~B.6 Mapping scheme for beacon timeslots and $K_{Cell}$ =4 Midambles

| m1 | m3 | m5 | m7 | |
|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 1code (see note 1) |
| **1** | **1** | 0 | 0 | 4 or 7 or 10 or 13 or 16 codes |
| **1** | 0 | **1** | 0 | 2 or 5 or 8 or 11 or 14 codes |
| **1** | 0 | 0 | **1** | 3 or 6 or 9 or 12 or 15 codes |

Note 1: If only one code is present in a beacon time slot, this code is a beacon channel and the beacon channel is the only channel in this slot, by default. Therefore, only the beacon midamble shall be used.

## ~~C~~B.7 Mapping scheme for Burst Type 2 and $K_{Cell}$ =6 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | |
|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 1 or 7 or 13 codes |
| 0 | **1** | 0 | 0 | 0 | 0 | 2 or 8 or 14 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 3 or 9 or 15 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 4 or 10 or 16 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 5 or 11 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 6 or 12 codes |

# BC.8 Mapping scheme for Burst Type 2 and $K_{Cell}$ =3 Midambles

| m1 | m2 | m3 | |
|---|---|---|---|
| **1** | 0 | 0 | 1 or 4 or 7 or 10 or 13 or 16 codes |
| 0 | **1** | 0 | 2 or 5 or 8 or 11 or 14 codes |
| 0 | 0 | **1** | 3 or 6 or 9 or 12 or 15 codes |

# Annex BA~~D~~ (normative): Signalling of the number of channelisation codes for the DL common midamble case for 1.28Mcps TDD

The following mapping schemes shall apply for the association between the number of channelisation codes employed in a timeslot and the use of a particular midamble shift in the DL common midamble case. In the following tables the presence of a particular midamble shift is indicated by '1'. Midamble shifts marked with '0' are left unused.

## BA~~D~~.1 Mapping scheme for K=16 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | M7 | M8 | m9 | m10 | m11 | m12 | M13 | m14 | m15 | m16 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 code |
| 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 10 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 11 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 12 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 13 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 14 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 15 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 16 codes |

## BA~~D~~.2 Mapping scheme for K=14 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | M7 | M8 | m9 | m10 | m11 | m12 | M13 | m14 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 or 15 code(s) |
| 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 or 16 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 8 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 9 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 10 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 11 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 12 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 13 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 14 codes |

# BA~~D~~.3 Mapping scheme for K=12 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | M7 | M8 | m9 | m10 | m11 | m12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 or 13 code(s) |
| 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 or 14 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 or 15 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 or 16 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 6 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 7 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 8 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 9 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 10 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 11 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 12 codes |

# BA~~D~~.4 Mapping scheme for K=10 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | M7 | M8 | m9 | m10 | |
|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 or 11 code(s) |
| 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 or 12 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 or 13codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 4 or 14 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 5 or 15 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 6 or 16 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 7 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 8 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 9 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 10 codes |

# BA~~D~~.5 Mapping scheme for K=8 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | m7 | m8 | |
|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 or 9 code(s) |
| 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 2 or 10 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 3 or 11 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 4 or 12 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 5 or 13 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 6 or 14 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 7 or 15 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 8 or 16 codes |

# BA~~D~~.6 Mapping scheme for K=6 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | |
|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 1 or 7 or 13 code(s) |
| 0 | **1** | 0 | 0 | 0 | 0 | 2 or 8 or 14 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 3 or 9 or 15 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 4 or 10 or 16 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 5 or 11 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 6 or 12 codes |

# BAD.7 Mapping scheme for K=4 Midambles

| m1 | m2 | m3 | m4 | |
|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 1 or 5 or 9 or 13 code(s) |
| 0 | **1** | 0 | 0 | 2 or 6 or 10 or 14 codes |
| 0 | 0 | **1** | 0 | 3 or 7 or 11 or 15 codes |
| 0 | 0 | 0 | **1** | 4 or 8 or 12 or 16 codes |

# BAD.8 Mapping scheme for K=2 Midambles

| m1 | m2 | |
|---|---|---|
| **1** | 0 | 1 or 3 or 5 or 7 or 9 or 11 or 13 or 15 code(s) |
| 0 | **1** | 2 or 4 or 6 or 8 or 10 or 12 or 14 or 16 codes |

# Annex CE (informative): CCPCH Multiframe Structure for the 3.84 Mcps option

In the following figures C.1 to C.3 some examples for Multiframe Structures on Primary and Secondary CCPCH are given. The figures show the placement of Common Transport Channels on the Common Control Physical Channels. Additional S-CCPCH capacity can be allocated on other codes and timeslots of course, e.g. FACH capacity is related to overall cell capacity and can be configured according to the actual needs. Channel capacities in the annex are derived using bursts with long midambles (Burst format 1). Every TrCH-box in the figures is assumed to be valid for two frames (see row ‘Frame #’), i.e. the transport channels in CCPCHs have an interleaving time of 20msec.

The actual CCPCH Multiframe Scheme used in the cell is described and broadcast on BCH. Thus the system information structure has its roots in this particular transport channel and allocations of other Common Channels can be handled this way, i.e. by pointing from BCH.

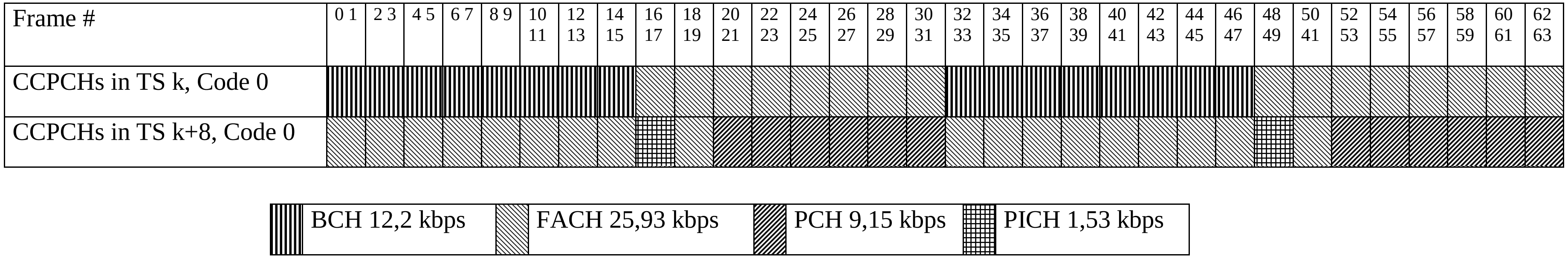



**Figure C.1: Example for a multiframe structure for CCPCHs and PICH that is repeated every 64th frame**

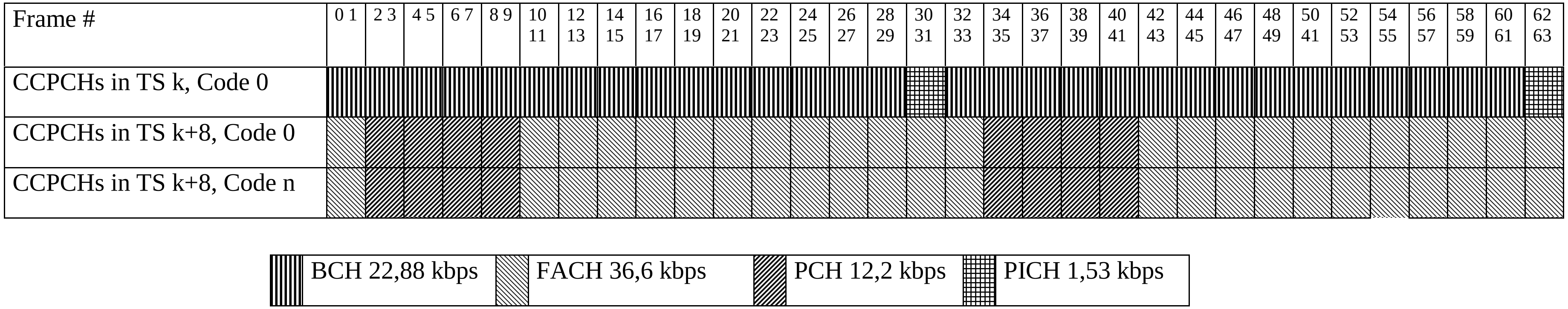



**Figure C.2: Example for a multiframe structure for CCPCHs and PICH that is repeated every 64th frame, n=1…7**

# Annex CA~~F~~ (informative): CCPCH Multiframe Structure for the 1.28 Mcps option

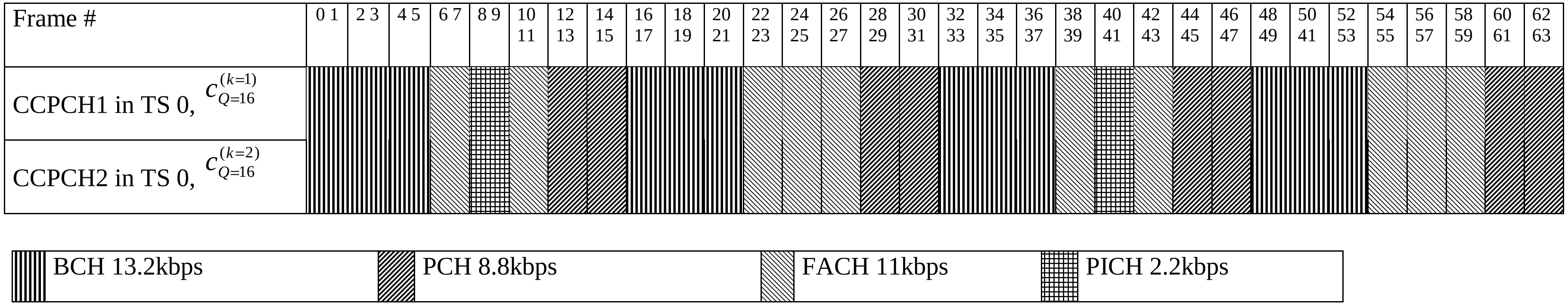



**Figure CA~~F~~.1: Example for a multiframe structure for CCPCHs and PICH that is repeated every 64th frame (128 sub-frame)**

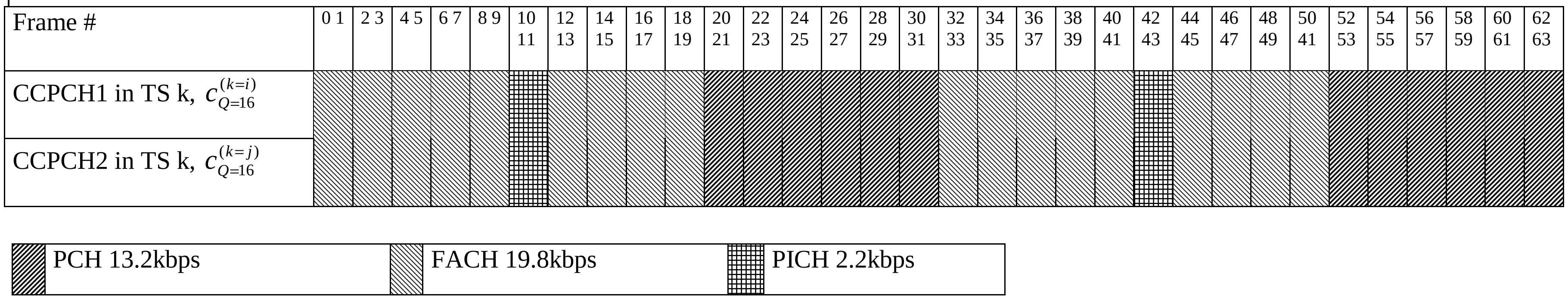



**Figure CA~~F~~.2: Example for a multiframe structure for S-CCPCHs and PICH that is repeated every 64th frame, i,j=1…16 (i≠j),k≠0, 1,(128 sub-frame)**

# Annex CB~~G~~ (informative): Examples of the association of UL TPC commands to UL uplink time slots for 1.28 Mcps TDD

In the following two examples of the association of UL TPC commands to UL time slots and CCTrCHs are shown (see ~~6~~5A.2.2.2):

**Table CB~~G~~.1 Two examples of the association of UL TPC commands to UL uplink time slots with NULslot=3**

Case 1: $N_{UL\_TPCsymbols}$=2; Case 2: $N_{UL\_TPCsymbols}$=4

| Sub-Frame Number | Case 1 (2 UL TPC symbols) | | The order of the served UL time slot and CCTrCH pairs (UL time slot and CCTrCH number) | Case 2 (4 UL TPC symbols) | |
|---|---|---|---|---|---|
| | The order of UL TPC symbols | | | The order of UL TPC symbols | |
| SFN'=0 | (1st $UL_{pos}$=0) | 0 | 0 (TS3) | 0 | (1st $UL_{pos}$=0) |
| | | 1 | 1 (TS4) | 1 | |
| | | | 2 (TS5) | 2 | |
| | | | 0 (TS3) | 3 | |
| SFN'=1 | (1st $UL_{pos}$=2) | 0 | 0 (TS3) | 0 | (1st $UL_{pos}$=1) |
| | | 1 | 1 (TS4) | 1 | |
| | | | 2 (TS5) | 2 | |
| | | | 0 (TS3) | 3 | |
| | | | 1 (TS4) | | |
| SFN'=2 | (1st $UL_{pos}$=1) | 0 | 0 (TS3) | 0 | (1st $UL_{pos}$=2) |
| | | 1 | 1 (TS4) | 1 | |
| | | | 2 (TS5) | 2 | |
| | | | 0 (TS3) | 3 | |
| | | | 1 (TS4) | | |
| | | | 2 (TS5) | | |
| . . . | . . . | | . . . | . . . | |

# Annex CC~~H~~ (informative): Examples of the association of UL SS commands to UL uplink time slots

In the following two examples of the association of UL SS commands to UL uplink time slots are shown (see ~~6~~5A.2.2.3):

**Table CC~~H~~.1 Two examples of the association of UL SS commands to UL uplink time slots with $N_{ULslot}$=3**

Case 1: $N_{SSsymbols}$=2; Case 2: $N_{SSsymbols}$=4

| Sub-Frame Number | Case 1 (2 UL SS symbols) | | The order of the served UL time slot (UL time slot number) | Case 2 (4 UL SS symbols) | |
|---|---|---|---|---|---|
| | The order of UL SS symbols | | | The order of UL SS symbols | |
| SFN'=0 | (1st $UL_{pos}$=0) | 0 | 0 (TS3) | 0 | (1st $UL_{pos}$=0) |
| | | 1 | 1 (TS4) | 1 | |
| | | | 2 (TS5) | 2 | |
| | | | 0 (TS3) | 3 | |
| SFN'=1 | (1st $UL_{pos}$=2) | 0 | 0 (TS3) | 0 | (1st $UL_{pos}$=1) |
| | | 1 | 1 (TS4) | 1 | |
| | | | 2 (TS5) | 2 | |
| | | | 0 (TS3) | 3 | |
| | | | 1 (TS4) | | |
| SFN'=2 | (1st $UL_{pos}$=1) | 0 | 0 (TS3) | 0 | (1st $UL_{pos}$=2) |
| | | 1 | 1 (TS4) | 1 | |
| | | | 2 (TS5) | 2 | |
| | | | 0 (TS3) | 3 | |
| | | | 1 (TS4) | | |
| | | | 2 (TS5) | | |
| .<br>.<br>. | .<br>.<br>. | | .<br>.<br>. | .<br>.<br>. | |

# Annex D~~1~~ (informative): Change history

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date | TSG # | TSG Doc. | CR | Rev | Subject/Comment | Old | New |
| 14/01/00 | RAN_05 | RP-99591 | - | | Approved at TSG RAN #5 and placed under Change Control | - | 3.0.0 |
| 14/01/00 | RAN_06 | RP-99691 | 001 | 02 | Primary and Secondary CCPCH in TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99691 | 002 | 02 | Removal of Superframe for TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99691 | 006 | - | Corrections to TS25.221 | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99691 | 007 | 1 | Clarifications for Spreading in UTRA TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99691 | 008 | - | Transmission of TFCI bits for TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99691 | 009 | - | Midamble Allocation in UTRA TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99690 | 010 | - | Introduction of the timeslot formats to the TDD specifications | 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-000067 | 003 | 2 | Cycling of cell parameters | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000067 | 011 | - | Correction of Midamble Definition for TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000067 | 012 | - | Introduction of the timeslot formats for RACH to the TDD specifications | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000067 | 013 | - | Paging Indicator Channel reference power | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000067 | 014 | 1 | Removal of Synchronisation Case 3 in TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000067 | 015 | 1 | Signal Point Constellation | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000067 | 016 | - | Association between Midambles and Channelisation Codes | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000067 | 017 | - | Removal of ODMA from the TDD specifications | 3.1.1 | 3.2.0 |
| 26/06/00 | RAN_08 | RP-000271 | 018 | 1 | Removal of the reference to ODMA | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000271 | 019 | - | Editorial changes in transport channels section | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000271 | 020 | 1 | TPC transmission for TDD | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000271 | 021 | - | Editorial modification of 25.221 | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000271 | 023 | - | Clarifications on TxDiversity for UTRA TDD | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000271 | 024 | - | Clarifications on PCH and PICH in UTRA TDD | 3.2.0 | 3.3.0 |
| 23/0900 | RAN_09 | RP-000344 | 022 | 1 | Correction to midamble generation in UTRA TDD | 3.3.0 | 3.4.0 |
| 23/0900 | RAN_09 | RP-000344 | 026 | 2 | Some corrections for TS25.221 | 3.3.0 | 3.4.0 |
| 23/0900 | RAN_09 | RP-000344 | 028 | - | Terminology regarding the beacon function | 3.3.0 | 3.4.0 |
| 23/0900 | RAN_09 | RP-000344 | 030 | 1 | TDD Access Bursts for HOV | 3.3.0 | 3.4.0 |
| 23/0900 | RAN_09 | RP-000344 | 031 | 1 | Number of codes signalling for the DL common midamble case | 3.3.0 | 3.4.0 |
| 15/12/00 | RAN_10 | RP-000542 | 034 | - | Correction on TFCI & TPC Transmission | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000542 | 035 | 1 | Clarifications on Midamble Associations | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000542 | 036 | - | Clarification on PICH power setting | 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-010062 | 033 | 2 | Correction to SCH section | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010062 | 037 | 1 | Bit Scrambling for TDD | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010062 | 039 | 1 | Corrections of PUSCH and PDSCH | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010062 | 040 | - | Alteration of SCH offsets to avoid overlapping Midamble | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010062 | 041 | - | Clarifications & Corrections for TS25.221 | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010062 | 045 | 1 | Corrections on the PRACH and clarifications on the midamble generation and the behaviour in case of an invalid TFI combination on the DCHs | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010062 | 046 | - | Clarification of TFCI transmission | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010062 | 048 | - | Corrections to Table 5.b “Timeslot formats for the Uplink” | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010073 | 042 | 2 | Introduction of the Physical Node B Synchronization Channel | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010071 | 043 | 1 | Inclusion of 1.28Mcps TDD in TS 25.221 | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010072 | 044 | - | Correction of beacon characteristics due to IPDLs | 3.5.0 | 4.0.0 |
| 15/06/01 | RAN_12 | RP-010336 | 051 | - | Clarification of Midamble Usage in TS25.221 | 4.0.0 | 4.1.0 |
| 15/06/01 | RAN_12 | RP-010336 | 053 | - | Addition to the abbreviation list, correction of references to tables and figures | 4.0.0 | 4.1.0 |
| 15/06/01 | RAN_12 | RP-010342 | 049 | - | Correction of spelling in definition of beacon characteristics | 4.0.0 | 4.1.0 |
| 15/06/01 | RAN_12 | RP-010342 | 055 | - | Correction of Note for PDSCH signalling methods | 4.0.0 | 4.1.0 |
| 21/09/01 | RAN_13 | RP-010522 | 057 | - | TFCI Terminology | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010522 | 063 | - | Clarification of notations in TS25.221 and TS25.223 | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010522 | 062 | - | Addition and correction of the reference | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010528 | 058 | 1 | Corrections for TS 25.221 | 4.1.0 | 4.2.0 |
| 14/12/01 | RAN_14 | RP-010741 | 065 | 1 | Transmit Diversity for P-CCPCH and PICH | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010741 | 067 | - | Clarification of midamble transmit power in TS25.221 | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010746 | 059 | - | Bit Scrambling for 1.28 Mcps TDD | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010746 | 068 | - | Transmit Diversity for P-CCPCH and PICH | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010746 | 069 | - | Corrections of reference numbers in TS 25.221 | 4.2.0 | 4.3.0 |
| 08/03/02 | RAN_15 | RP-020049 | 071 | 2 | Clarification of spreading for UL physical channels | 4.3.0 | 4.4.0 |
| 08/03/02 | RAN_15 | RP-020049 | 073 | 1 | Common midamble allocation for beacon time slot | 4.3.0 | 4.4.0 |
| 08/03/02 | RAN_15 | RP-020049 | 075 | 3 | Correction to a transmission of paging indicators bits | 4.3.0 | 4.4.0 |

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 07/06/02 | RAN_16 | RP-020313 | 079 | - | Clarification of shared channel functionality for TDD | 4.4.0 | 4.5.0 |
| 18/09/02 | RAN_17 | RP-020559 | 091 | 1 | Corrections to channelisation code mapping for 1.28 Mcps TDD | 4.5.0 | 4.6.0 |
| 18/09/02 | RAN_17 | RP-020576 | 093 | - | Correction to S-CCPCH description for 1.28 Mcps TDD | 4.5.0 | 4.6.0 |
| 18/09/02 | RAN_17 | RP-020569 | 089 | 1 | Corrections to channelisation code mappings for 3.84 Mcps TDD | 4.5.0 | 4.6.0 |
| 18/09/02 | RAN_17 | RP-020579 | 103 | 1 | Corrections to transmit diversity mode for TDD beacon-function physical channels | 4.5.0 | 4.6.0 |
| 18/09/02 | RAN_17 | RP-020572 | 096 | 2 | Corrections to transmit diversity mode for TDD beacon-function physical channels | 4.5.0 | 4.6.0 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**3GPP TSG-RAN1 Meeting #29**
**Shanghai, China, 5 – 8 November 2002**

***R1-02-1389***

*CR-Form-v7*

# CHANGE REQUEST

| | | | | | |
|---|---|---|---|---|---|
| ⌘ **25.221** | **CR 107** | ⌘ **rev** | **-** | ⌘ Current version: | **5.2.0** ⌘ |

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

***Proposed change affects:*** UICC apps⌘ [ ] ME [X] Radio Access Network [X] Core Network [ ]

| | | | |
|---|---|---|---|
| ***Title:*** | ⌘ Editorial modification to the section numberings | | |
| ***Source:*** | ⌘ TSG RAN WG1 | | |
| ***Work item code:*** | ⌘ TEI5 | ***Date:*** ⌘ | 28/10/2002 |
| ***Category:*** | ⌘ **D** | ***Release:*** ⌘ | Rel-5 |
| | *Use one of the following categories:*<br>***F*** *(correction)*<br>***A*** *(corresponds to a correction in an earlier release)*<br>***B*** *(addition of feature),*<br>***C*** *(functional modification of feature)*<br>***D*** *(editorial modification)*<br>Detailed explanations of the above categories can be found in 3GPP TR 21.900. | | *Use one of the following releases:*<br>*2 (GSM Phase 2)*<br>*R96 (Release 1996)*<br>*R97 (Release 1997)*<br>*R98 (Release 1998)*<br>*R99 (Release 1999)*<br>*Rel-4 (Release 4)*<br>*Rel-5 (Release 5)*<br>*Rel-6 (Release 6)* |

| | |
|---|---|
| ***Reason for change:*** ⌘ | The numbering used is not consistent with TS21.801. |
| ***Summary of change:*** ⌘ | The sections, figures, and tables numberings are adjusted to follow the guidlines given in TS21.801. |
| ***Consequences if not approved:*** ⌘ | Confusion and misunderstanding, not consistent with specification guidelines and the rest of the document. |

| | | | | |
|---|---|---|---|---|
| ***Clauses affected:*** ⌘ | All the document | | | |
| | **Y** | **N** | | |
| ***Other specs affected:*** ⌘ | | **X** | Other core specifications | ⌘ |
| | | **X** | Test specifications | |
| | | **X** | O&M Specifications | |
| ***Other comments:*** ⌘ | | | | |

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

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification

which are not relevant to the change request.

# Contents

# Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

# 1 Scope

The present document describes the characteristics of the physicals channels and the mapping of the transport channels to physical channels in the TDD 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.


[1] 3GPP TS 25.201: "Physical layer - general description".

[2] 3GPP TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)".

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

[4] 3GPP TS 25.213: "Spreading and modulation (FDD)".

[5] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[6] 3GPP TS 25.215: "Physical layer – Measurements (FDD)".

[7] 3GPP TS 25.222: "Multiplexing and channel coding (TDD)".

[8] 3GPP TS 25.223: "Spreading and modulation (TDD)".

[9] 3GPP TS 25.224: "Physical layer procedures (TDD)".

[10] 3GPP TS 25.225: "Physical layer – Measurements (TDD)".

[11] 3GPP TS 25.301: "Radio Interface Protocol Architecture".

[12] 3GPP TS 25.302: "Services Provided by the Physical Layer".

[13] 3GPP TS 25.401: "UTRAN Overall Description".

[14] 3GPP TS 25.402: "Synchronisation in UTRAN, Stage 2".

[15] 3GPP TS 25.304: " UE Procedures in Idle Mode and Procedures for Cell Reselection in Connected Mode".

[16] 3GPP TS 25.427: "UTRAN Iur and Iub interface user plane protocols for DCH data streams".

[17] 3GPP TS 25.435: "UTRAN $I_{ub}$ Interface User Plane Protocols for Common Transport Channel Data Streams".

[18] 3GPP TS25.308: High Speed Downlink Packet Access (HSDPA); Overall description; Stage 2


# 3 Abbreviations

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

16QAM 16 Quadrature Amplitude Modulation

| | |
|---|---|
| BCH | Broadcast Channel |
| CCPCH | Common Control Physical Channel |
| CCTrCH | Coded Composite Transport Channel |
| CDMA | Code Division Multiple Access |
| CQI | Channel Quality Indicator |
| DCH | Dedicated Channel |
| DL | Downlink |
| DPCH | Dedicated Physical Channel |
| DRX | Discontinuous Reception |
| DSCH | Downlink Shared Channel |
| DTX | Discontinuous Transmission |
| DwPCH | Downlink Pilot Channel |
| DwPTS | Downlink Pilot Time Slot |
| FACH | Forward Access Channel |
| FDD | Frequency Division Duplex |
| FEC | Forward Error Correction |
| GP | Guard Period |
| GSM | Global System for Mobile Communication |
| HARQ | Hybrid ARQ |
| HS-DSCH | High Speed Downlink Shared Channel |
| HS-PDSCH | High Speed Physical Downlink Shared Channel |
| HS-SCCH | Shared Control Channel for HS-DSCH |
| HS-SICH | Shared Information Channel for HS-DSCH |
| MIB | Master Information Block |
| NRT | Non-Real Time |
| OVSF | Orthogonal Variable Spreading Factor |
| P-CCPCH | Primary CCPCH |
| PCH | Paging Channel |
| PDSCH | Physical Downlink Shared Channel |
| PI | Paging Indicator (value calculated by higher layers) |
| PICH | Page Indicator Channel |
| $P_q$ | Paging Indicator (indicator set by physical layer) |
| PRACH | Physical Random Access Channel |
| PUSCH | Physical Uplink Shared Channel |
| RACH | Random Access Channel |
| RF | Radio Frame |
| RT | Real Time |
| S-CCPCH | Secondary CCPCH |
| SCH | Synchronisation Channel |
| SCTD | Space Code Transmit Diversity |
| SF | Spreading Factor |
| SFN | Cell System Frame Number |
| SS | Synchronisation Shift |
| TCH | Traffic Channel |
| TDD | Time Division Duplex |
| TDMA | Time Division Multiple Access |
| TFC | Transport Format Combination |
| TFCI | Transport Format Combination Indicator |
| TFI | Transport Format Indicator |
| TPC | Transmitter Power Control |
| TrCH | Transport Channel |
| TSTD | Time Switched Transmit Diversity |
| TTI | Transmission Time Interval |
| UE | User Equipment |
| UL | Uplink |
| UMTS | Universal Mobil Telecommunications System |
| UpPTS | Uplink Pilot Time Slot |
| UpPCH | Uplink Pilot Channel |
| USCH | Uplink Shared Channel |
| UTRAN | UMTS Terrestrial Radio Access Network |

# 4 Services offered to higher layers

## 4.1 Transport channels

Transport channels are the services offered by layer 1 to the higher layers. A transport channel is defined by how and with what characteristics data is transferred over the air interface. A general classification of transport channels is into two groups:

- Dedicated Channels, using inherent addressing of UE
- Common Channels, using explicit addressing of UE if addressing is needed

General concepts about transport channels are described in [12].

### 4.1.1 Dedicated transport channels

The Dedicated Channel (DCH) is an up- or downlink transport channel that is used to carry user or control information between the UTRAN and a UE.

### 4.1.2 Common transport channels

There are six types of transport channels: BCH, FACH, PCH, RACH, USCH, DSCH

#### 4.1.2.1 BCH - Broadcast Channel

The Broadcast Channel (BCH) is a downlink transport channel that is used to broadcast system- and cell-specific information.

#### 4.1.2.2 FACH – Forward Access Channel

The Forward Access Channel (FACH) is a downlink transport channel that is used to carry control information to a mobile station when the system knows the location cell of the mobile station. The FACH may also carry short user packets.

#### 4.1.2.3 PCH – Paging Channel

The Paging Channel (PCH) is a downlink transport channel that is used to carry control information to a mobile station when the system does not know the location cell of the mobile station.

#### 4.1.2.4 RACH – Random Access Channel

The Random Access Channel (RACH) is an up link transport channel that is used to carry control information from mobile station. The RACH may also carry short user packets.

#### 4.1.2.5 USCH – Uplink Shared Channel

The uplink shared channel (USCH) is an uplink transport channel shared by several UEs carrying dedicated control or traffic data.

#### 4.1.2.6 DSCH – Downlink Shared Channel

The downlink shared channel (DSCH) is a downlink transport channel shared by several UEs carrying dedicated control or traffic data.

#### 4.1.2.7 HS-DSCH – High Speed Downlink Shared Channel

The High Speed Downlink Shared Channel (HS-DSCH) is a downlink transport channel shared by several UEs. The HS-DSCH is associated with one downlink DPCH, and one or several Shared Control Channels (HS-SCCH). The HS-DSCH is transmitted over the entire cell or over only part of the cell using e.g. beam-forming antennas.

## 4.2 Indicators

Indicators are means of fast low-level signalling entities which are transmitted without using information blocks sent over transport channels. The meaning of indicators is implicit to the receiver.

The indicator(s) defined in the current version of the specifications are: Paging Indicator.

# 5 Physical channels for the 3.84 Mcps option

All physical channels take three-layer structure with respect to timeslots, radio frames and system frame numbering (SFN), see [14]. Depending on the resource allocation, the configuration of radio frames or timeslots becomes different. All physical channels need a guard period in every timeslot. The time slots are used in the sense of a TDMA component to separate different user signals in the time domain. The physical channel signal format is presented in figure 1.

A physical channel in TDD is a burst, which is transmitted in a particular timeslot within allocated Radio Frames. The allocation can be continuous, i.e. the time slot in every frame is allocated to the physical channel or discontinuous, i.e. the time slot in a subset of all frames is allocated only. A burst is the combination of two data parts, a midamble part and a guard period. The duration of a burst is one time slot. Several bursts can be transmitted at the same time from one transmitter. In this case, the data parts must use different OVSF channelisation codes, but the same scrambling code. The midamble parts are either identicaly or differently shifted versions of a cell-specific basic midamble code, see section 5.2.3.

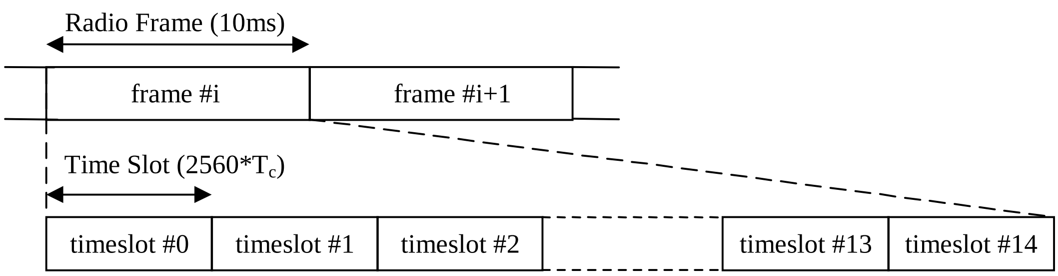



**Figure 1: Physical channel signal format**

The data part of the burst is spread with a combination of channelisation code and scrambling code. The channelisation code is a OVSF code, that can have a spreading factor of 1, 2, 4, 8, or 16. The data rate of the physical channel is depending on the used spreading factor of the used OVSF code.

The midamble part of the burst can contain two different types of midambles: a short one of length 256 chips, or a long one of 512 chips. The data rate of the physical channel is depending on the used midamble length.

So a physical channel is defined by frequency, timeslot, channelisation code, burst type and Radio Frame allocation. The scrambling code and the basic midamble code are broadcast and may be constant within a cell. When a physical channel is established, a start frame is given. The physical channels can either be of infinite duration, or a duration for the allocation can be defined.

## 5.1 Frame structure

The TDMA frame has a duration of 10 ms and is subdivided into 15 time slots (TS) of 2560*$T_c$ duration each. A time slot corresponds to 2560 chips. The physical content of the time slots are the bursts of corresponding length as described in subclause 5.2.2.

Each 10 ms frame consists of 15 time slots, each allocated to either the uplink or the downlink (figure 2). With such a flexibility, the TDD mode can be adapted to different environments and deployment scenarios. In any configuration at least one time slot has to be allocated for the downlink and at least one time slot has to be allocated for the uplink.

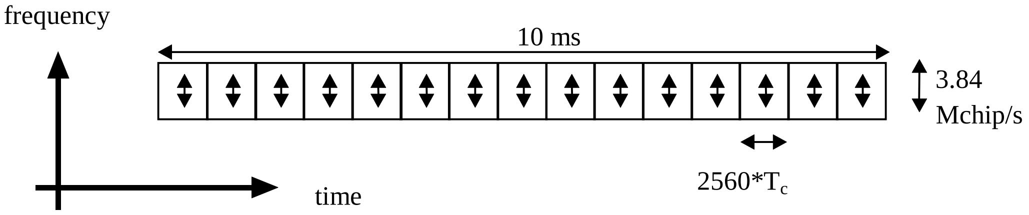
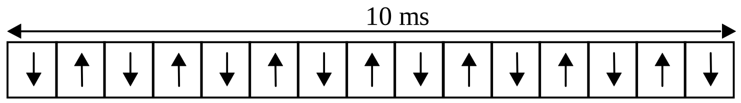
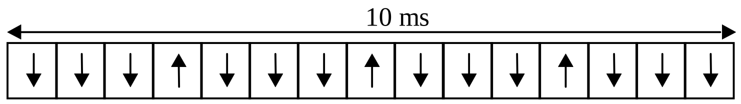



**Figure 2: The TDD frame structure**

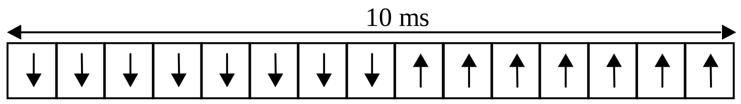
Examples for multiple and single switching point configurations as well as for symmetric and asymmetric UL/DL allocations are given in figure 3.



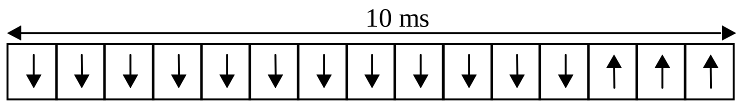

**Multiple-switching-point configuration (symmetric DL/UL allocation)**




**Multiple-switching-point configuration (asymmetric DL/UL allocation)**




**Single-switching-point configuration (symmetric DL/UL allocation)**




**Single-switching-point configuration (asymmetric DL/UL allocation)**

**Figure 3: TDD frame structure examples**

## 5.2 Dedicated physical channel (DPCH)

The DCH as described in subclause 4.1.1 is mapped onto the dedicated physical channel.

### 5.2.1 Spreading

Spreading is applied to the data part of the physical channels and consists of two operations. The first is the channelisation operation, which transforms every data symbol into a number of chips, thus increasing the bandwidth of the signal. The number of chips per data symbol is called the Spreading Factor (SF). The second operation is the scrambling operation, where a scrambling code is applied to the spread signal. Details on channelisation and scrambling operation can be found in [8].

#### 5.2.1.1 Spreading for Downlink Physical Channels

Downlink physical channels shall use SF =16. Multiple parallel physical channels can be used to support higher data rates. These parallel physical channels shall be transmitted using different channelisation codes, see [8]. These codes with SF =16 are generated as described in [8].

Operation with a single code with spreading factor 1 is possible for the downlink physical channels.

#### 5.2.1.2 Spreading for Uplink Physical Channels

The range of spreading factor that may be used for uplink physical channels shall range from 16 down to 1. For each physical channel an individual minimum spreading factor $SF_{min}$ is transmitted by means of the higher layers. There are two options that are indicated by UTRAN:

1. The UE shall use the spreading factor $SF_{min}$, independent of the current TFC.

2. The UE shall autonomously increase the spreading factor depending on the current TFC.

If the UE autonomously changes the SF, it shall always vary the channelisation code along the branch with the higher code numbering of the allowed OVSF sub tree, as depicted in [8].

For multicode transmission a UE shall use a maximum of two physical channels per timeslot simultaneously. These two parallel physical channels shall be transmitted using different channelisation codes, see [8].

### 5.2.2 Burst Types

Three types of bursts for dedicated physical channels are defined. All of them consist of two data symbol fields, a midamble and a guard period, the lengths of which are different for the individual burst types. Thus, the number of data symbols in a burst depends on the SF and the burst type, as depicted in table 1.

**Table 1: Number of data symbols (N) for burst type 1, 2, and 3**

| Spreading factor (SF) | Burst Type 1 | Burst Type 2 | Burst Type 3 |
|---|---|---|---|
| 1 | 1952 | 2208 | 1856 |
| 2 | 976 | 1104 | 928 |
| 4 | 488 | 552 | 464 |
| 8 | 244 | 276 | 232 |
| 16 | 122 | 138 | 116 |

The support of all three burst types is mandatory for the UE. The three different bursts defined here are well suited for different applications, as described in the following sections.

#### 5.2.2.1 Burst Type 1

The burst type 1 can be used for uplink and downlink. Due to its longer midamble field this burst type supports the construction of a larger number of training sequences, see 5.2.3. The maximum number of training sequences depend on the cell configuration, see annex A. For the burst type 1 this number may be 4, 8, or 16.

The data fields of the burst type 1 are 976 chips long. The corresponding number of symbols depends on the spreading factor, as indicated in table 1 above. The midamble of burst type 1 has a length of 512 chips. The guard period for the burst type 1 is 96 chip periods long. The burst type 1 is shown in Figure 4. The contents of the burst fields are described in table 2.

**Table 2: The contents of the burst type 1 fields**

| Chip number (CN) | Length of field in chips | Length of field in symbols | | Contents of field |
|---|---|---|---|---|
| 0-975 | 976 | Cf table 1 | | Data symbols |
| 976-1487 | 512 | - | | Midamble |
| 1488-2463 | 976 | Cf table 1 | | Data symbols |
| 2464-2559 | 96 | - | | Guard period |

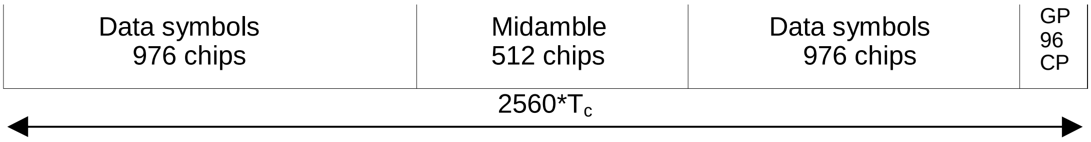



**Figure 4**: **Burst structure of the burst type 1. GP denotes the guard period and CP the chip periods**

### 5.2.2.2 Burst Type 2

The burst type 2 can be used for uplink and downlink. It offers a longer data field than burst type 1 on the cost of a shorter midamble. Due to the shorter midamble field the burst type 2 supports a maximum number of training sequences of 3 or 6 only, depending on the cell configuration, see annex A.

The data fields of the burst type 2 are 1104 chips long. The corresponding number of symbols depends on the spreading factor, as indicated in table 1 above. The guard period for the burst type 2 is 96 chip periods long.The burst type 2 is shown in Figure 5. The contents of the burst fields are described in table 3.

**Table 3: The contents of the burst type 2 fields**

| Chip number (CN) | Length of field in chips | Length of field in symbols | | Contents of field |
|---|---|---|---|---|
| 0-1103 | 1104 | cf table 1 | | Data symbols |
| 1104-1359 | 256 | - | | Midamble |
| 1360-2463 | 1104 | cf table 1 | | Data symbols |
| 2464-2559 | 96 | - | | Guard period |

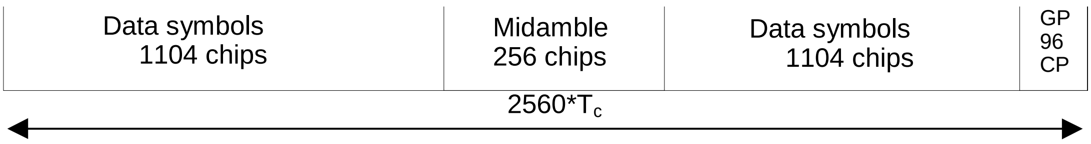



**Figure 5**: **Burst structure of the burst type 2. GP denotes the guard period and CP the chip periods**

### 5.2.2.3 Burst Type 3

The burst type 3 is used for uplink only. Due to the longer guard period it is suitable for initial access or access to a new cell after handover. It offers the same number of training sequences as burst type 1.

The data fields of the burst type 3 have a length of 976 chips and 880 chips, respectively. The corresponding number of symbols depends on the spreading factor, as indicated in table 1 above. The midamble of burst type 3 has a length of 512 chips. The guard period for the burst type 3 is 192 chip periods long. The burst type 3 is shown in Figure 6. The contents of the burst fields are described in table 4.

**Table 4: The contents of the burst type 3 fields**

| Chip number (CN) | Length of field in chips | Length of field in symbols | | Contents of field |
|---|---|---|---|---|
| 0-975 | 976 | Cf table 1 | | Data symbols |
| 976-1487 | 512 | - | | Midamble |
| 1488-2367 | 880 | Cf table 1 | | Data symbols |
| 2368-2559 | 192 | - | | Guard period |

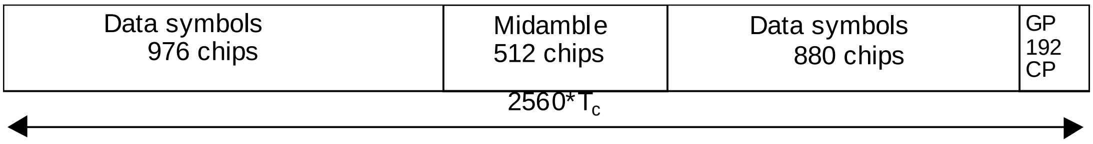



**Figure 6**: **Burst structure of the burst type 3. GP denotes the guard period and CP the chip periods**

## 5.2.2.4 Transmission of TFCI

All burst types 1, 2 and 3 provide the possibility for transmission of TFCI.

The transmission of TFCI is negotiated at call setup and can be re-negotiated during the call. For each CCTrCH it is indicated by higher layer signalling, which TFCI format is applied. Additionally for each allocated timeslot it is signalled individually whether that timeslot carries the TFCI or not. The TFCI is always present in the first timeslot in a radio frame for each CCTrCH. If a time slot contains the TFCI, then it is always transmitted using the physical channel with the lowest physical channel sequence number (*p*) in that timeslot.  Physical channel sequence numbering is determined by the rate matching function and is described in [7].

The transmission of TFCI is done in the data parts of the respective physical channel. In DL the TFCI code word bits and data bits are subject to the same spreading procedure as depicted in [8]. In UL, independent of the SF that is applied to the data symbols in the burst, the data in the TFCI field are always spread with SF=16 using the channelisation code in the branch with the highest code numbering of the allowed OVSF sub tree, as depicted in [8]. Hence the midamble structure and length is not changed. The TFCI code word is to be transmitted directly adjacent to the midamble, possibly after the TPC. Figure 7 shows the position of the TFCI code word in a traffic burst in downlink. Figure 8 shows the position of the TFCI code word in a traffic burst in uplink.

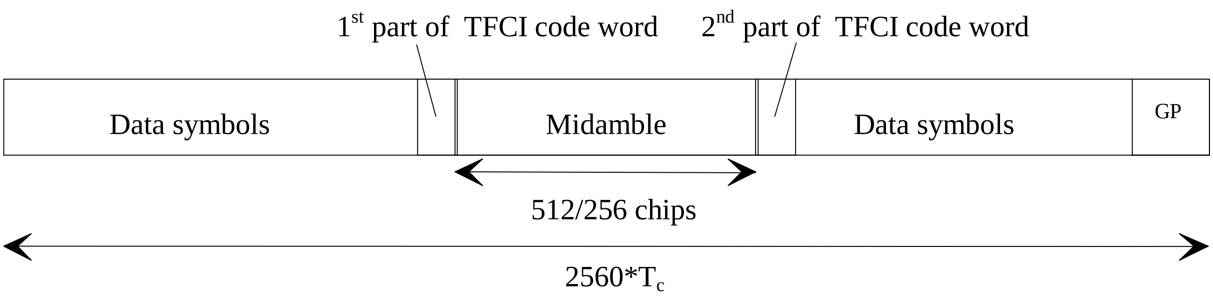



**Figure 7: Position of the TFCI code word in the traffic burst in case of downlink**

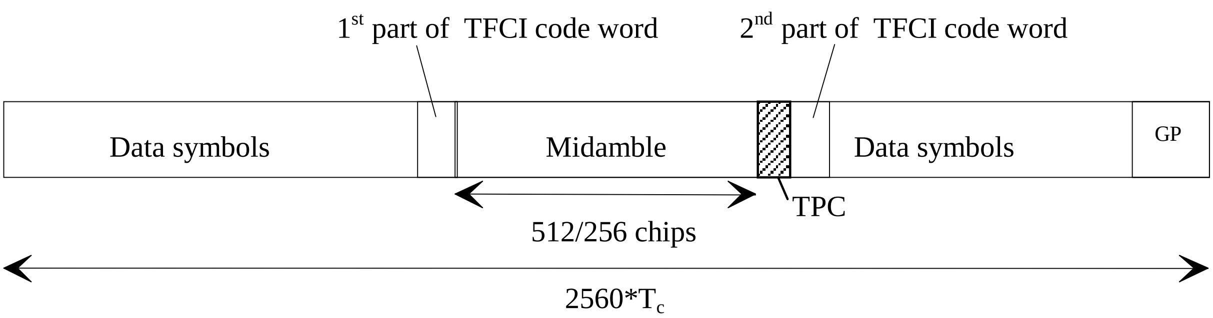



**Figure 8: Position of the TFCI code word in the traffic burst in case of uplink**

Two examples of TFCI transmission in the case of multiple DPCHs used for a connection are given in the Figure 9 and Figure 10 below. Combinations of the two schemes shown are also applicable.

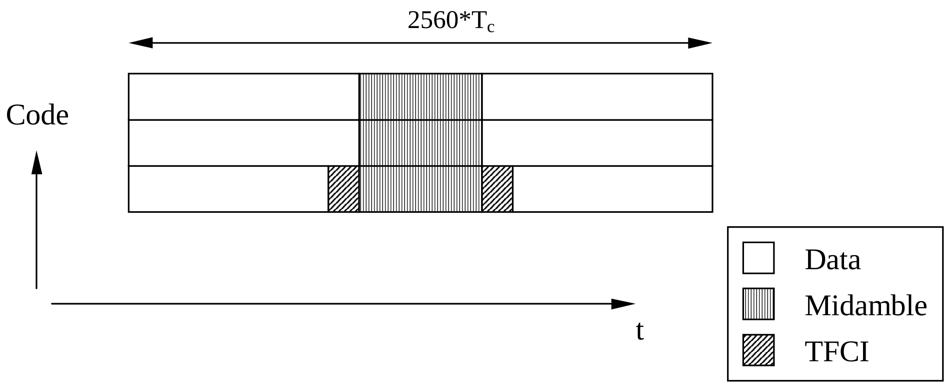



**Figure 9: Example of TFCI transmission with physical channels multiplexed in code domain**

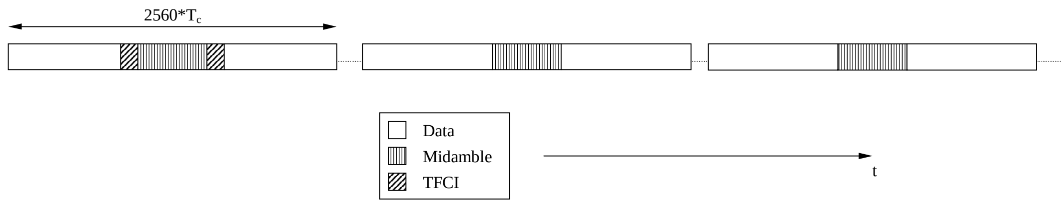



**Figure 10: Example of TFCI transmission with physical channels multiplexed in time domain**

In case the Node B receives an invalid TFI combination on the DCHs mapped to one CCTrCH the procedure described in [16] shall be applied. According to this procedure DTX shall be applied to all DPCHs to which the CCTrCH is mapped to.

### 5.2.2.5 Transmission of TPC

All burst types 1, 2 and 3 for dedicated channels provide the possibility for transmission of TPC in uplink.

The transmission of TPC is done in the data parts of the traffic burst. Independent of the SF that is applied to the data symbols in the burst, the data in the TPC field are always spread with SF=16 using the channelisation code in the branch with the highest code numbering of the allowed OVSF sub tree, as depicted in [8]. Hence the midamble structure and length is not changed. The TPC information is to be transmitted directly after the midamble. Figure 11 shows the position of the TPC in a traffic burst.

For every user the TPC information shall be transmitted at least once per transmitted frame. If a TFCI is applied for a CCTrCH, TPC shall be transmitted with the same channelization codes and in the same timeslots as the TFCI. If no TFCI is applied for a CCTrCH, TPC shall be transmitted using the physical channel corresponding to physical channel sequence number *p*=1. Physical channel sequence numbering is determined by the rate matching function and is described in [7].

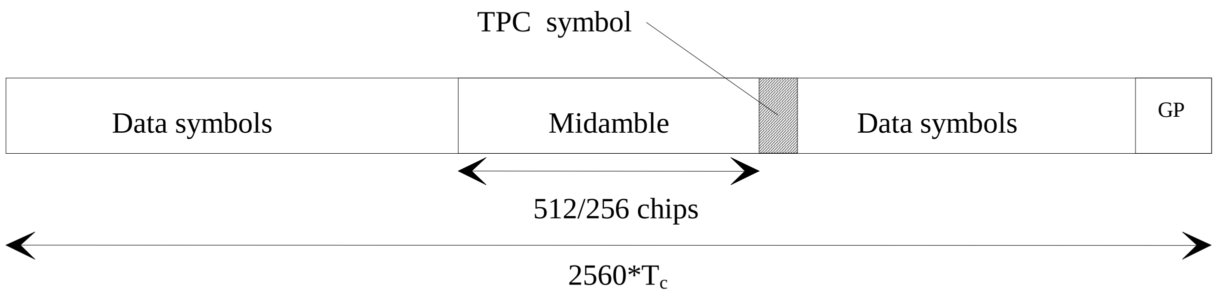



**Figure 11: Position of TPC information in the traffic burst**

The length of the TPC command is one symbol. The relationship between the TPC symbol and the TPC command is shown in table 4a.

**Table 4a: TPC bit pattern**

| TPC Bits | TPC command | Meaning |
|---|---|---|
| 00 | 'Down' | Decrease Tx Power |
| 11 | 'Up' | Increase Tx Power |

## 5.2.2.6 Timeslot formats

### 5.2.2.6.1 Downlink timeslot formats

The downlink timeslot format depends on the spreading factor, midamble length and on the number of the TFCI code word bits, as depicted in the table 5a.

**Table 5a: Time slot formats for the Downlink**

| Slot Format # | Spreading Factor | Midamble length (chips) | $N_{TFCI\ code\ word}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data\ field}$ (bits) |
|---|---|---|---|---|---|---|
| 0 | 16 | 512 | 0 | 244 | 244 | 122 |
| 1 | 16 | 512 | 4 | 244 | 240 | 120 |
| 2 | 16 | 512 | 8 | 244 | 236 | 118 |
| 3 | 16 | 512 | 16 | 244 | 228 | 114 |
| 4 | 16 | 512 | 32 | 244 | 212 | 106 |
| 5 | 16 | 256 | 0 | 276 | 276 | 138 |
| 6 | 16 | 256 | 4 | 276 | 272 | 136 |
| 7 | 16 | 256 | 8 | 276 | 268 | 134 |
| 8 | 16 | 256 | 16 | 276 | 260 | 130 |
| 9 | 16 | 256 | 32 | 276 | 244 | 122 |
| 10 | 1 | 512 | 0 | 3904 | 3904 | 1952 |
| 11 | 1 | 512 | 4 | 3904 | 3900 | 1950 |
| 12 | 1 | 512 | 8 | 3904 | 3896 | 1948 |
| 13 | 1 | 512 | 16 | 3904 | 3888 | 1944 |
| 14 | 1 | 512 | 32 | 3904 | 3872 | 1936 |
| 15 | 1 | 256 | 0 | 4416 | 4416 | 2208 |
| 16 | 1 | 256 | 4 | 4416 | 4412 | 2206 |
| 17 | 1 | 256 | 8 | 4416 | 4408 | 2204 |
| 18 | 1 | 256 | 16 | 4416 | 4400 | 2200 |
| 19 | 1 | 256 | 32 | 4416 | 4384 | 2192 |

#### 5.2.2.6.2 Uplink timeslot formats

The uplink timeslot format depends on the spreading factor, midamble length, guard period length and on the number of the TFCI code word bits. Due to TPC, different amount of bits are mapped to the two data fields. The timeslot formats are depicted in the table 5b.

**Table 5b: Timeslot formats for the Uplink**

| Slot Format # | Spreading Factor | Midamble length (chips) | Guard Period (chips) | $N_{TFCI}$ code word (bits) | $N_{TPC}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data\ field(1)}$ (bits) | $N_{data/data\ field(2)}$ (bits) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 16 | 512 | 96 | 0 | 0 | 244 | 244 | 122 | 122 |
| 1 | 16 | 512 | 96 | 0 | 2 | 244 | 242 | 122 | 120 |
| 2 | 16 | 512 | 96 | 4 | 2 | 244 | 238 | 120 | 118 |
| 3 | 16 | 512 | 96 | 8 | 2 | 244 | 234 | 118 | 116 |
| 4 | 16 | 512 | 96 | 16 | 2 | 244 | 226 | 114 | 112 |
| 5 | 16 | 512 | 96 | 32 | 2 | 244 | 210 | 106 | 104 |
| 6 | 16 | 256 | 96 | 0 | 0 | 276 | 276 | 138 | 138 |
| 7 | 16 | 256 | 96 | 0 | 2 | 276 | 274 | 138 | 136 |
| 8 | 16 | 256 | 96 | 4 | 2 | 276 | 270 | 136 | 134 |
| 9 | 16 | 256 | 96 | 8 | 2 | 276 | 266 | 134 | 132 |
| 10 | 16 | 256 | 96 | 16 | 2 | 276 | 258 | 130 | 128 |
| 11 | 16 | 256 | 96 | 32 | 2 | 276 | 242 | 122 | 120 |
| 12 | 8 | 512 | 96 | 0 | 0 | 488 | 488 | 244 | 244 |
| 13 | 8 | 512 | 96 | 0 | 2 | 486 | 484 | 244 | 240 |
| 14 | 8 | 512 | 96 | 4 | 2 | 482 | 476 | 240 | 236 |
| 15 | 8 | 512 | 96 | 8 | 2 | 478 | 468 | 236 | 232 |
| 16 | 8 | 512 | 96 | 16 | 2 | 470 | 452 | 228 | 224 |
| 17 | 8 | 512 | 96 | 32 | 2 | 454 | 420 | 212 | 208 |
| 18 | 8 | 256 | 96 | 0 | 0 | 552 | 552 | 276 | 276 |
| 19 | 8 | 256 | 96 | 0 | 2 | 550 | 548 | 276 | 272 |
| 20 | 8 | 256 | 96 | 4 | 2 | 546 | 540 | 272 | 268 |
| 21 | 8 | 256 | 96 | 8 | 2 | 542 | 532 | 268 | 264 |
| 22 | 8 | 256 | 96 | 16 | 2 | 534 | 516 | 260 | 256 |
| 23 | 8 | 256 | 96 | 32 | 2 | 518 | 484 | 244 | 240 |
| 24 | 4 | 512 | 96 | 0 | 0 | 976 | 976 | 488 | 488 |
| 25 | 4 | 512 | 96 | 0 | 2 | 970 | 968 | 488 | 480 |
| 26 | 4 | 512 | 96 | 4 | 2 | 958 | 952 | 480 | 472 |
| 27 | 4 | 512 | 96 | 8 | 2 | 946 | 936 | 472 | 464 |
| 28 | 4 | 512 | 96 | 16 | 2 | 922 | 904 | 456 | 448 |
| 29 | 4 | 512 | 96 | 32 | 2 | 874 | 840 | 424 | 416 |
| 30 | 4 | 256 | 96 | 0 | 0 | 1104 | 1104 | 552 | 552 |
| 31 | 4 | 256 | 96 | 0 | 2 | 1098 | 1096 | 552 | 544 |
| 32 | 4 | 256 | 96 | 4 | 2 | 1086 | 1080 | 544 | 536 |
| 33 | 4 | 256 | 96 | 8 | 2 | 1074 | 1064 | 536 | 528 |
| 34 | 4 | 256 | 96 | 16 | 2 | 1050 | 1032 | 520 | 512 |
| 35 | 4 | 256 | 96 | 32 | 2 | 1002 | 968 | 488 | 480 |
| 36 | 2 | 512 | 96 | 0 | 0 | 1952 | 1952 | 976 | 976 |
| 37 | 2 | 512 | 96 | 0 | 2 | 1938 | 1936 | 976 | 960 |
| 38 | 2 | 512 | 96 | 4 | 2 | 1910 | 1904 | 960 | 944 |
| 39 | 2 | 512 | 96 | 8 | 2 | 1882 | 1872 | 944 | 928 |
| 40 | 2 | 512 | 96 | 16 | 2 | 1826 | 1808 | 912 | 896 |
| 41 | 2 | 512 | 96 | 32 | 2 | 1714 | 1680 | 848 | 832 |
| 42 | 2 | 256 | 96 | 0 | 0 | 2208 | 2208 | 1104 | 1104 |
| 43 | 2 | 256 | 96 | 0 | 2 | 2194 | 2192 | 1104 | 1088 |
| 44 | 2 | 256 | 96 | 4 | 2 | 2166 | 2160 | 1088 | 1072 |
| 45 | 2 | 256 | 96 | 8 | 2 | 2138 | 2128 | 1072 | 1056 |
| 46 | 2 | 256 | 96 | 16 | 2 | 2082 | 2064 | 1040 | 1024 |
| 47 | 2 | 256 | 96 | 32 | 2 | 1970 | 1936 | 976 | 960 |

| Slot Format # | Spreading Factor | Midamble length (chips) | Guard Period (chips) | $N_{TFCI}$ code word (bits) | $N_{TPC}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data field(1)}$ (bits) | $N_{data/data field(2)}$ (bits) |
|---|---|---|---|---|---|---|---|---|---|
| 48 | 1 | 512 | 96 | 0 | 0 | 3904 | 3904 | 1952 | 1952 |
| 49 | 1 | 512 | 96 | 0 | 2 | 3874 | 3872 | 1952 | 1920 |
| 50 | 1 | 512 | 96 | 4 | 2 | 3814 | 3808 | 1920 | 1888 |
| 51 | 1 | 512 | 96 | 8 | 2 | 3754 | 3744 | 1888 | 1856 |
| 52 | 1 | 512 | 96 | 16 | 2 | 3634 | 3616 | 1824 | 1792 |
| 53 | 1 | 512 | 96 | 32 | 2 | 3394 | 3360 | 1696 | 1664 |
| 54 | 1 | 256 | 96 | 0 | 0 | 4416 | 4416 | 2208 | 2208 |
| 55 | 1 | 256 | 96 | 0 | 2 | 4386 | 4384 | 2208 | 2176 |
| 56 | 1 | 256 | 96 | 4 | 2 | 4326 | 4320 | 2176 | 2144 |
| 57 | 1 | 256 | 96 | 8 | 2 | 4266 | 4256 | 2144 | 2112 |
| 58 | 1 | 256 | 96 | 16 | 2 | 4146 | 4128 | 2080 | 2048 |
| 59 | 1 | 256 | 96 | 32 | 2 | 3906 | 3872 | 1952 | 1920 |
| 60 | 16 | 512 | 192 | 0 | 0 | 232 | 232 | 122 | 110 |
| 61 | 16 | 512 | 192 | 0 | 2 | 232 | 230 | 122 | 108 |
| 62 | 16 | 512 | 192 | 4 | 2 | 232 | 226 | 120 | 106 |
| 63 | 16 | 512 | 192 | 8 | 2 | 232 | 222 | 118 | 104 |
| 64 | 16 | 512 | 192 | 16 | 2 | 232 | 214 | 114 | 100 |
| 65 | 16 | 512 | 192 | 32 | 2 | 232 | 198 | 106 | 92 |
| 66 | 8 | 512 | 192 | 0 | 0 | 464 | 464 | 244 | 220 |
| 67 | 8 | 512 | 192 | 0 | 2 | 462 | 460 | 244 | 216 |
| 68 | 8 | 512 | 192 | 4 | 2 | 458 | 452 | 240 | 212 |
| 69 | 8 | 512 | 192 | 8 | 2 | 454 | 444 | 236 | 208 |
| 70 | 8 | 512 | 192 | 16 | 2 | 446 | 428 | 228 | 200 |
| 71 | 8 | 512 | 192 | 32 | 2 | 430 | 396 | 212 | 184 |
| 72 | 4 | 512 | 192 | 0 | 0 | 928 | 928 | 488 | 440 |
| 73 | 4 | 512 | 192 | 0 | 2 | 922 | 920 | 488 | 432 |
| 74 | 4 | 512 | 192 | 4 | 2 | 910 | 904 | 480 | 424 |
| 75 | 4 | 512 | 192 | 8 | 2 | 898 | 888 | 472 | 416 |
| 76 | 4 | 512 | 192 | 16 | 2 | 874 | 856 | 456 | 400 |
| 77 | 4 | 512 | 192 | 32 | 2 | 826 | 792 | 424 | 368 |
| 78 | 2 | 512 | 192 | 0 | 0 | 1856 | 1856 | 976 | 880 |
| 79 | 2 | 512 | 192 | 0 | 2 | 1842 | 1840 | 976 | 864 |
| 80 | 2 | 512 | 192 | 4 | 2 | 1814 | 1808 | 960 | 848 |
| 81 | 2 | 512 | 192 | 8 | 2 | 1786 | 1776 | 944 | 832 |
| 82 | 2 | 512 | 192 | 16 | 2 | 1730 | 1712 | 912 | 800 |
| 83 | 2 | 512 | 192 | 32 | 2 | 1618 | 1584 | 848 | 736 |
| 84 | 1 | 512 | 192 | 0 | 0 | 3712 | 3712 | 1952 | 1760 |
| 85 | 1 | 512 | 192 | 0 | 2 | 3682 | 3680 | 1952 | 1728 |
| 86 | 1 | 512 | 192 | 4 | 2 | 3622 | 3616 | 1920 | 1696 |
| 87 | 1 | 512 | 192 | 8 | 2 | 3562 | 3552 | 1888 | 1664 |
| 88 | 1 | 512 | 192 | 16 | 2 | 3442 | 3424 | 1824 | 1600 |
| 89 | 1 | 512 | 192 | 32 | 2 | 3202 | 3168 | 1696 | 1472 |

## 5.2.3 Training sequences for spread bursts

In this subclause, the training sequences for usage as midambles in burst type 1, 2 and 3 (see subclause 5.2.2) are defined. The training sequences, i.e. midambles, of different users active in the same cell and same time slot are cyclically shifted versions of one cell-specific single basic midamble code. The applicable basic midamble codes are given in Annex A.1 and A.2. As different basic midamble codes are required for different burst formats, the Annex A.1 shows the basic midamble codes $\mathbf{m}_{PL}$ for burst type 1 and 3, and Annex and A.2 shows $\mathbf{m}_{PS}$ for burst type 2. It should be noted that burst type 2 must not be mixed with burst type 1 or 3 in the same timeslot of one cell.

The basic midamble codes in Annex A.1 and A.2 are listed in hexadecimal notation. The binary form of the basic midamble code shall be derived according to table 6 below.

**Table 6: Mapping of 4 binary elements $m_i$ on a single hexadecimal digit**

| 4 binary elements $m_i$ | Mapped on hexadecimal digit |
|---|---|
| -1 -1 -1 -1 | 0 |
| -1 -1 -1 1 | 1 |
| -1 -1 1 –1 | 2 |
| -1 -1 1 1 | 3 |
| -1 1 -1 –1 | 4 |
| -1 1 -1 1 | 5 |
| -1 1 1 –1 | 6 |
| -1 1 1 1 | 7 |
| 1 -1 -1 –1 | 8 |
| 1 -1 -1 1 | 9 |
| 1 -1 1 –1 | A |
| 1 -1 1 1 | B |
| 1 1 -1 –1 | C |
| 1 1 -1 1 | D |
| 1 1 1 –1 | E |
| 1 1 1 1 | F |

For each particular basic midamble code, its binary representation can be written as a vector $\mathbf{m}_\mathrm{P}$ :

$$\mathbf{m}_\mathrm{P} = \left(m_1, m_2, ..., m_P\right) \quad (1)$$

According to Annex A.1, the size of this vector $\mathbf{m}_\mathrm{P}$ is P=456 for burst type 1 and 3. Annex A.2 is setting P=192 for burst type 2. As QPSK modulation is used, the training sequences are transformed into a complex form, denoted as the complex vector $\underline{\mathbf{m}}_\mathrm{P}$ :

$$\underline{\mathbf{m}}_\mathrm{P} = \left(\underline{m}_1, \underline{m}_2, ..., \underline{m}_P\right) \quad (2)$$

The elements $\underline{m}_i$ of $\underline{\mathbf{m}}_\mathrm{P}$ are derived from elements $m_i$ of $\mathbf{m}_\mathrm{P}$ using equation (3):

$$\underline{m}_i = (\mathrm{j})^i \cdot m_i \text{ for all } i = 1, ..., P \quad (3)$$

Hence, the elements $\underline{m}_i$ of the complex basic midamble code are alternating real and imaginary.

To derive the required training sequences (different shifts), this vector $\underline{\mathbf{m}}_\mathrm{P}$ is periodically extended to the size:

$$i_{\max} = L_m + (K'-1)W + \lfloor P/K \rfloor \quad (4)$$

Notes on equation (4):

- $L_m$: Midamble length
- K': Maximum number of different midamble shifts in a cell, when no intermediate shifts are used. This value depends on the midamble length.
- K: Maximum number of different midamble shifts in a cell, when intermediate shifts are used, K=2K'. This value depends on the midamble length.
- W: Shift between the midambles, when the number of midambles is K'.

- $\lfloor x \rfloor$ denotes the largest integer smaller or equal to x

Allowed values for $L_m$, K' and W are given in Annex A.1 and A.2.

So we obtain a new vector $\underline{\mathbf{m}}$ containing the periodic basic midamble sequence:

$$\underline{\mathbf{m}} = \left(\underline{m}_1, \underline{m}_2, ..., \underline{m}_{i_{\max}}\right) = \left(\underline{m}_1, \underline{m}_2, ..., \underline{m}_{L_m+(K'-1)W+\lfloor P/K \rfloor}\right) \quad (5)$$

The first P elements of this vector $\underline{\mathbf{m}}$ are the same ones as in vector $\underline{\mathbf{m}}_P$ , the following elements repeat the beginning:

$$\underline{m}_i = \underline{m}_{i-P} \text{ for the subset } i = (P+1), ..., i_{\max} \quad (6)$$

Using this periodic basic midamble sequence $\underline{\mathbf{m}}$ for each shift k a midamble $\underline{\mathbf{m}}^{(k)}$ of length $L_m$ is derived, which can be written as a shift specific vector:

$$\underline{\mathbf{m}}^{(k)} = \left(\underline{m}_1^{(k)}, \underline{m}_2^{(k)}, ..., \underline{m}_{L_m}^{(k)}\right) \quad (7)$$

The $L_m$ midamble elements $\underline{m}_i^{(k)}$ are generated for each midamble of the first K' shifts (k = 1,...,K') based on:

$$\underline{m}_i^{(k)} = \underline{m}_{i+(K'-k)W} \text{ with } i = 1, ..., L_m \text{ and } k = 1, ..., K' \quad (8)$$

The elements of midambles for the second K' shifts (k = (K'+1),...,K = (K'+1),...,2K') are generated based on a slight modification of this formula introducing intermediate shifts:

$$\underline{m}_i^{(k)} = \underline{m}_{i+(K-k-1)W+\lfloor P/K \rfloor} \text{with } i = 1, ..., L_m \text{ and } k = K'+1, ..., K-1 \quad (9)$$

$$\underline{m}_i^{(k)} = \underline{m}_{i+(K'-1)W+\lfloor P/K \rfloor} \text{with } i = 1, ..., L_m \text{ and } k = K \quad (10)$$

The number $K_{Cell}$ of midambles that is supported in each cell can be smaller than K, depending on the cell size and the possible delay spreads, see annex A. The number $K_{Cell}$ is signalled by higher layers. The midamble sequences derived according to equations (7) to (10) have complex values and are not subject to channelisation or scrambling process, i.e. the elements $\underline{m}_i^{(k)}$ represent complex chips for usage in the pulse shaping process at modulation.

The term 'a midamble code set' or 'a midamble code family' denotes K specific midamble codes $\underline{\mathbf{m}}^{(k)}$; k=1,...,K, based on a single basic midamble code $\mathbf{m}_P$ according to (1).

### 5.2.4 Beamforming

When DL beamforming is used, at least that user to which beamforming is applied and which has a dedicated channel shall get one individual midamble according to subclause 5.2.3, even in DL.

## 5.3 Common physical channels

### 5.3.1 Primary common control physical channel (P-CCPCH)

The BCH as described in subclause 4.1.2 is mapped onto the Primary Common Control Physical Channel (P-CCPCH). The position (time slot / code) of the P-CCPCH is known from the Physical Synchronisation Channel (PSCH), see subclause 5.3.4.

#### 5.3.1.1 P-CCPCH Spreading

The P-CCPCH uses fixed spreading with a spreading factor SF = 16 as described in subclause 5.2.1.1. The P-CCPCH always uses channelisation code $c_{Q=16}^{(k=1)}$.

#### 5.3.1.2 P-CCPCH Burst Types

The burst type 1 as described in subclause 5.2.2 is used for the P-CCPCH. No TFCI is applied for the P-CCPCH.

#### 5.3.1.3 P-CCPCH Training sequences

The training sequences, i.e. midambles, as described in subclause 5.2.3 are used for the P-CCPCH.

### 5.3.2 Secondary common control physical channel (S-CCPCH)

PCH and FACH as described in subclause 4.1.2 are mapped onto one or more secondary common control physical channels (S-CCPCH). In this way the capacity of PCH and FACH can be adapted to the different requirements.

#### 5.3.2.1 S-CCPCH Spreading

The S-CCPCH uses fixed spreading with a spreading factor SF = 16 as described in subclause 5.2.1.1.

#### 5.3.2.2 S-CCPCH Burst Types

The burst types 1 or 2 as described in subclause 5.2.2 are used for the S-CCPCHs. TFCI may be applied for S-CCPCHs.

#### 5.3.2.3 S-CCPCH Training sequences

The training sequences, i.e. midambles, as described in subclause 5.2.3 are used for the S-CCPCH.

### 5.3.3 The physical random access channel (PRACH)

The RACH as described in subclause 4.1.2 is mapped onto one uplink physical random access channel (PRACH).

#### 5.3.3.1 PRACH Spreading

The uplink PRACH uses either spreading factor SF=16 or SF=8 as described in subclause 5.2.1.2. The set of admissible spreading codes for use on the PRACH and the associated spreading factors are broadcast on the BCH (within the RACH configuration parameters on the BCH).

#### 5.3.3.2 PRACH Burst Type

The UEs send uplink access bursts of type 3 randomly in the PRACH. TFCI and TPC are not applied for the PRACH.

#### 5.3.3.3 PRACH Training sequences

The training sequences, i.e. midambles, of different users active in the same time slot are time shifted versions of a single periodic basic code. The basic midamble codes for burst type 3 are shown in Annex A. The necessary time shifts are obtained by choosing either *all* k=1,2,3...,K' (for cells with small radius) or *uneven* k=1,3,5,...≤K' (for cells with large radius). Different cells use different periodic basic codes, i.e. different midamble sets.

For cells with large radius additional midambles may be derived from the time-inverted Basic Midamble Sequence. Thus, the second Basic Midamble Code $m_2$ is the time inverted version of Basic Midamble Code $m_1$.

In this way, a joint channel estimation for the channel impulse responses of all active users within one time slot can be performed by a maximum of two cyclic correlations (in cells with small radius, a single cyclic correlator suffices). The different user specific channel impulse response estimates are obtained sequentially in time at the output of the cyclic correlators.

#### 5.3.3.4 PRACH timeslot formats

For the PRACH the timeslot format is only spreading factor dependent. The timeslot formats 60 and 66 of table 5b are applicable for the PRACH.

### 5.3.3.5 Association between Training Sequences and Channelisation Codes

For the PRACH there exists a fixed association between the training sequence and the channelisation code. The generic rule to define this association is based on the order of the channelisation codes $\mathbf{c}_Q^{(k)}$ given by *k* and the order of the midambles $\mathbf{m}_j^{(k)}$ given by *k*, firstly, and *j*, secondly, with the constraint that the midamble for a spreading factor *Q* is the same as in the upper branch for the spreading factor 2*Q*. The index *j=1 or 2* indicates whether the original Basic Midamble Sequence (j=1) or the time-inverted Basic Midamble Sequence is used (j=2).

- For the case that all *k* are allowed and only one periodic basic code $m_1$ is available for the RACH, the association depicted in figure 12 is straightforward.

- For the case that only odd *k* are allowed the principle of the association is shown in figure 13. This association is applied for one and two basic periodic codes.

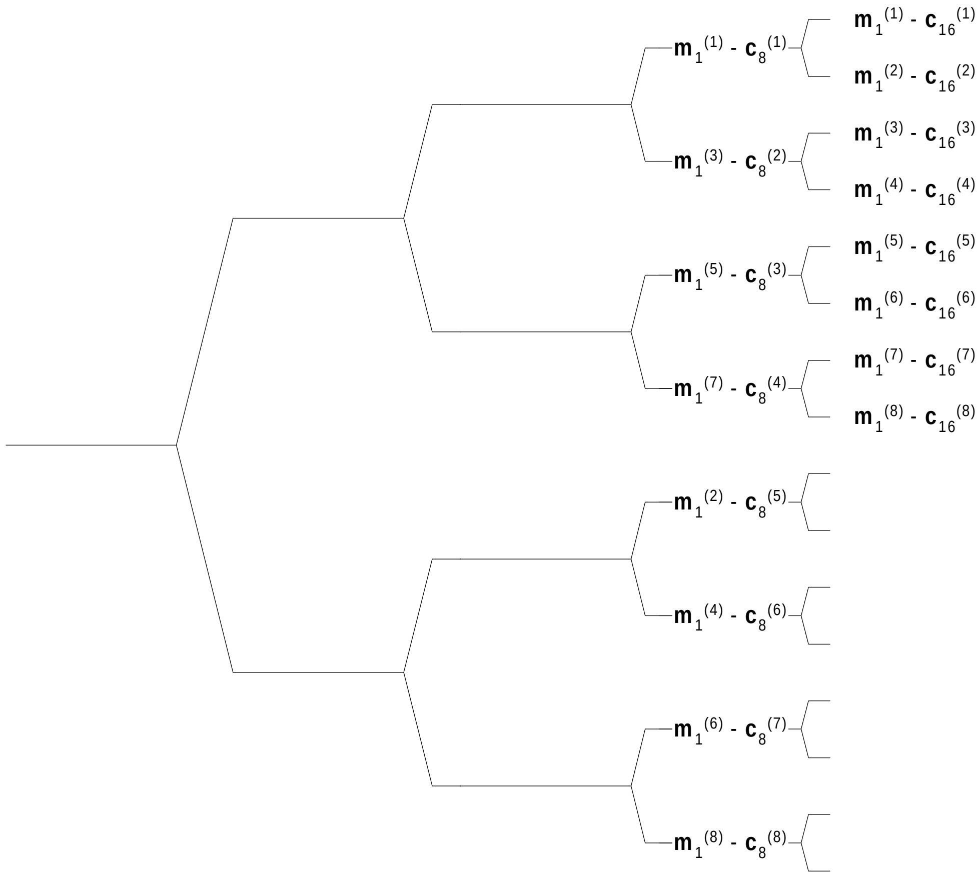



**Figure 12: Association of Midambles to Channelisation Codes in the OVSF tree for all *k***

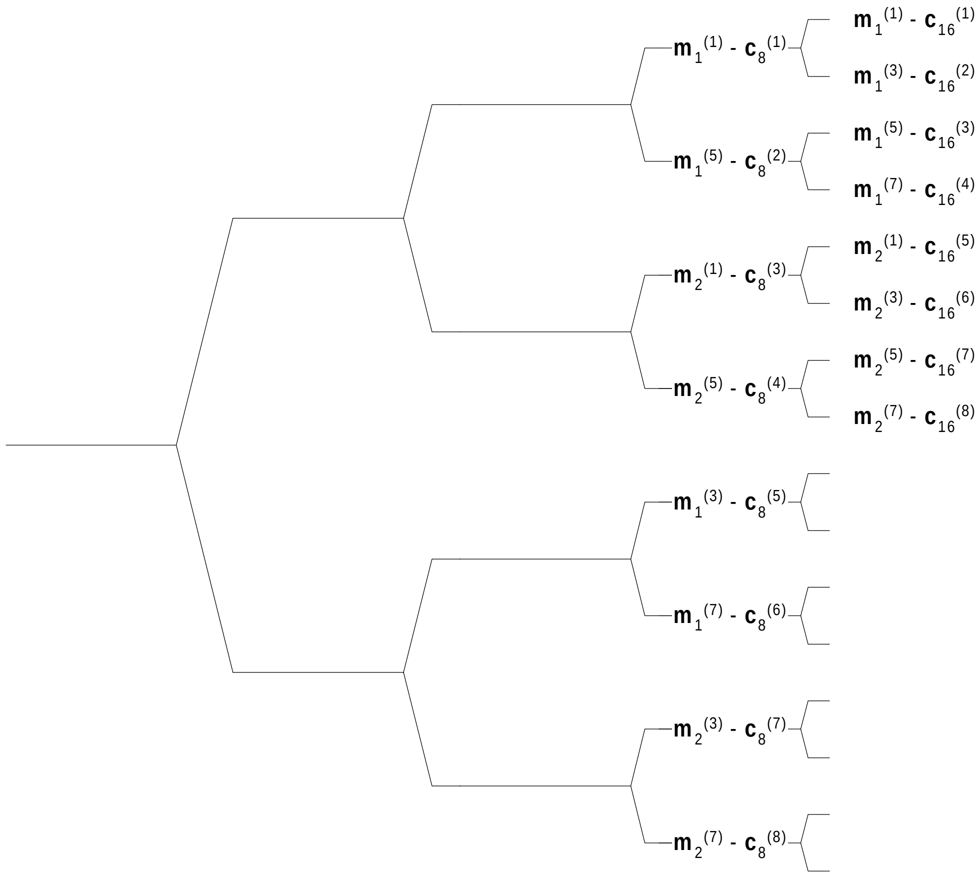



**Figure 13: Association of Midambles to Channelisation Codes in the OVSF tree for odd *k***

### 5.3.4 The synchronisation channel (SCH)

In TDD mode code group of a cell can be derived from the synchronisation channel. In order not to limit the uplink/downlink asymmetry the SCH is mapped on one or two downlink slots per frame only.

There are two cases of SCH and P-CCPCH allocation as follows:

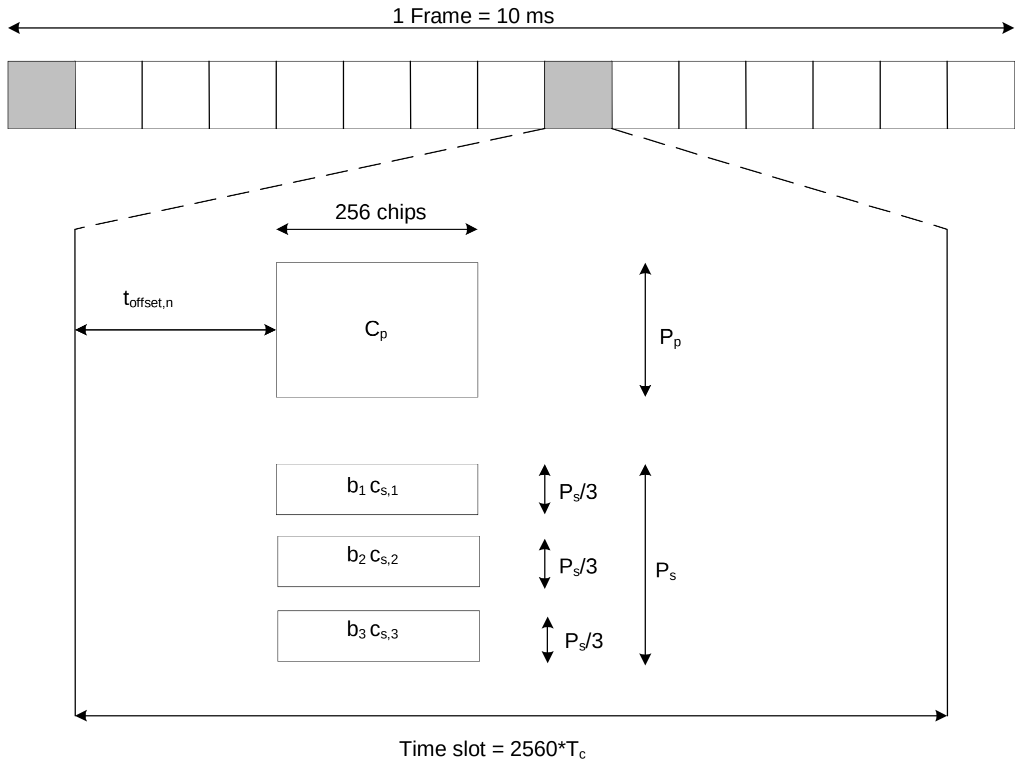
Case 1) SCH and P-CCPCH allocated in TS#k, k=0….14

Case 2) SCH allocated in two TS: TS#k and TS#k+8, k=0…6; P-CCPCH allocated in TS#k.

The position of SCH (value of k) in frame can change on a long term basis in any case.

Due to this SCH scheme, the position of P-CCPCH is known from the SCH.

Figure 14 is an example for transmission of SCH, k=0, of Case 2.




$b_i \in \{\pm 1, \pm j\}$, $C_{s,i} \in \{C_0, C_1, C_3, C_4, C_5, C_6, C_8, C_{10}, C_{12}, C_{13}, C_{14}, C_{15}\}$, i=1,2,3; see [8]

**Figure 14: Scheme for Synchronisation channel SCH consisting of one primary sequence $C_p$ and 3 parallel secondary sequences $C_{s,i}$ in slot k and k+8 (example for k=0 in Case 2)**

As depicted in figure 14, the SCH consists of a primary and three secondary code sequences each 256 chips long. The primary and secondary code sequences are defined in [8] clause 8 'Synchronisation codes for the 3.84 Mcps option'.

Due to mobile to mobile interference, it is mandatory for public TDD systems to keep synchronisation between base stations. As a consequence of this, a capture effect concerning SCH can arise. The time offset $t_{offset,n}$ enables the system to overcome the capture effect.

The time offset $t_{offset,n}$ is one of 32 values, depending on the code group of the cell, n, cf. 'table 6 Mapping scheme for Cell Parameters, Code Groups, Scrambling Codes, Midambles and $t_{offset}$' in [8]. Note that the cell parameter will change from frame to frame, cf. 'Table 7 Alignment of cell parameter cycling and system frame number' in [8], but the cell will belong to only one code group and thus have one time offset $t_{offset,n}$. The exact value for $t_{offset,n}$, regarding column 'Associated $t_{offset}$' in table 6 in [8] is given by:

$$t_{offset,n} = \begin{cases} n \cdot 48 \cdot T_c & n < 16 \\ (720 + n \cdot 48)T_c & n \geq 16 \end{cases}; \quad n = 0, ...., 31$$

## 5.3.5 Physical Uplink Shared Channel (PUSCH)

The USCH as desribed in subclause 4.1.2 is mapped onto one or more physical uplink shared channels (PUSCH). Timing advance, as described in [9], subclause 4.3, is applied to the PUSCH.

### 5.3.5.1 PUSCH Spreading

The spreading factors that can be applied to the PUSCH are SF = 1, 2, 4, 8, 16 as described in subclause 5.2.1.2.

#### 5.3.5.2 PUSCH Burst Types

Burst types 1, 2 or 3 as described in subclause 5.2.2 can be used for PUSCH. TFCI and TPC can be transmitted on the PUSCH.

#### 5.3.5.3 PUSCH Training Sequences

The training sequences as desribed in subclause 5.2.3 are used for the PUSCH.

#### 5.3.5.4 UE Selection

The UE that shall transmit on the PUSCH is selected by higher layer signalling.

### 5.3.6 Physical Downlink Shared Channel (PDSCH)

The DSCH as described in subclause 4.1.2 is mapped onto one or more physical downlink shared channels (PDSCH).

#### 5.3.6.1 PDSCH Spreading

The PDSCH uses either spreading factor SF = 16 or SF = 1 as described in subclause 5.2.1.1.

#### 5.3.6.2 PDSCH Burst Types

Burst types 1 or 2 as described in subclause 5.2.2 can be used for PDSCH. TFCI can be transmitted on the PDSCH.

#### 5.3.6.3 PDSCH Training Sequences

The training sequences as described in subclause 5.2.3 are used for the PDSCH.

#### 5.3.6.4 UE Selection

To indicate to the UE that there is data to decode on the DSCH, three signalling methods are available:

1) using the TFCI field of the associated channel or PDSCH;
2) using on the DSCH user specific midamble derived from the set of midambles used for that cell;
3) using higher layer signalling.

When the midamble based method is used, the UE specific midamble allocation method shall be employed (see subclause 5.6), and the UE shall decode the PDSCH if the PDSCH was transmitted with the midamble assigned to the UE by UTRAN. For this method no other physical channels may use the same time slot as the PDSCH and only one UE may share the PDSCH time slot within one TTI.

Note: From the above mentioned signalling methods, only the higher layer signalling method is supported by higher layers in this release.

### 5.3.7 The Paging Indicator Channel (PICH)

The Paging Indicator Channel (PICH) is a physical channel used to carry the paging indicators.

#### 5.3.7.1 Mapping of Paging Indicators to the PICH bits

Figure 15 depicts the structure of a PICH burst and the numbering of the bits within the burst. The same burst type is used for the PICH in every cell. $N_{PIB}$ bits in a normal burst of type 1 or 2 are used to carry the paging indicators, where $N_{PIB}$ depends on the burst type: $N_{PIB}$=240 for burst type 1 and $N_{PIB}$=272 for burst type 2. The bits $s_{NPIB+1}$,..., $s_{NPIB+4}$ adjacent to the midamble are reserved for possible future use.

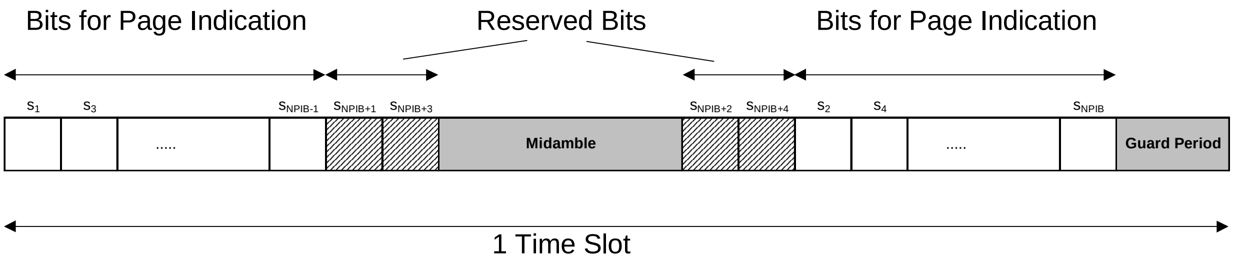



**Figure 15: Transmission and numbering of paging indicator carrying bits in a PICH burst**

Each paging indicator $P_q$ in one time slot is mapped to the bits $\{s_{2Lpi*q+1},...,s_{2Lpi*(q+1)}\}$ within this time slot. Thus, due to the interleaved transmission of the bits half of the symbols used for each paging indicator are transmitted in the first data part, and the other half of the symbols are transmitted in the second data part, as exemplary shown in figure 16 for a paging indicator length $L_{PI}$ of 4 symbols.

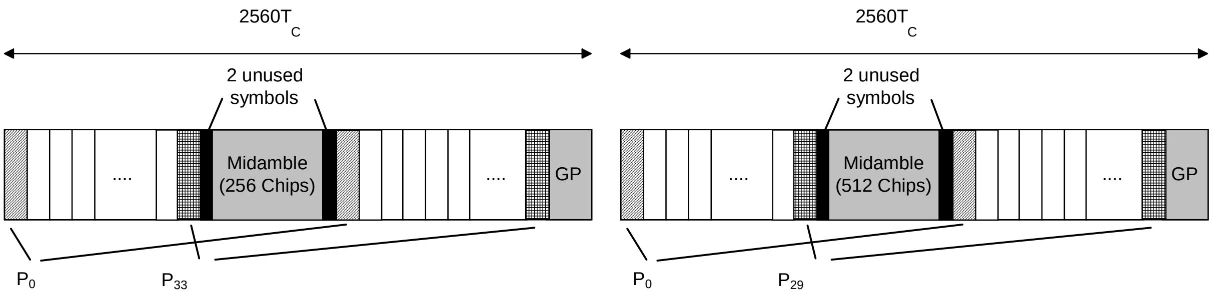



**Figure 16: Example of mapping of paging indicators on PICH bits for $L_{PI}$=4**

The setting of the paging indicators and the corresponding PICH bits (including the reserved ones) is described in [7].

$N_{PI}$ paging indicators of length $L_{PI}$=2, $L_{PI}$=4 or $L_{PI}$=8 symbols are transmitted in each radio frame that contains the PICH. The number of paging indicators $N_{PI}$ per radio frame is given by the paging indicator length and the burst type, which are both known by higher layer signalling. In table 7 this number is shown for the different possibilities of burst types and paging indicator lengths.

**Table 7: Number $N_{PI}$ of paging indicators per time slot for the different burst types and paging indicator lengths $L_{PI}$**

| | $L_{PI}$=2 | $L_{PI}$=4 | $L_{PI}$=8 |
|---|---|---|---|
| Burst Type 1 | $N_{PI}$=60 | $N_{PI}$=30 | $N_{PI}$=15 |
| Burst Type 2 | $N_{PI}$=68 | $N_{PI}$=34 | $N_{PI}$=17 |

### 5.3.7.2 Structure of the PICH over multiple radio frames

As shown in figure 17, the paging indicators of $N_{PICH}$ consecutive frames form a PICH block, $N_{PICH}$ is configured by higher layers. Thus, $N_P=N_{PICH}*N_{PI}$ paging indicators are transmitted in each PICH block.

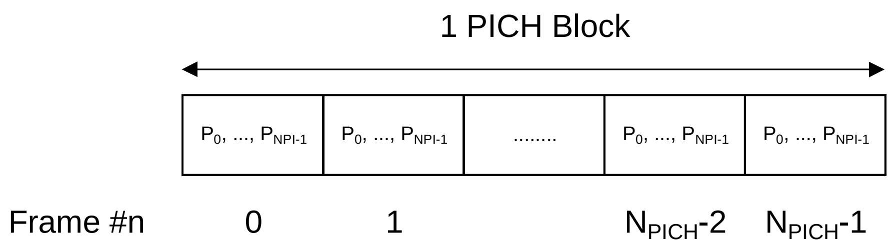



**Figure 17: Structure of a PICH block**

The value PI (PI = 0, ..., $N_P$-1) calculated by higher layers for use for a certain UE, see [15], is associated to the paging indicator $P_q$ in the nth frame of one PICH block, where q is given by

$$q = PI \bmod N_{PI}$$

and n is given by

$$n = PI \operatorname{div} N_{PI}.$$

The PI bitmap in the PCH data frames over Iub contains indication values for all possible higher layer PI values, see [17]. Each bit in the bitmap indicates if the paging indicator $P_q$ associated with that particular PI shall be set to 0 or 1. Hence, the calculation in the formulas above is to be performed in Node B to make the association between PI and $P_q$.

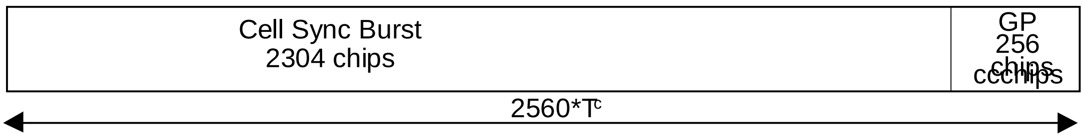
#### 5.3.7.3 PICH Training sequences

The training sequences, i.e. midambles for the PICH.are generated as described in subclause 5.2.3. The allocation of midambles depends on whether SCTD is applied to the PICH.

- If no antenna diversity is applied the PICH the midambles can be allocated as described in subclause 5.6.
- If SCTD antenna diversity is applied to the PICH the allocation of midambles shall be as described in [9].

### 5.3.8 The physical node B synchronisation channel (PNBSCH)

In case cell sync bursts are used for Node B synchronisation the PNBSCH shall be used for the transmission of the cell sync burst [8]. The PNBSCH shall be mapped on the same timeslot as the PRACH acc. to a higher layer schedule. The cell sync burst shall be transmitted at the beginning of a timeslot. In case of Node B synchronisation via the air interface the transmission of a RACH may be prohibited on higher layer command in specified frames and timeslots.




### 5.3.9 High Speed Physical Downlink Shared Channel (HS-PDSCH)

The HS-DSCH as desribed in subclause 4.1.2 is mapped onto one or more high speed physical downlink shared channels (HS-PDSCH).

#### 5.3.9.1 HS-PDSCH Spreading

The HS-PDSCH shall use either spreading factor SF = 16 or SF=1, as described in 5.2.1.1.

#### 5.3.9.2 HS-PDSCH Burst Types

Burst types 1 or 2 as described in subclause 5.2.2 can be used for PDSCH. TFCI shall not be transmitted on the HS-PDSCH. The TF of the HS-DSCH is derived from the associated HS-SCCH.

#### 5.3.9.3 HS-PDSCH Training Sequences

The training sequences as described in subclause 5.2.3 are used for the HS-PDSCH.

#### 5.3.9.4 UE Selection

To indicate to the UE that there is data to decode on the HS-DSCH, the UE id on the associated HS-SCCH shall be used.

#### 5.3.9.5 HS-PDSCH timeslot formats

An HS-PDSCH may use QPSK or 16QAM modulation symbols. The time slot formats are shown in table 7A~~8~~.

**Table 7A8: Time slot formats for the HS-PDSCH**

| Slot Format # | Spreading Factor | Midamble length (chips) | $N_{TFCI\ code\ word}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data\ field}$ (bits) |
|---|---|---|---|---|---|---|
| 0 (QPSK) | 16 | 512 | 0 | 244 | 244 | 122 |
| 1 (16QAM) | 16 | 512 | 0 | 488 | 488 | 244 |
| 2 (QPSK) | 16 | 256 | 0 | 276 | 276 | 138 |
| 3 (16QAM) | 16 | 256 | 0 | 552 | 552 | 276 |
| 4 (QPSK) | 1 | 512 | 0 | 3904 | 3904 | 1952 |
| 5 (16QAM) | 1 | 512 | 0 | 7808 | 7808 | 3904 |
| 6 (QPSK) | 1 | 256 | 0 | 4416 | 4416 | 2208 |
| 7(16QAM) | 1 | 256 | 0 | 8832 | 8832 | 4416 |

## 5.3.10 Shared Control Channel for HS-DSCH (HS-SCCH)

The HS-SCCH is a DL physical channel that carries higher layer control information for HS-DSCH. The physical layer will process this information according to [7] and will transmit the resulting bits on the HS-SCCH the structure of which is described below.

### 5.3.10.1 HS-SCCH Spreading

The HS-SCCH shall use spreading factor SF = 16, as described in 5.2.1.1.

### 5.3.10.2 HS-SCCH Burst Types

Burst type 1 as described in subclause 5.2.2 can be used for HS-SCCH. TFCI shall not be transmitted on the HS-SCCH.

### 5.3.10.3 HS-SCCH Training Sequences

The training sequences as described in subclause 5.2.3 are used for the HS-SCCH.

### 5.3.10.4 HS-SCCH timeslot formats

The HS-SCCH always uses time slot format #0 from table 5a, see section 5.2.2.6.1.

## 5.3.11 Shared Information Channel for HS-DSCH (HS-SICH)

The HS-SICH is a UL physical channel that carries higher layer control information and the Channel Quality Indicator CQI for HS-DSCH. The physical layer will process this information according to [7] and will transmit the resulting bits on the HS-SICH the structure of which is described below.

### 5.3.11.1 HS-SICH Spreading

The HS-SICH shall use spreading factor SF = 16, as described in 5.2.1.2.

### 5.3.11.2 HS-SICH Burst Types

Burst types 1 or 2 as described in subclause 5.2.2 can be used for HS-SICH. TFCI shall not be transmitted on the HS-SICH, however, the HS-SICH shall carry TPC information.

### 5.3.11.3 HS-SICH Training Sequences

The training sequences as described in subclause 5.2.3 are used for the HS-SICH.

#### 5.3.11.4 HS-SICH timeslot formats

The HS-SICH may use time slot format #1 or #7 from table 5b, see section 5.2.2.6.2.

## 5.4 Transmit Diversity for DL Physical Channels

Table 8~~9~~ summarizes the different transmit diversity schemes for different downlink physical channel types that are described in [9].

**Table 8~~9~~: Application of Tx diversity schemes on downlink physical channel types "X" – can be applied, "–" – must not be applied**

| Physical channel type | Open loop TxDiversity | | Closed loop TxDiversity |
|---|---|---|---|
| | TSTD | SCTD(*) | |
| P-CCPCH | – | X | – |
| S-CCPCH | -- | X | -- |
| SCH | X | – | – |
| DPCH | – | – | X |
| PDSCH | – | X | X |
| PICH | – | X | – |
| HS-SCCH | - | X | X |
| HS-PDSCH | - | X | X |

(*) Note: SCTD may only be applied to physical channels when they are allocated to beacon locations.

## 5.5 Beacon characteristics of physical channels

For the purpose of measurements, common physical channels that are allocated to particular locations (time slot, code) shall have particular physical characteristics, called beacon characteristics. Physical channels with beacon characteristics are called beacon channels. The locations of the beacon channels are called beacon locations. The ensemble of beacon channels shall provide the beacon function, i.e. a reference power level at the beacon locations, regularly existing in each radio frame. Thus, beacon channels must be present in each radio frame, the only exception is when idle periods are used to support time difference measurements for location services [9]. Then it may be possible that the beacon channels occur in the same frame and time slot as the idle periods. In this case, the beacon channels will not be transmitted in that particular frame and time slot.

### 5.5.1 Location of beacon channels

The beacon locations are determined by the SCH and depend on the SCH allocation case, see subclause 5.3.4:

Case 1) The beacon function shall be provided by the physical channels that are allocated to channelisation code $c_{Q=16}^{(k=1)}$ and to TS#k, k=0,…,14.

Case 2) The beacon function shall be provided by the physical channels that are allocated to channelisation code $c_{Q=16}^{(k=1)}$ and to TS#k and TS#k+8, k=0,…,6.

Note that by this definition the P-CCPCH always has beacon characteristics.

### 5.5.2 Physical characteristics of beacon channels

The beacon channels shall have the following physical characteristics. They:

- are transmitted with reference power;
- are transmitted without beamforming;
- use burst type 1;
- use midamble $m^{(1)}$ and $m^{(2)}$ exclusively in this time slot; and

- midambles $m^{(9)}$ and $m^{(10)}$ are always left unused in this time slot, if 16 midambles are allowed in that cell.

Note that in the time slot where the P-CCPCH is transmitted only the midambles $m^{(1)}$ to $m^{(8)}$ shall be used, see 5.6.1. Thus, midambles $m^{(9)}$ and $m^{(10)}$ are always left unused in this time slot.

The reference power corresponds to the sum of the power allocated to both midambles $m^{(1)}$ and $m^{(2)}$. Two possibilities exist:

- If SCTD antenna diversity is not applied to beacon channels all the reference power of any beacon channel is allocated to $m^{(1)}$.
- If SCTD antenna diversity is applied to beacon channels, for any beacon channel midambles $m^{(1)}$ and $m^{(2)}$ are each allocated half of the reference power.

# 5.6 Midamble Allocation for Physical Channels

Midambles are part of the physical channel configuration which is performed by higher layers. Three different midamble allocation schemes exist:

- UE specific midamble allocation: A UE specific midamble for DL or UL is explicitly assigned by higher layers.
- Default midamble allocation: The midamble for DL or UL is allocated by layer 1 depending on the associated channelisation code.
- Common midamble allocation: The midamble for the DL is allocated by layer 1 depending on the number of channelisation codes currently being present in the DL time slot.

If a midamble is not explicitly assigned and the use of the common midamble allocation scheme is not signalled by higher layers, the midamble shall be allocated by layer 1, based on the default midamble allocation scheme. This default midamble allocation scheme is given by a fixed association between midambles and channelisation codes, see clause A.3, and shall be applied individually to all channelisation codes within one time slot. Different associations apply for different burst types and cell configurations with respect to the maximum number of midambles.

## 5.6.1 Midamble Allocation for DL Physical Channels

Beacon channels shall always use the reserved midambles $m^{(1)}$ and $m^{(2)}$, see 5.5. For DL physical channels that are located in the same time slot as the P-CCPCH, midambles shall be allocated based on the default midamble allocation scheme, using the association for burst type 1 and $K_{Cell}$ =8 midambles. For all other DL physical channels, the midamble is explicitly assigned by higher layers or allocated by layer 1.

### 5.6.1.1 Midamble Allocation by signalling from higher layers

UE specific midambles may be signalled by higher layers to UE's as a part of the physical channel configuration, if:

- multiple UEs use the physical channels in one DL time slot; and
- beamforming is applied to all of these DL physical channels; and
- no closed loop TxDiversity is applied to any of these DL physical channels;

or

- PDSCH physical layer signalling based on the midamble is used.

### 5.6.1.2 Midamble Allocation by layer 1

#### 5.6.1.2.1 Default midamble

If a midamble is not explicitly assigned and the use of the common midamble allocation scheme is not signalled by higher layers, the UE shall derive the midambles from the allocated channelisation codes and shall use an individual midamble for each channelisation code group containing one primary and a set of secondary channelisation codes. The association between midambles and channelisation code groups is given in annex A.3. All the secondary channelisation codes within a set use the same midamble as the primary channelisation code to which they are associated.

Higher layers shall allocate the channelisation codes in a particular order. Secondary codes shall only be allocated if the associated primary code is also allocated. If midambles are reserved for the beacon channels, all primary and secondary channelisation codes that are associated with the reserved midambles shall not be used.

Channelisation codes of one channelisation code group shall not be allocated to different UE's.

In the case that secondary channelisation codes are used, secondary channelisation codes of one channelisation code group shall be allocated in ascending order, with respect to their numbering, and beginning with the lowest code index in this channelisation code group.

The UE shall assume different channel estimates for each of the individual midambles.

The default midamble allocation shall not apply for those downlink channels that are intended for a UE which will be the only UE assigned to a given time slot or slots for the duration of the assigned channel's existence (as in the case of high rate services).

#### 5.6.1.2.2 Common Midamble

The use of the common midamble allocation scheme is signalled to the UE by higher layers as a part of the physical channel configuration. A common midamble may be assigned by layer 1 to all physical channels in one DL time slot, if:

- a single UE uses all physical channels in one DL time slot (as in the case of high rate service);

or

- multiple UEs use the physical channels in one DL time slot; and
- no beamforming is applied to any of these DL physical channels; and
- no closed loop TxDiversity is applied to any of these DL physical channels; and
- midambles are not used for PDSCH physical layer signalling.

The number of channelisation codes currently employed in the DL time slot is associated with the use of a particular common midamble. Different associations apply for different burst types and cell configurations with respect to the maximum number of midambles, see annex B~~C~~.

### 5.6.2 Midamble Allocation for UL Physical Channels

If the midamble is explicitly assigned by higher layers, an individual midamble shall be assigned to all UE's in one UL time slot.

If no midamble is explicitly assigned by higher layers, the UE shall derive the midamble from the channelisation code that is used for the data part (except for TFCI/TPC) of the burst. The associations between midamble and channelisation code are the same as for DL physical channels.

## 5.7 Midamble Transmit Power

There shall be no offset between the sum of the powers allocated to all midambles in a timeslot and the sum of the powers allocated to the data symbol fields. The transmit power within a timeslot is hence constant.

The midamble transmit power of beacon channels is equal to the reference power. If SCTD is used for beacon channels, the reference power is equally divided between the midambles $m^{(1)}$ and $m^{(2)}$.

The midamble transmit power of all other physical channels depends on the midamble allocation scheme used. The following rules apply

- In case of Default Midamble Allocation, every midamble is transmitted with the same power as the associated codes.

- In case of Common Midamble Allocation in the downlink, the transmit power of this common midamble is such that there is no power offset between the data parts and the midamble part of the overall transmit signal within one time slot.

- In case of UE Specific Midamble Allocation, the transmit power of the UE specific midamble is such that there is no power offset between the data parts and the midamble part of every user within one time slot.

The following figure 18 depicts the midamble powers for the different channel types and midamble allocation schemes.

Note 1: In figure 18, the codes c(1) to c(16) represent the set of usable codes and not the set of used codes.

Note 2: The common midamble allocation and the midamble allocation by higher layers are not applicable in those beacon time slots, in which the P-CCPCH is located, see section 5.6.1.

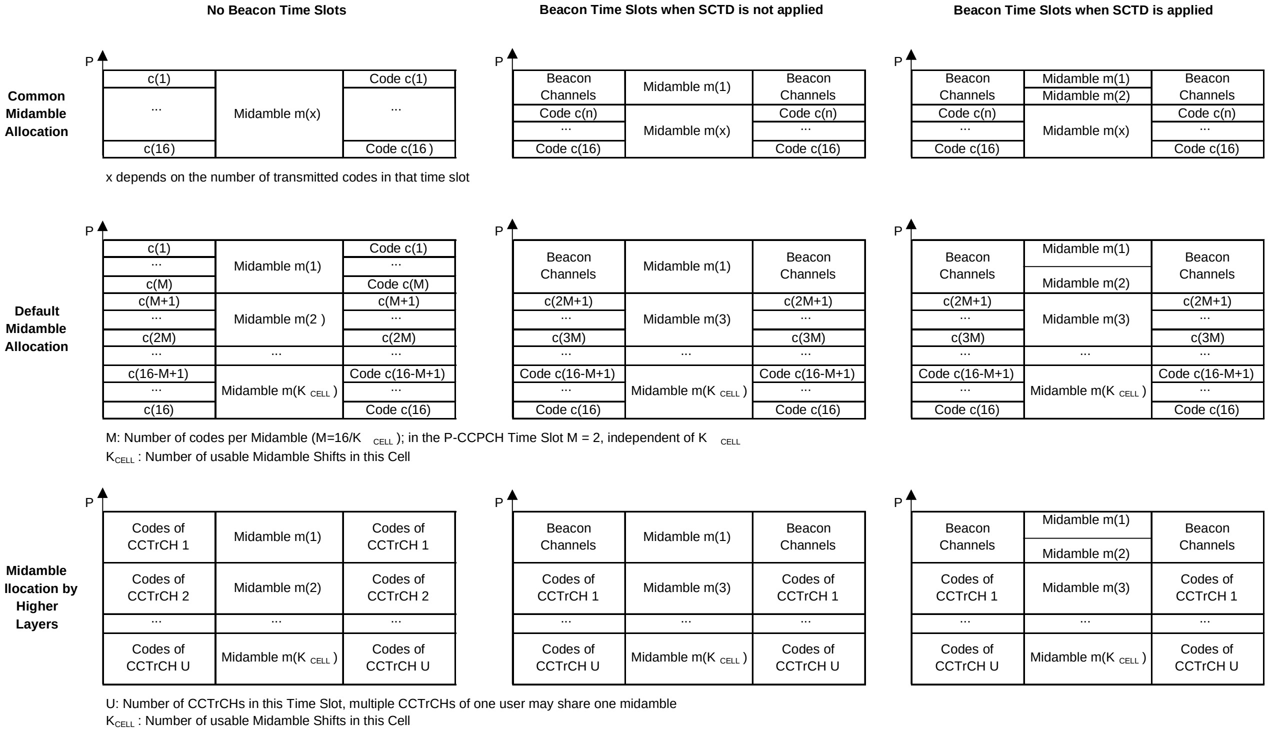



**Figure 18: Midamble powers for the different midamble allocation schemes**

# 5A~~6~~ Physical channels for the 1.28 Mcps option

All physical channels take three-layer structure with respect to timeslots, radio frames and system frame numbering (SFN), see [14]. Depending on the resource allocation, the configuration of radio frames or timeslots becomes different. All physical channels need guard symbols in every timeslot. The time slots are used in the sense of a TDMA component to separate different user signals in the time and the code domain. The physical channel signal format for 1.28Mcps TDD is presented in figure 18A~~19~~.

A physical channel in TDD is a burst, which is transmitted in a particular timeslot within allocated Radio Frames. The allocation can be continuous, i.e. the time slot in every frame is allocated to the physical channel or discontinuous, i.e. the time slot in a subset of all frames is allocated only. A burst is the combination of a data part, a midamble and a guard period. The duration of a burst is one time slot. Several bursts can be transmitted at the same time from one transmitter. In this case, the data part must use different OVSF channelisation codes, but the same scrambling code. The midamble part has to use the same basic midamble code, but can use different midambles.

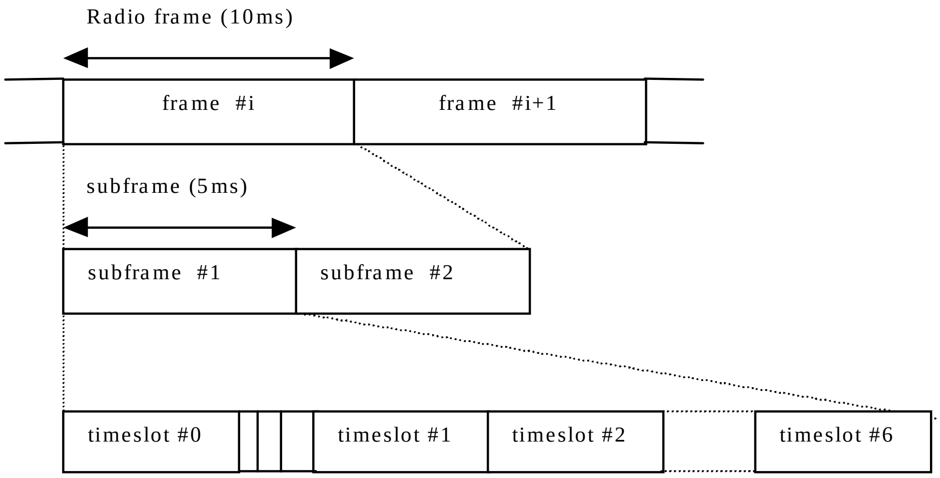



**Figure 18A19: Physical channel signal format for 1.28Mcps TDD option**

The data part of the burst is spread with a combination of channelisation code and scrambling code. The channelisation code is a OVSF code, that can have a spreading factor of 1, 2, 4, 8, or 16. The data rate of the physical channel is depending on the used spreading factor of the used OVSF code.

So a physical channel is defined by frequency, timeslot, channelisation code, burst type and Radio Frame allocation The scrambling code and the basic midamble code are broadcast and may be constant within a cell. When a physical channel is established, a start frame is given. The physical channels can either be of infinite duration, or a duration for the allocation can be defined.

## 5A6.1 Frame structure

The TDMA frame has a duration of 10 ms and is divided into 2 sub-frames of 5ms. The frame structure for each sub-frame in the 10ms frame length is the same.

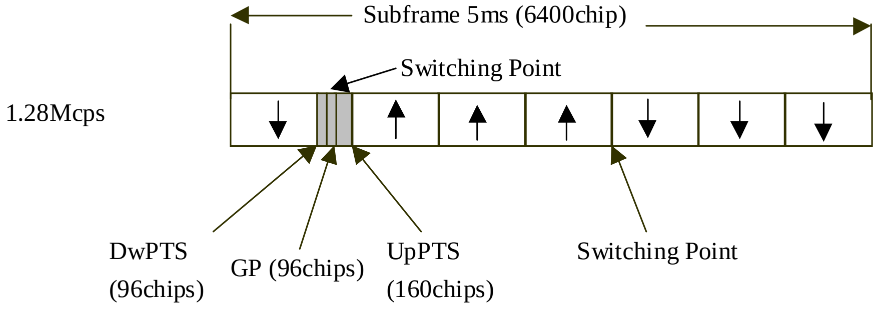



**Figure 18B20: Structure of the sub-frame for 1.28Mcps TDD option**

Time slot#n (n from 0 to 6): the n[th] traffic time slot, 864 chips duration;

DwPTS: downlink pilot time slot, 96 chips duration;

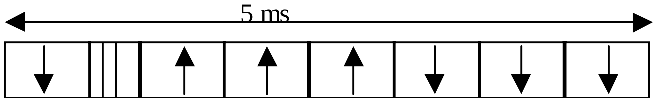
UpPTS: uplink pilot time slot, 160 chips duration;

GP: main guard period for TDD operation, 96 chips duration;

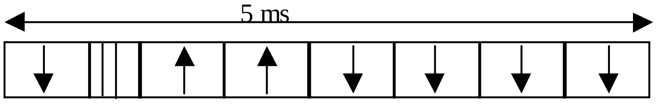
In Figure 18B20, the total number of traffic time slots for uplink and downlink is 7, and the length for each traffic time slot is 864 chips duration. Among the 7 traffic time slots, time slot#0 is always allocated as downlink while time slot#1 is always allocated as uplink. The time slots for the uplink and the downlink are separated by switching points. Between the downlink time slots and uplink time slots, the special period is the switching point to separate the uplink and downlink. In each sub-frame of 5ms for 1.28Mcps option, there are two switching points (uplink to downlink and vice versa).

Using the above frame structure, the 1.28Mcps TDD option can operate on both symmetric and asymmetric mode by properly configuring the number of downlink and uplink time slots. In any configuration at least one time slot (time slot#0) has to be allocated for the downlink and at least one time slot has to be allocated for the uplink (time slot#1).

Examples for symmetric and asymmetric UL/DL allocations are given in figure 18C~~21~~.




**symmetric DL/UL allocation**




**asymmetric DL/UL allocation**

**Figure 18C~~21~~: 1.28Mcps TDD sub-frame structure examples**

# 5A~~6~~.2 Dedicated physical channel (DPCH)

The DCH as described in subclause 4.1 'Dedicated transport channels' is mapped onto the dedicated physical channel.

## 5A~~6~~.2.1 Spreading

The spreading of physical channels is the same as in 3.84 Mcps TDD (cf. 5.2.1 'Spreading').

## 5A~~6~~.2.2 Burst Format

A traffic burst consists of two data symbol fields, a midamble of 144 chips and a guard period. The data fields of the burst are 352 chips long. The corresponding number of symbols depends on the spreading factor, as indicated in table 8A~~10~~ below. The guard period is 16 chip periods long.

The burst format is shown in Figure 18D~~22~~. The contents of the traffic burst fields is described in table 8B~~10~~.

**Table 8A~~10~~: number of symbols per data field in a traffic burst**

| Spreading factor (Q) | Number of symbols (N) per data field in Burst |
|---|---|
| 1 | 352 |
| 2 | 176 |
| 4 | 88 |
| 8 | 44 |
| 16 | 22 |

**Table 8B~~11~~: The contents of the traffic burst format fields**

| Chip number (CN) | Length of field in chips | Length of field in symbols | Contents of field |
|---|---|---|---|
| 0-351 | 352 | cf table 8A~~10~~ | Data symbols |
| 352-495 | 144 | - | Midamble |
| 496-847 | 352 | cf table 8A~~10~~ | Data symbols |
| 848-863 | 16 | - | Guard period |

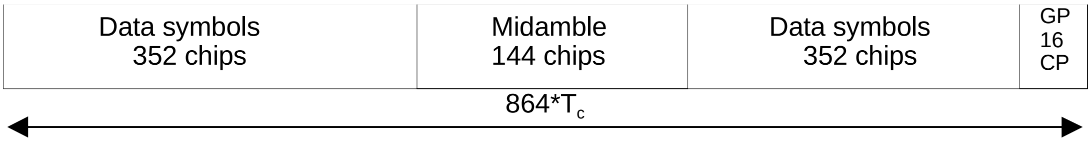



**Figure 18D~~22~~: Burst structure of the traffic burst format (GP denotes the guard period and CP the chip periods)**

### 5A~~6~~.2.2.1 Transmission of TFCI

The traffic burst format provides the possibility for transmission of TFCI in uplink and downlink.

The transmission of TFCI is configured by higher Layers. For each CCTrCH it is indicated by higher layer signalling, which TFCI format is applied. Additionally for each allocated timeslot it is signalled individually whether that timeslot carries the TFCI or not. The TFCI is always present in the first timeslot in a radio frame for each CCTrCH. If a time slot contains the TFCI, then it is always transmitted using the physical channel with the lowest physical channel sequence number (*p*) in that timeslot. Physical channel sequence numbering is determined by the rate matching function and is described in [7].

The transmission of TFCI is done in the data parts of the respective physical channel, this means that TFCI code word bits and data bits are subject to the same spreading procedure as depicted in [8]. Hence the midamble structure and length is not changed.

The TFCI code word bits are equally distributed between the two subframes and the respective data fields. The TFCI code word is to be transmitted possibly either directly adjacent to the midamble or after the SS and TPC symbols. Figure 18E~~23~~ shows the position of the TFCI code word in a traffic burst, if neither SS nor TPC are transmitted. Figure 18F~~24~~ shows the position of the TFCI code word in a traffic burst , if SS and TPC are transmitted.

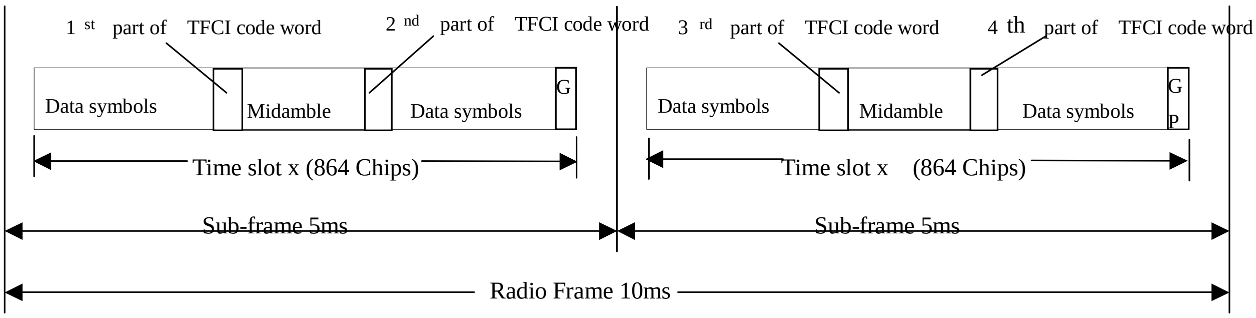



**Figure 18E~~23~~: Position of the TFCI code word in the traffic burst in case of no TPC and SS in 1.28 Mcps TDD**

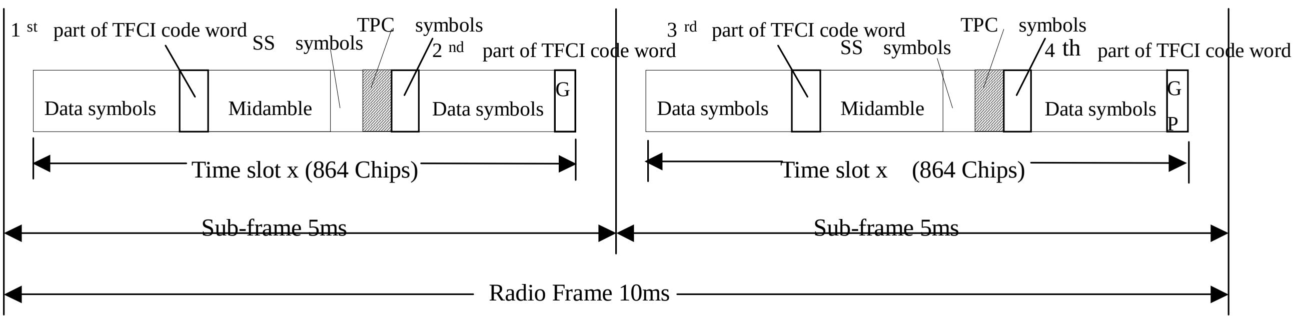



**Figure 18F~~24~~:Position of the TFCI code word in the traffic burst in case of TPC and SS in 1.28 Mcps TDD**

### 5A~~6~~.2.2.2 Transmission of TPC

The burst type for dedicated channels provides the possibility for transmission of TPC in uplink and downlink.

The transmission of TPC is done in the data parts of the traffic burst. Hence the midamble structure and length is not changed. The TPC information is to be transmitted directly after the SS information, which is transmitted after the midamble. Figure 18G25 shows the position of the TPC command in a traffic burst.

For every user the TPC information is to be transmitted at least once per 5ms sub-frame. For each allocated timeslot it is signalled individually whether that timeslot carries TPC information or not. If applied in a timeslot, transmission of TPC symbols is done in the data parts of the traffic burst and they are transmitted using the physical channel with the lowest physical channel sequence number (*p*) in that timeslot. Physical channel sequence numbering is determined by the rate matching function and is described in [7].

TPC symbols may also be transmitted on more than one physical channel in a time slot. For this purpose, higher layers allocate an additional number of $N_{TPC}$ physical channels, individually for each time slot. The TPC symbols shall then be transmitted using the physical channels with the $N_{TPC}+1$ lowest physical channel sequence numbers (*p*) in that time slot. Physical channel sequence numbering is determined by the rate matching function and is described in [7]. If the rate matching function results in $N_{RM} < N_{TPC}+1$ remaining physical channels in this time slot, TPC symbols shall be transmitted only on the $N_{RM}$ remaining physical channels.

The TPC symbols are spread with the same spreading factor (SF) and spreading code as the data parts of the respective physical channel.

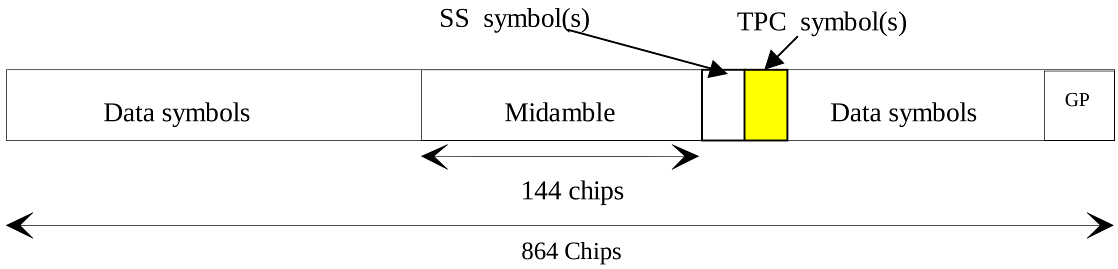



**Figure 18G25: Position of TPC information in the traffic burst in downlink and uplink**

For the number of TPC symbols per time slot there are 3 possibilities, that can be configured by higher layers, individually for each timeslot:

1) one TPC symbol
2) no TPC symbols
3) 16/SF TPC symbols

So, in case 3), when SF=1, there are 16 TPC symbols which correspond to 32 bits (for QPSK) and 48 bits (for 8PSK).

In the following the uplink is described only. For the description of the downlink, downlink (DL) and uplink (UL) have to be interchanged.

Each of the TPC symbols for uplink power control in the DL will be associated with an UL time slot and an UL CCTrCH pair. This association varies with

- the number of allocated UL time slots and UL CCTrCHs on these time slots (time slot and CCTrCH pair) and
- the allocated TPC symbols in the DL.

In case a UE has

- more than one channelisation code

and/or

- channelisation codes being of lower spreading factor than 16 and using 16/SF SS and 16/SF TPC symbols,

the TPC commands for each ULtime slot CCTrCH pair (all channelisation codes on that time slot belonging to the same time slot and CCTrCH pair have the same TPC command) will be distributed to the following rules:

1. The ULtime slots and CCTrCH pairs the TPC commands are intended for will be numbered from the first to the last ULtime slot and CCTrCH pair allocated to the regarded UE (starting with 0). The number of a time slot and

CCTrCH pair is smaller then the number of another time slot and CCTrCH pair within the same time slot if its spreading code with the lowest SC number according to the following table has a lower SC number then the spreading code with the lowest SC number of the other time slot and CCTrCH pair.

2. The commanding TPC symbols on all DL CCTrCHs allocated to one UE are numbered consecutively starting with zero according to the following rules:

   a) The numbers of the TPC commands of a regarded DL time slot are lower than those of DL time slots being transmitted after that time slot

   b) Within a DL time slot the numbers of the TPC commands of a regarded channelisation code are lower than those of channelisation codes having a higher spreading code number

   The spreading code number is defined by the following table (see[8]):

| SC number | SF (Q) | Walsh code number (k) |
|---|---|---|
| 0 | 16 | $\mathbf{c}_{Q=16}^{(k=1)}$ |
| | ... | |
| 15 | 16 | $\mathbf{c}_{Q=16}^{(k=16)}$ |
| 16 | 8 | $\mathbf{c}_{Q=8}^{(k=1)}$ |
| | … | |
| 23 | 8 | $\mathbf{c}_{Q=8}^{(k=8)}$ |
| 24 | 4 | $\mathbf{c}_{Q=4}^{(k=1)}$ |
| | … | |
| 27 | 4 | $\mathbf{c}_{Q=4}^{(k=4)}$ |
| 28 | 2 | $\mathbf{c}_{Q=2}^{(k=1)}$ |
| 29 | 2 | $\mathbf{c}_{Q=2}^{(k=2)}$ |
| 30 | 1 | $\mathbf{c}_{Q=1}^{(k=1)}$ |

Note: Spreading factors 2-8 are not used in DL

   c) Within a channelisation code numbers of the TPC commands are lower than those of TPC commands being transmitted after that time

The following equation is used to determine the UL time slot which is controlled by the regarded TPC symbol in the DL:

$$UL_{pos} = \left(SFN' \cdot N_{UL\_TPCsymbols} + TPC_{DLpos} + \left(\left(SFN' \cdot N_{UL\_TPCsymbols} + TPC_{DLpos}\right)\mathrm{div}\left(N_{ULslot}\right)\right)\right)\mathrm{mod}\left(N_{ULslot}\right),$$

where

$UL_{pos}$ is the number of the controlled uplink time slot and CCTrCH pairs.

SFN' is the system frame number counting the sub-frames. The system frame number of the radio frames (SFN) can be derived from SFN' by

SFN=SFN' div 2, where div is the remainder free division operation.

$N_{UL\_PCsymbols}$ is the number of UL TPC symbols in a sub-frame.

$TPC_{DLpos}$ is the number of the regarded UL TPC symbol in the DL within the sub-frame.

$N_{ULslot}$ is the number of UL slots and CCTrCH pairs in a frame.

When one of the above parameters is changed due to higher layer reconfiguration, the new relationship between TPC symbols and controlled UL time slots shall be valid, beginning with the radio frame, for which the new parameters are set.

In Annex CBG two examples of the association of TPC commands to time slots and CCTrCH pairs are shown.

Coding of TPC:

The relationship between the TPC Bits and the transmitter power control command for QPSK is the same as in the 3.84Mcps TDD cf. [5.2.2.5 'Transmission of TPC'].

The relationship between the TPC Bits and the transmitter power control command for 8PSK is given in table 8C12

**Table 8C12: TPC Bit Pattern for 8PSK**

| TPC Bits | TPC command | Meaning |
|---|---|---|
| 000 | 'Down' | Decrease Tx Power |
| 110 | 'Up' | Increase Tx Power |

#### 5A6.2.2.3 Transmission of SS

The burst type for dedicated channels provides the possibility for transmission of uplink synchronisation control (ULSC).

The transmission of ULSC is done in the data parts of the traffic burst. Hence the midamble structure and length is not changed. The ULSC information is to be transmitted directly after the midamble. Figure 18H26 shows the position of the SS command in a traffic burst.

For every user the ULSC information shall be transmitted at least once per transmitted sub-frame.

For each allocated timeslot it is signalled individually whether that timeslot carries ULSC information or not. If applied in a time slot, transmission of SS symbols is done in the data parts of the traffic burst and they are transmitted using the physical channel with the lowest physical channel sequence number (*p*) in that timeslot. Physical channel sequence numbering is determined by the rate matching function and is described in [7].

SS symbols may also be transmitted on more than one physical channel in a time slot. For this purpose, higher layers allocate an additional number of $N_{SS}$ physical channels, individually for each time slot. The SS symbols shall then be transmitted using the physical channels with the $N_{SS}+1$ lowest physical channel sequence numbers (*p*) in that time slot. Physical channel sequence numbering is determined by the rate matching function and is described in [7]. If the rate matching function results in $N_{RM} < N_{SS}+1$ remaining physical channels in this time slot, SS symbols shall be transmitted only on the $N_{RM}$ remaining physical channels.

The SS symbols are spread with the same spreading factor (SF) and spreading code as the data parts of the respective physical channel.

The SS is utilised to command a timing adjustment by (k/8) Tc each M sub-frames, where Tc is the chip period. The k and M values are signalled by the network. The SS, as one of L1 signals, is to be transmitted once per 5ms sub-frame.

M (1-8) and k (1-8) can be adjusted during call setup or readjusted during the call.

Note: The smallest step for the SS signalled by the UTRAN is 1/8 Tc. For the UE capabilities regarding the SS adjustment of the UE it is suggested to set the tolerance for the executed command to be [1/9;1/7] Tc.

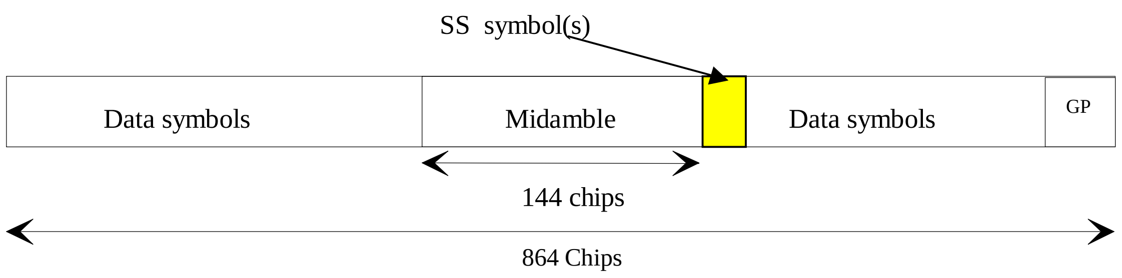



**Figure 18H26: Position of ULSC information in the traffic burst (downlink and uplink)**

Note that for the uplink where there is no SS symbol used, the SS symbol space is reserved for future use. This can keep UL and DL slots the same structure.

For the number of SS symbols per time slot there are 3 possibilities, that cn be configured by higher layers individually for each time slot:

- one SS symbol
- no SS symbol
- 16/SF SS symbols

So, in case 3, when SF=1, there are 16 SS symbols which correspond to 32 bits (for QPSK) and 48 bits (for 8PSK).

Each of the SS symbols in the DL will be associated with an UL time slot depending on the allocated UL time slots and the allocated SS symbols in the DL.

Note: Even though the different time slots of the UE are controlled with independent SS commands, the UE is not in need to execute SS commands leading to a deviation of more than [3] chip with respect to the average timing advance applied by the UE.

The synchronisation shift commands for each UL time slot (all channelisation codes on that time slot have the same SS command) will be distributed to the following rules:

1. The UL time slots the SS commands are intended for will be numbered from the first to the last UL time slot occupied by the regarded UE (starting with 0) considering all CCTrCHs allocated to that UE.

2. The commanding SS symbols on all downlink CCTrCHs allocated to one UE are numbered consecutively starting with zero according to the following rules:

   a) The numbers of the SS commands of a regarded DL time slot are lower than those of DL time slots being transmitted after that time slot

   b) Within a DL time slot the numbers of the SS commands of a regarded channelisation code are lower than those of channelisation codes having a bigger spreading code number

   The spreading code number is defined by the following table: (see TS 25.223)

| Spreading code number | SF (Q) | Walsh code number (k) |
|---|---|---|
| 0 | 16 | $\mathbf{c}_{Q=16}^{(k=1)}$ |
| | ... | |
| 15 | 16 | $\mathbf{c}_{Q=16}^{(k=16)}$ |
| | Spreading factors 2-8 are nor used in DL | |
| 30 | 1 | $\mathbf{c}_{Q=1}^{(k=1)}$ |

c) Within a channelisation code numbers of the SS commands are lower than those of SS commands being transmitted after that time

The following equation is used to determine the UL time slot which is controlled by the regarded SS symbol:

$$UL_{pos} = \left(SFN' \cdot N_{SSsymbols} + SS_{pos} + \left(\left(SFN' \cdot N_{SSsymbols} + SS_{pos}\right) \operatorname{div}\left(N_{ULslot}\right)\right)\right) \operatorname{mod}\left(N_{ULslot}\right),$$

where

$UL_{pos}$ is the number of the controlled uplink time slot.

SFN' is the system frame number counting the sub-frames. The system frame number of the radio frames (SFN) can be derived from SFN' by

SFN=SFN' div 2, where div is the remainder free division operation.

$N_{SSsymbols}$ is the number of SS symbols in a frame.

$SS_{pos}$ is the number of the regarded SS symbol within the sub-frame.

$N_{ULslot}$ is the number of UL slots in a frame.

When one of the above parameters is changed due to higher layer reconfiguration, the new relationship between SS symbols and controlled UL time slots shall be valid, beginning with the radio frame, for which the new parameters are set.

The relationship between the SS Bits and the SS command for QPSK is the given in table 8D13:

**Table 8D13: Coding of the SS for QPSK**

| SS Bits | SS command | Meaning |
|---|---|---|
| 00 | 'Down' | Decrease synchronisation shift by k/8 Tc |
| 11 | 'Up' | Increase synchronisation shift by k/8 Tc |
| 01 | 'Do nothing' | No change |

The relationship between the SS Bits and the SS command for 8PSK is given in table 8E14:

**Table 8E14: Coding of the SS for 8PSK**

| SS Bits | SS command | Meaning |
|---|---|---|
| 000 | 'Down' | Decrease synchronisation shift by k/8 Tc |
| 110 | 'Up' | Increase synchronisation shift by k/8 Tc |
| 011 | 'Do nothing' | No change |

#### 5A6.2.2.4 Timeslot formats

The timeslot format depends on the spreading factor, the number of the TFCI code word bits, the number of SS and TPC symbols and the applied modulation scheme (QPSK/8PSK) as depicted in the following tables.

#### 5A~~6~~.2.2.4.1 Timeslot formats for QPSK

##### 5A~~6~~.2.2.4.1.1 Downlink timeslot formats

**Table 8F~~15~~ : Time slot formats for the Downlink**

| Slot Format # | Spreading Factor | Midamble length (chips) | $N_{TFCI}$ code word (bits) | $N_{SS}$ & $N_{TPC}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data\ field(1)}$ (bits) | $N_{data/data\ field(2)}$ (bits) |
|---|---|---|---|---|---|---|---|---|
| 0 | 16 | 144 | 0 | 0 & 0 | 88 | 88 | 44 | 44 |
| 1 | 16 | 144 | 4 | 0 & 0 | 88 | 86 | 42 | 44 |
| 2 | 16 | 144 | 8 | 0 & 0 | 88 | 84 | 42 | 42 |
| 3 | 16 | 144 | 16 | 0 & 0 | 88 | 80 | 40 | 40 |
| 4 | 16 | 144 | 32 | 0 & 0 | 88 | 72 | 36 | 36 |
| 5 | 16 | 144 | 0 | 2 & 2 | 88 | 84 | 44 | 40 |
| 6 | 16 | 144 | 4 | 2 & 2 | 88 | 82 | 42 | 40 |
| 7 | 16 | 144 | 8 | 2 & 2 | 88 | 80 | 42 | 38 |
| 8 | 16 | 144 | 16 | 2 & 2 | 88 | 76 | 40 | 36 |
| 9 | 16 | 144 | 32 | 2 & 2 | 88 | 68 | 36 | 32 |
| 10 | 1 | 144 | 0 | 0 & 0 | 1408 | 1408 | 704 | 704 |
| 11 | 1 | 144 | 4 | 0 & 0 | 1408 | 1406 | 702 | 704 |
| 12 | 1 | 144 | 8 | 0 & 0 | 1408 | 1404 | 702 | 702 |
| 13 | 1 | 144 | 16 | 0 & 0 | 1408 | 1400 | 700 | 700 |
| 14 | 1 | 144 | 32 | 0 & 0 | 1408 | 1392 | 696 | 696 |
| 15 | 1 | 144 | 0 | 2 & 2 | 1408 | 1404 | 704 | 700 |
| 16 | 1 | 144 | 4 | 2 & 2 | 1408 | 1402 | 702 | 700 |
| 17 | 1 | 144 | 8 | 2 & 2 | 1408 | 1400 | 702 | 698 |
| 18 | 1 | 144 | 16 | 2 & 2 | 1408 | 1396 | 700 | 696 |
| 19 | 1 | 144 | 32 | 2 & 2 | 1408 | 1388 | 696 | 692 |
| 20 | 1 | 144 | 0 | 32 & 32 | 1408 | 1344 | 704 | 640 |
| 21 | 1 | 144 | 4 | 32 & 32 | 1408 | 1342 | 702 | 640 |
| 22 | 1 | 144 | 8 | 32 & 32 | 1408 | 1340 | 702 | 638 |
| 23 | 1 | 144 | 16 | 32 & 32 | 1408 | 1336 | 700 | 636 |
| 24 | 1 | 144 | 32 | 32 & 32 | 1408 | 1328 | 696 | 632 |

#### 5A~~6~~.2.2.4.1.2 Uplink timeslot formats

**Table 8G~~16~~ : Time slot formats for the Uplink**

| Slot Format # | Spreading Factor | Midamble length (chips) | $N_{TFCI}$ code word (bits) | $N_{SS}$ & $N_{TPC}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data\ field(1)}$ (bits) | $N_{data/data\ field(2)}$ (bits) |
|---|---|---|---|---|---|---|---|---|
| 0 | 16 | 144 | 0 | 0 & 0 | 88 | 88 | 44 | 44 |
| 1 | 16 | 144 | 4 | 0 & 0 | 88 | 86 | 42 | 44 |
| 2 | 16 | 144 | 8 | 0 & 0 | 88 | 84 | 42 | 42 |
| 3 | 16 | 144 | 16 | 0 & 0 | 88 | 80 | 40 | 40 |
| 4 | 16 | 144 | 32 | 0 & 0 | 88 | 72 | 36 | 36 |
| 5 | 16 | 144 | 0 | 2 & 2 | 88 | 84 | 44 | 40 |
| 6 | 16 | 144 | 4 | 2 & 2 | 88 | 82 | 42 | 40 |
| 7 | 16 | 144 | 8 | 2 & 2 | 88 | 80 | 42 | 38 |
| 8 | 16 | 144 | 16 | 2 & 2 | 88 | 76 | 40 | 36 |
| 9 | 16 | 144 | 32 | 2 & 2 | 88 | 68 | 36 | 32 |
| 10 | 8 | 144 | 0 | 0 & 0 | 176 | 176 | 88 | 88 |
| 11 | 8 | 144 | 4 | 0 & 0 | 176 | 174 | 86 | 88 |
| 12 | 8 | 144 | 8 | 0 & 0 | 176 | 172 | 86 | 86 |
| 13 | 8 | 144 | 16 | 0 & 0 | 176 | 168 | 84 | 84 |
| 14 | 8 | 144 | 32 | 0 & 0 | 176 | 160 | 80 | 80 |
| 15 | 8 | 144 | 0 | 2 & 2 | 176 | 172 | 88 | 84 |
| 16 | 8 | 144 | 4 | 2 & 2 | 176 | 170 | 86 | 84 |
| 17 | 8 | 144 | 8 | 2 & 2 | 176 | 168 | 86 | 82 |
| 18 | 8 | 144 | 16 | 2 & 2 | 176 | 164 | 84 | 80 |
| 19 | 8 | 144 | 32 | 2 & 2 | 176 | 156 | 80 | 76 |
| 20 | 8 | 144 | 0 | 4 & 4 | 176 | 168 | 88 | 80 |
| 21 | 8 | 144 | 4 | 4 & 4 | 176 | 166 | 86 | 80 |
| 22 | 8 | 144 | 8 | 4 & 4 | 176 | 164 | 86 | 78 |
| 23 | 8 | 144 | 16 | 4 & 4 | 176 | 160 | 84 | 76 |
| 24 | 8 | 144 | 32 | 4 & 4 | 176 | 152 | 80 | 72 |
| 25 | 4 | 144 | 0 | 0 & 0 | 352 | 352 | 176 | 176 |
| 26 | 4 | 144 | 4 | 0 & 0 | 352 | 350 | 174 | 176 |
| 27 | 4 | 144 | 8 | 0 & 0 | 352 | 348 | 174 | 174 |
| 28 | 4 | 144 | 16 | 0 & 0 | 352 | 344 | 172 | 172 |
| 29 | 4 | 144 | 32 | 0 & 0 | 352 | 336 | 168 | 168 |
| 30 | 4 | 144 | 0 | 2 & 2 | 352 | 348 | 176 | 172 |
| 31 | 4 | 144 | 4 | 2 & 2 | 352 | 346 | 174 | 172 |
| 32 | 4 | 144 | 8 | 2 & 2 | 352 | 344 | 174 | 170 |
| 33 | 4 | 144 | 16 | 2 & 2 | 352 | 340 | 172 | 168 |
| 34 | 4 | 144 | 32 | 2 & 2 | 352 | 332 | 168 | 164 |
| 35 | 4 | 144 | 0 | 8 & 8 | 352 | 336 | 176 | 160 |
| 36 | 4 | 144 | 4 | 8 & 8 | 352 | 334 | 174 | 160 |
| 37 | 4 | 144 | 8 | 8 & 8 | 352 | 332 | 174 | 158 |
| 38 | 4 | 144 | 16 | 8 & 8 | 352 | 328 | 172 | 156 |
| 39 | 4 | 144 | 32 | 8 & 8 | 352 | 320 | 168 | 152 |
| 40 | 2 | 144 | 0 | 0 & 0 | 704 | 704 | 352 | 352 |
| 41 | 2 | 144 | 4 | 0 & 0 | 704 | 702 | 350 | 352 |
| 42 | 2 | 144 | 8 | 0 & 0 | 704 | 700 | 350 | 350 |
| 43 | 2 | 144 | 16 | 0 & 0 | 704 | 696 | 348 | 348 |
| 44 | 2 | 144 | 32 | 0 & 0 | 704 | 688 | 344 | 344 |
| 45 | 2 | 144 | 0 | 2 & 2 | 704 | 700 | 352 | 348 |
| 46 | 2 | 144 | 4 | 2 & 2 | 704 | 698 | 350 | 348 |

| Slot Format # | Spreading Factor | Midamble length (chips) | $N_{TFCI}$ code word (bits) | $N_{SS}$ & $N_{TPC}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data field(1)}$ (bits) | $N_{data/data field(2)}$ (bits) |
|---|---|---|---|---|---|---|---|---|
| 47 | 2 | 144 | 8 | 2 & 2 | 704 | 696 | 350 | 346 |
| 48 | 2 | 144 | 16 | 2 & 2 | 704 | 692 | 348 | 344 |
| 49 | 2 | 144 | 32 | 2 & 2 | 704 | 684 | 344 | 340 |
| 50 | 2 | 144 | 0 | 16 & 16 | 704 | 672 | 352 | 320 |
| 51 | 2 | 144 | 4 | 16 & 16 | 704 | 670 | 350 | 320 |
| 52 | 2 | 144 | 8 | 16 & 16 | 704 | 668 | 350 | 318 |
| 53 | 2 | 144 | 16 | 16 & 16 | 704 | 664 | 348 | 316 |
| 54 | 2 | 144 | 32 | 16 & 16 | 704 | 656 | 344 | 312 |
| 55 | 1 | 144 | 0 | 0 & 0 | 1408 | 1408 | 704 | 704 |
| 56 | 1 | 144 | 4 | 0 & 0 | 1408 | 1406 | 702 | 704 |
| 57 | 1 | 144 | 8 | 0 & 0 | 1408 | 1404 | 702 | 702 |
| 58 | 1 | 144 | 16 | 0 & 0 | 1408 | 1400 | 700 | 700 |
| 59 | 1 | 144 | 32 | 0 & 0 | 1408 | 1392 | 696 | 696 |
| 60 | 1 | 144 | 0 | 2 & 2 | 1408 | 1404 | 704 | 700 |
| 61 | 1 | 144 | 4 | 2 & 2 | 1408 | 1402 | 702 | 700 |
| 62 | 1 | 144 | 8 | 2 & 2 | 1408 | 1400 | 702 | 698 |
| 63 | 1 | 144 | 16 | 2 & 2 | 1408 | 1396 | 700 | 696 |
| 64 | 1 | 144 | 32 | 2 & 2 | 1408 | 1388 | 696 | 692 |
| 65 | 1 | 144 | 0 | 32 & 32 | 1408 | 1344 | 704 | 640 |
| 66 | 1 | 144 | 4 | 32 & 32 | 1408 | 1342 | 702 | 640 |
| 67 | 1 | 144 | 8 | 32 & 32 | 1408 | 1340 | 702 | 638 |
| 68 | 1 | 144 | 16 | 32 & 32 | 1408 | 1336 | 700 | 636 |
| 69 | 1 | 144 | 32 | 32 & 32 | 1408 | 1328 | 696 | 632 |

#### 5A6.2.2.4.2 Time slot formats for 8PSK

The Downlink and the Uplink timeslot formats are described together in the following table.

**Table 8H17: Timeslot formats for 8PSK modulation**

| Slot Format # | Spreading Factor | Midamble length (chips) | $N_{TFCI}$ code word (bits) | $N_{SS}$ & $N_{TPC}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data\ field(1)}$ (bits) | $N_{data/data\ field(2)}$ (bits) |
|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 144 | 0 | 0 & 0 | 2112 | 2112 | 1056 | 1056 |
| 1 | 1 | 144 | 6 | 0 & 0 | 2112 | 2109 | 1053 | 1056 |
| 2 | 1 | 144 | 12 | 0 & 0 | 2112 | 2106 | 1053 | 1053 |
| 3 | 1 | 144 | 24 | 0 & 0 | 2112 | 2100 | 1050 | 1050 |
| 4 | 1 | 144 | 48 | 0 & 0 | 2112 | 2088 | 1044 | 1044 |
| 5 | 1 | 144 | 0 | 3 & 3 | 2112 | 2106 | 1056 | 1050 |
| 6 | 1 | 144 | 6 | 3 & 3 | 2112 | 2103 | 1053 | 1050 |
| 7 | 1 | 144 | 12 | 3 & 3 | 2112 | 2100 | 1053 | 1047 |
| 8 | 1 | 144 | 24 | 3 & 3 | 2112 | 2094 | 1050 | 1044 |
| 9 | 1 | 144 | 48 | 3 & 3 | 2112 | 2082 | 1044 | 1038 |
| 10 | 1 | 144 | 0 | 48 & 48 | 2112 | 2016 | 1056 | 960 |
| 11 | 1 | 144 | 6 | 48 & 48 | 2112 | 2013 | 1053 | 960 |
| 12 | 1 | 144 | 12 | 48 & 48 | 2112 | 2010 | 1053 | 957 |
| 13 | 1 | 144 | 24 | 48 & 48 | 2112 | 2004 | 1050 | 954 |
| 14 | 1 | 144 | 48 | 48 & 48 | 2112 | 1992 | 1044 | 948 |
| 15 | 16 | 144 | 0 | 0 & 0 | 132 | 132 | 66 | 66 |
| 16 | 16 | 144 | 6 | 0 & 0 | 132 | 129 | 63 | 66 |
| 17 | 16 | 144 | 12 | 0 & 0 | 132 | 126 | 63 | 63 |
| 18 | 16 | 144 | 24 | 0 & 0 | 132 | 120 | 60 | 60 |
| 19 | 16 | 144 | 48 | 0 & 0 | 132 | 108 | 54 | 54 |
| 20 | 16 | 144 | 0 | 3 & 3 | 132 | 126 | 66 | 60 |
| 21 | 16 | 144 | 6 | 3 & 3 | 132 | 123 | 63 | 60 |
| 22 | 16 | 144 | 12 | 3 & 3 | 132 | 120 | 63 | 57 |
| 23 | 16 | 144 | 24 | 3 & 3 | 132 | 114 | 60 | 54 |
| 24 | 16 | 144 | 48 | 3 & 3 | 132 | 102 | 54 | 48 |

### 5A6.2.3 Training sequences for spread bursts

In this subclause, the training sequences for usage as midambles are defined. The training sequences, i.e. midambles, of different users active in the same cell and same time slot are cyclically shifted versions of one single basic midamble code. The applicable basic midamble codes are given in Annex AAB.1.

The basic midamble codes in Annex AAB.1 are listed in hexadecimal notation. The binary form of the basic midamble code shall be derived according to table 8I18 below.

**Table 8l~~18~~: Mapping of 4 binary elements $m_i$ on a single hexadecimal digit:**

| 4 binary elements $m_i$ | Mapped on hexadecimal digit |
|---|---|
| -1 -1 -1 -1 | 0 |
| -1 -1 -1 1 | 1 |
| -1 -1 1 –1 | 2 |
| -1 -1 1 1 | 3 |
| -1 1 -1 –1 | 4 |
| -1 1 -1 1 | 5 |
| -1 1 1 –1 | 6 |
| -1 1 1 1 | 7 |
| 1 -1 -1 –1 | 8 |
| 1 -1 -1 1 | 9 |
| 1 -1 1 –1 | A |
| 1 -1 1 1 | B |
| 1 1 -1 –1 | C |
| 1 1 -1 1 | D |
| 1 1 1 –1 | E |
| 1 1 1 1 | F |

For each particular basic midamble code, its binary representation can be written as a vector $\mathbf{m}_P$ :

$$\mathbf{m}_P = (m_1, m_2, ..., m_P) \quad (1)$$

According to Annex AA~~B~~.1, the size of this vector $\mathbf{m}_P$ is P=128. As QPSK modulation is used, the training sequences are transformed into a complex form, denoted as the complex vector $\underline{\mathbf{m}}_P$ :

$$\underline{\mathbf{m}}_P = (\underline{m}_1, \underline{m}_2, ..., \underline{m}_P) \quad (2)$$

The elements $\underline{m}_i$ of $\underline{\mathbf{m}}_P$ are derived from elements $m_i$ of $\mathbf{m}_P$ using equation (3):

$$\underline{m}_i = (\mathrm{j})^i \cdot m_i \text{ for all } i = 1, ..., P \quad (3)$$

Hence, the elements $\underline{m}_i$ of the complex basic midamble code are alternating real and imaginary.

To derive the required training sequences, this vector $\underline{\mathbf{m}}_P$ is periodically extended to the size:

$$i_{\max} = L_m + (K-1)W \quad (4)$$

Notes on equation (4):

K and W are taken from Annex AA~~B~~.1

So we obtain a new vector $\underline{\mathbf{m}}$ containing the periodic basic midamble sequence:

$$\underline{\mathbf{m}} = (\underline{m}_1, \underline{m}_2, ..., \underline{m}_{i_{\max}}) = (\underline{m}_1, \underline{m}_2, ..., \underline{m}_{L_m+(K-1)W}) \quad (5)$$

The first P elements of this vector $\underline{\mathbf{m}}$ are the same ones as in vector $\underline{\mathbf{m}}_P$ , the following elements repeat the beginning:

$$\underline{m}_i = \underline{m}_{i-P} \text{ for the subset } i = (P+1), ..., i_{\max} \quad (6)$$

Using this periodic basic midamble sequence $\underline{\mathbf{m}}$ for each user k a midamble $\underline{\mathbf{m}}^{(k)}$ of length $L_m$ is derived, which can be written as a user specific vector:

$$\underline{\mathbf{m}}^{(k)} = (\underline{m}_1^{(k)}, \underline{m}_2^{(k)}, ..., \underline{m}_{L_m}^{(k)}) \quad (7)$$

The $L_m$ midamble elements $\underline{m}_i^{(k)}$ are generated for each midamble of the k users (k = 1,...,K) based on:

$$\underline{m}_i^{(k)} = \underline{m}_{i+(K-k)W} \text{ with } i = 1,\ldots,L_m \text{ and } k = 1,\ldots,K \qquad (8)$$

The midamble sequences derived according to equations (7) to (8) have complex values and are not subject to channelisation or scrambling process, i.e. the elements $\underline{m}_i^{(k)}$ represent complex chips for usage in the pulse shaping process at modulation.

The term 'a midamble code set' or 'a midamble code family' denotes K specific midamble codes $\underline{\mathbf{m}}^{(k)}$; k=1,...,K, based on a single basic midamble code $\mathbf{m}_P$ according to (1).

### 5A~~6~~.2.4 Beamforming

Beamforming is same as that of the 3.84Mcps TDD, cf. [ 5.2.4 Beamforming ].

## 5A~~6~~.3 Common physical channels

### 5A~~6~~.3.1 Primary common control physical channel (P-CCPCH)

The BCH as described in section 4.1.2 'Common Transport Channels' is mapped onto the Primary Common Control Physical Channels (P-CCPCH1 and P-CCPCH2). The position (time slot / code) of the P-CCPCHs is fixed in the 1.28Mcps TDD. The P-CCPCHs are mapped onto the first two code channels of timeslot#0 with spreading factor of 16. The P-CCPCH is always transmitted with an antenna pattern configuration that provides whole cell coverage.

#### 5A~~6~~.3.1.1 P-CCPCH Spreading

The P-CCPCH uses fixed spreading with a spreading factor SF = 16. The P-CCPCH1 and P-CCPCH2 always use channelisation code $c_{Q=16}^{(k=1)}$ and $c_{Q=16}^{(k=2)}$ respectively.

#### 5A~~6~~.3.1.2 P-CCPCH Burst Format

The burst format as described in section 5A~~6~~.2.2 is used for the P-CCPCH. No TFCI is applied for the P-CCPCH.

#### 5A~~6~~.3.1.3 P-CCPCH Training sequences

The training sequences, i.e. midambles, as described in subclause 5A~~6~~.2.3 are used for the P-CCPCH.

### 5A~~6~~.3.2 Secondary common control physical channel (S-CCPCH)

PCH and FACH as described in subclause 4.1.2 are mapped onto one or more secondary common control physical channels (S-CCPCH). In this way the capacity of PCH and FACH can be adapted to the different requirements. The time slot and codes used for the S-CCPCH are broadcast on the BCH.

#### 5A~~6~~.3.2.1 S-CCPCH Spreading

The S-CCPCH uses fixed spreading with a spreading factor SF = 16. as described in subclause 5A~~6~~.2.1

#### 5A~~6~~.3.2.2 S-CCPCH Burst Format

The burst format as described in section 5A~~6~~.2.2 is used for the S-CCPCH. TFCI may be applied for S-CCPCHs.

#### 5A~~6~~.3.2.3 S-CCPCH Training sequences

The training sequences, i.e. midambles, as described in the subclause 5A~~6~~.2.3 are also used for the S-CCPCH.

## 5A6.3.3 Fast Physical Access CHannel (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. FPACH makes use of one code with spreading factor 16, so that its burst is composed by 44 symbols. The spreading code, training sequence and time slot position are configured by the network and signalled on the BCH.

### 5A6.3.3.1 FPACH burst

The FPACH burst contains 32 information bits. Table 8J19 reports the content description of the FPACH information bits and their priority order:

**Table 8J19: FPACH information bits description**

| Information field | Length (in bits) |
|---|---|
| Signature Reference Number | 3 (MSB) |
| Relative Sub-Frame Number | 2 |
| Received starting position of the UpPCH ($UpPCH_{POS}$) | 11 |
| Transmit Power Level Command for RACH message | 7 |
| Reserved bits (default value: 0) | 9 (LSB) |

In the use and generation of the information fields is explained in [9].

#### 5A6.3.3.1.1 Signature Reference Number

The reported number corresponds to the numbering principle for the cell signatures as described in [8].

The Signature Reference Number value range is 0 – 7 coded in 3 bits such that:

bit sequence(0 0 0) corresponds to the first signature of the cell; …; bit sequence (1 1 1) corresponds to the 8$^{th}$ signature of the cell.

#### 5A6.3.3.1.2 Relative Sub-Frame Number

The Relative Sub-Frame Number value range is 0 – 3 coded such that:

bit sequence (0 0) indicates one sub-frame difference; …; bit sequence (1 1) indicates 4 sub-frame difference.

#### 5A6.3.3.1.3 Received starting position of the UpPCH ($UpPCH_{POS}$)

The received starting position of the UpPCH value range is 0 – 2047 coded such that:

bit sequence (0 0 … 0 0 0) indicates the received starting position zero chip; …; bit sequence (1 1 … 1 1 1) indicates the received starting position 2047*1/8 chip.

#### 5A6.3.3.1.4 Transmit Power Level Command for the RACH message

The transmit power level command is transmitted in 7 bits.

### 5A6.3.3.2 FPACH Spreading

The FPACH uses only spreading factor SF=16 as described in subclause 5A6.3.3. The set of admissible spreading codes for use on the FPACH is broadcast on the BCH.

### 5A6.3.3.32 FPACH Burst Format

The burst format as described in section 5A6.2.2 is used for the FPACH.

#### 5A6.3.3.43 FPACH Training sequences

The training sequences, i.e. midambles, as described in subclause 5A6.2.3 are used for FPACH.

#### 5A6.3.3.54 FPACH timeslot formats

The FPACH uses slot format #0 of the DL time slot formats given in subclause 5A6.2.2.4.1.1.

### 5A6.3.4 The physical random access channel (PRACH)

The RACH as described in subclause 4.1.2 is mapped onto one or more uplink physical random access channels (PRACH). In such a way the capacity of RACH can be flexibly scaled depending on the operators need.

#### 5A6.3.4.1 PRACH Spreading

The uplink PRACH uses either spreading factor SF=16, SF=8 or SF=4 as described in subclause 5A6.2.1. The set of admissible spreading codes for use on the PRACH and the associated spreading factors are broadcast on the BCH (within the RACH configuration parameters on the BCH).

#### 5A6.3.4.2 PRACH Burst Format

The burst format as described in section 5A6.2.2 is used for the PRACH.

#### 5A6.3.4.3 PRACH Training sequences

The training sequences, i.e. midambles, of different users active in the same time slot are time shifted versions of a single periodic basic code. The basic midamble codes as described in subclause 5A6.2.3 are used for PRACH.

#### 5A6.3.4.4 PRACH timeslot formats

The PRACH uses the following time slot formats taken from the uplink timeslot formats described in sub-clause 5A6.2.2.4.1.2:

| Spreading Factor | Slot Format # |
|---|---|
| 16 | 0 |
| 8 | 10 |
| 4 | 25 |

#### 5A6.3.4.5 Association between Training Sequences and Channelisation Codes

The association between training sequences and channelisation codes of PRACH in the 1.28McpsTDD is same as that of the DPCH.

### 5A6.3.5 The synchronisation channels (DwPCH, UpPCH)

There are two dedicated physical synchronisation channels —DwPCH and UpPCH in each 5ms sub-frame of the 1.28Mcps TDD. The DwPCH is used for the down link synchronisation and the UpPCH is used for the uplink synchronisation.

The position and the contents of the DwPCH are equal to the DwPTS as described in the subclause 5A6.1., while the position and the contents of the UpPCH are equal to the UpPTS.

The DwPCH is transmitted at each sub-frame with an antenna pattern configuration which provides whole cell coverage. Furthermore it is transmitted with a constant power level which is signalled by higher layers.

The burst structure of the DwPCH ( DwPTS) is described in the figure 18I27.

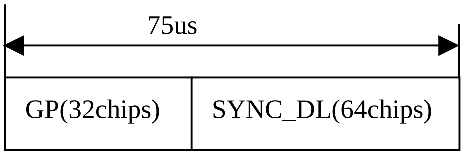



**Figure 18I~~27~~: burst structure of the DwPCH ( DwPTS)**

Note: 'GP' for 'Guard Period'

The burst structure of the UpPCH ( UpPTS) is described in the figure 18J~~28~~.

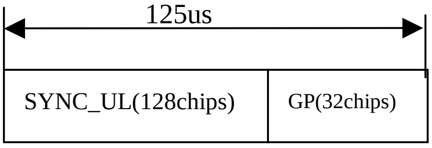



**Figure 18J~~28~~: burst structure of the UpPCH ( UpPTS)**

The SYNC-DL code in DwPCH and the SYNC-UL code in UpPCH are not spreaded. The details about the SYNC-DL and SYNC-UL code are described in the corresponding subclause and annex in [8].

### 5A~~6~~.3.6 Physical Uplink Shared Channel (PUSCH)

For Physical Uplink Shared Channel (PUSCH) the burst structure of DPCH as described in subclause 5A~~6~~.2 and the training sequences as described in subclause 5A~~6~~.2.3 shall be used. PUSCH provides the possibility for transmission of TFCI, SS, and TPC in uplink.

The PUSCH is common with 3.84 Mcps TDD with respect to Spreading and UE selection, cf. [5.3.5 Physical Uplink Shared Channel (PUSCH)].

### 5A~~6~~.3.7 Physical Downlink Shared Channel (PDSCH)

For Physical Downlink Shared Channel (PDSCH) the burst structure of DPCH as described in subclause 5A~~6~~.2 and the training sequences as described in subclause 5A~~6~~.2.3 shall be used. PDSCH provides the possibility for transmission of TFCI, SS, and TPC in downlink.

The PDSCH is common with 3.84 Mcps TDD with respect to Spreading and UE selection, cf. [5.3.6 Physical Downlink Shared Channel (PDSCH)].

### 5A~~6~~.3.8 The Page Indicator Channel (PICH)

The Paging Indicator Channel (PICH) is a physical channel used to carry the paging indicators.

#### 5A~~6~~.3.8.1 Mapping of Paging Indicators to the PICH bits

Figure 18K~~29~~ depicts the structure of a PICH transmission and the numbering of the bits within the bursts. The burst type as described in [5A~~6~~.2.2 ‘Burst Format’] is used for the PICH. $N_{PIB}$ bits are used to carry the paging indicators, where $N_{PIB}$=352.

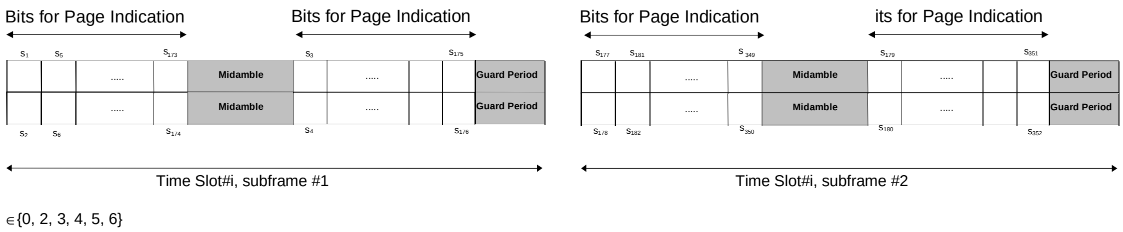



**Figure 18K~~29~~: Transmission and numbering of paging indicator carrying bits in the PICH bursts**

Each paging indicator $P_q$ (where $P_q$, $q = 0, ..., N_{PI}-1$, $P_q \in \{0, 1\}$) in one radio frame is mapped to the bits $\{s_{2L_{PI}*q+1},...,s_{2L_{PI}*(q+1)}\}$ in subframe #1 or subframe #2.

The setting of the paging indicators and the corresponding PICH bits is described in [7].

$N_{PI}$ paging indicators of length $L_{PI}$=2, $L_{PI}$=4 or $L_{PI}$=8 symbols are transmitted in each radio frame that contains the PICH. The number of paging indicators $N_{PI}$ per radio frame is given by the paging indicator length, which signalled by higher layers. In table 8K~~20~~ this number is shown for the different possibilities of paging indicator lengths.

**Table 8K~~20~~: Number $N_{PI}$ of paging indicators per radio frame for different paging indicator lengths $L_{PI}$**

| | $L_{PI}$=2 | $L_{PI}$=4 | $L_{PI}$=8 |
|---|---|---|---|
| $N_{PI}$ per radio frame | 88 | 44 | 22 |

### 5A~~6~~.3.8.2 Structure of the PICH over multiple radio frames

The structure of the PICH over multiple radio frames is common with 3.84 Mcps TDD, cf. [5.3.7.2 Structure of the PICH over multiple radio frames]

## 5A~~6~~.3.9 High Speed Physical Downlink Shared Channel (HS-PDSCH)

The HS-DSCH as described in subclause 4.1.2 is mapped onto one or more high speed physical downlink shared channels (HS-PDSCH).

### 5A~~6~~.3.9.1 HS-PDSCH Spreading

Spreading of the HS-PDSCH is common with 3.84 Mcps TDD, cf. [5.3.91HS-PDSCH Spreading]

### 5A~~6~~.3.9.2 HS-PDSCH Burst Types

The burst type as described in section 5A~~6~~.2.2 shall be used for the HS-PDSCH.

### 5A~~6~~.3.9.3 HS-PDSCH Training Sequences

The training sequences as described in subclause 5A~~6~~.2.3 are used for the HS-PDSCH.

### 5A~~6~~.3.9.4 UE Selection

UE selection is common with 3.84 Mcps TDD, cf. [5.3.9.4 UE selection].

### 5A~~6~~.3.9.5 HS-PDSCH timeslot formats

An HS-PDSCH may use QPSK or 16QAM modulation symbols. The time slot formats are shown in table 8KA~~21~~.

**Table 8KA~~21~~: Time slot formats for the HS-PDSCH**

| Slot Format # | SF | Midamble length (chips) | $N_{TFCI}$ code word (bits) | $N_{SS}$ & $N_{TPC}$ (bits) | Bits/slot | $N_{Data/Slot}$ (bits) | $N_{data/data\ field(1)}$ (bits) | $N_{data/data\ field(2)}$ (bits) |
|---|---|---|---|---|---|---|---|---|
| 0 (QPSK) | 16 | 144 | 0 | 0 & 0 | 88 | 88 | 44 | 44 |
| 1 (16QAM) | 16 | 144 | 0 | 0 & 0 | 176 | 176 | 88 | 88 |
| 2 (QPSK) | 1 | 144 | 0 | 0 & 0 | 1408 | 1408 | 704 | 704 |
| 3 (16QAM) | 1 | 144 | 0 | 0 & 0 | 2816 | 2816 | 1408 | 1408 |

## 5A~~6~~.3.10 Shared Control Channel for HS-DSCH (HS-SCCH)

The HS-SCCH is a DL physical channel that carries higher layer control information for HS-DSCH. The physical layer will process this information according to [7] and will transmit the resulting bits on the HS-SCCH the structure of which is described below.

The information on the HS-SCCH is carried by two separate physical channels (HS-SCCH1 and HS-SCCH2). The term HS-SCCH refers to the ensemble of these physical channels.

### 5A~~6~~.3.10.1 HS-SCCH Spreading

Spreading of the HS-SCCH is common with 3.84 Mcps TDD, cf. [5.3.10.1 HS-SCCH Spreading].

### 5A~~6~~.3.10.2 HS-SCCH Burst Types

The burst type as described in section 5A~~6~~.2.2 shall be used for the HS-SCCH.

### 5A~~6~~.3.10.3 HS-SCCH Training Sequences

The training sequences as described in subclause 5A~~6~~.2.3 are used for the HS-SCCH.

### 5A~~6~~.3.10.4 HS-SCCH timeslot formats

HS-SCCH1 shall use time slot format #5 and HS-SCCH2 shall use time slot format #0 from table 15, see section 5A~~6~~.2.2.4.1.1, i.e. HS-SCCH shall carry TPC and SS but no TFCI.

## 5A~~6~~.3.11 Shared Information Channel for HS-DSCH (HS-SICH)

The HS-SICH is a UL physical channel that carries higher layer control information and the Channel Quality Indicator CQI for HS-DSCH. The physical layer will process this information according to [7] and will transmit the resulting bits on the HS-SICH the structure of which is described below.

### 5A~~6~~.3.11.1 HS-SICH Spreading

Spreading of the HS-SICH is common with 3.84 Mcps TDD, cf. [5.3.11.1 HS-SICH Spreading].

### 5A~~6~~.3.11.2 HS-SICH Burst Types

The burst type as described in section 6.2.2 shall be used for the HS-SICH.

### 5A~~6~~.3.11.3 HS-SICH Training Sequences

The training sequences as described in subclause 5A~~6~~.2.3 are used for the HS-SCCH.

#### 5.3.11.4 HS-SICH timeslot formats

The HS-SICH may use time slot format #5 from table 16, see section 5A~~6~~.2.2.4.1.2, i.e., it shall carry TPC and SS but no TFCI.

## 5A~~6~~.4 Transmit Diversity for DL Physical Channels

Table 8L~~22~~ summarizes the different transmit diversity schemes for different downlink physical channel types in 1.28Mcps TDD that are described in [9].

**Table 8L~~22~~: Application of Tx diversity schemes on downlink physical channel types in 1.28Mcps TDD**
**"X" – can be applied, "–" – must not be applied**

| Physical channel type | Open loop TxDiversity | | Closed loop TxDiversity |
|---|---|---|---|
| | TSTD | SCTD | |
| P-CCPCH | X | X | – |
| S-CCPCH | X | X | – |
| DwPCH | X | – | – |
| DPCH | X | – | X |
| PDSCH | X | X | X |
| PICH | X | X | - |
| HS-SCCH | - | X | X |
| HS-PDSCH | - | - | X |

(*) Note: SCTD may only be applied to physical channels when they are allocated to beacon locations.

## 5A~~6~~.5 Beacon characteristics of physical channels

For the purpose of measurements, common physical channels that are allocated to particular locations (time slot, code) shall have particular physical characteristics, called beacon characteristics. Physical channels with beacon characteristics are called beacon channels. The location of the beacon channels is called beacon location. The beacon channels shall provide the beacon function, i.e. a reference power level at the beacon location, regularly existing in each subframe. Thus, beacon channels must be present in each subframe.

### 5A~~6~~.5.1 Location of beacon channels

The beacon location is described as follows :

The beacon function shall be provided by the physical channels that are allocated to channelisation code $c_{Q=16}^{(k=1)}$ and $c_{Q=16}^{(k=2)}$ in Timeslot#0.

Note that by this definition the P-CCPCH always has beacon characteristics.

### 5A~~6~~.5.2 Physical characteristics of the beacon function

The beacon channels shall have the following physical characteristics.

They:

- are transmitted with reference power;
- are transmitted without beamforming;
- use midamble $m^{(1)}$ and $m^{(2)}$ exclusively in this time slot

The reference power corresponds to the sum of the power allocated to both midambles $m^{(1)}$ and $m^{(2)}$. Two possibilities exist:

- If SCTD antenna diversity is not applied to beacon channels, all the reference power of any beacon channel is allocated to $m^{(1)}$.
- If SCTD antenna diversity is applied to beacon channels, for any beacon channel midambles $m^{(1)}$ and $m^{(2)}$ are each allocated half of the reference power.

# 5A~~6~~.6 Midamble Allocation for Physical Channels

The midamble allocation schemes for physical channels are the same as in the 3.84Mcps TDD option. The associations between channelisation codes and midambles for the default and common midamble allocation differ from the 3.84 Mcps TDD option. The associations are given in Annex AA~~B~~.2 [Association between Midambles and channelisation Codes] and D [Signalling of the number of channelisation codes for the DL common midamble case for 1.28Mcps TDD] respectively

## 5A~~6~~.6.1 Midamble Allocation for DL Physical Channels

Beacon channels shall always use the reserved midambles $m^{(1)}$ and $m^{(2)}$, see 5A~~6~~.5. For the other DL physical channels that are located in timeslot #0, midambles shall be allocated based on the default midamble allocation scheme, using the association for K=8 midambles. For all other DL physical channels, the midamble is explicitly assigned by higher layers or allocated by layer 1.

### 5A~~6~~.6.1.1 Midamble Allocation by signalling from higher layers

The midamble allocation by signalling is the same like in the 3.84 Mcps TDD cf. [5.6.1.1 Midamble allocation by signalling from higher layers]

### 5A~~6~~.6.1.2 Midamble Allocation by layer 1

#### 5A~~6~~.6.1.2.1 Default midamble

The default midamble allocation by layer 1 is the same like in the 3.84 Mcps TDD cf. [5.6.1.2.1 Default midamble]. The associations between midambles and channelisation codes are given in Annex AA~~B~~.2 [Association between Midambles and channelisation Codes].

#### 5A~~6~~.6.1.2.2 Common Midamble

The common midamble allocation by layer 1 is the same like in the 3.84 Mcps TDD cf. [5.6.1.2.2 Common midamble]. The respective associations are given in Annex BA~~D~~ [Signalling of the number of channelisation codes for the DL common midamble case for 1.28 Mcps TDD].

## 5A~~6~~.6.2 Midamble Allocation for UL Physical Channels

The midamble allocation for UL Physical Channels is the same as in the 3.84 Mcps TDD cf. [5.6.2 Midamble allocation for UL Physical Channels]

# 5A~~6~~.7 Midamble Transmit Power

The setting of the midamble transmit power is done as in the 3.84 Mcps TDD option cf. 5.7 ‘Midamble Transmit Power’

# 6~~7~~ Mapping of transport channels to physical channels for the 3.84 Mcps option

This clause describes the way in which transport channels are mapped onto physical resources, see figure 19~~30~~.

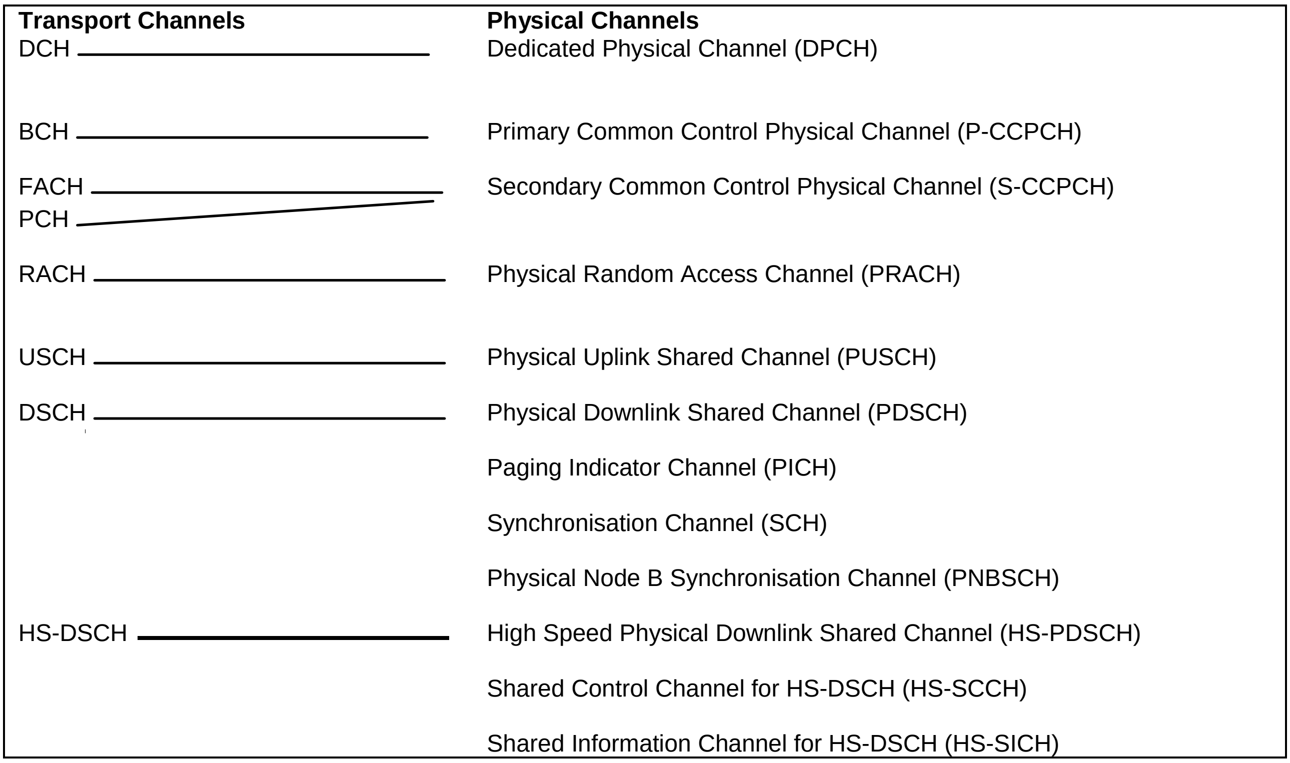



**Figure 19~~30~~: Transport channel to physical channel mapping**

## 6~~7~~.1 Dedicated Transport Channels

A dedicated transport channel is mapped onto one or more physical channels. An interleaving period is associated with each allocation. The frame is subdivided into slots that are available for uplink and downlink information transfer. The mapping of transport blocks on physical channels is described in TS 25.222 ("multiplexing and channel coding").

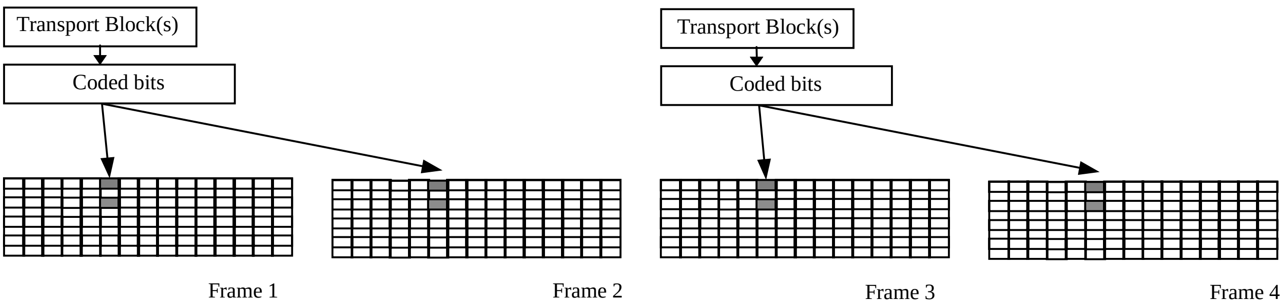



**Figure 20~~31~~: Mapping of Transport Blocks onto the physical bearer**

For NRT packet data services, shared channels (USCH and DSCH) can be used to allow efficient allocations for a short period of time.

## 67.2 Common Transport Channels

### 67.2.1 The Broadcast Channel (BCH)

The BCH is mapped onto the P-CCPCH. The secondary SCH codes indicate in which timeslot a mobile can find the P-CCPCH containing BCH.

### 67.2.2 The Paging Channel (PCH)

The PCH is mapped onto one or several S-CCPCHs so that capacity can be matched to requirements. The location of the PCH is indicated on the BCH. It is always transmitted at a reference power level.

To allow an efficient DRX, the PCH is divided into PCH blocks, each of which comprising $N_{PCH}$ paging sub-channels. $N_{PCH}$ is configured by higher layers. Each paging sub-channel is mapped onto 2 consecutive PCH frames within one PCH block. Layer 3 information to a particular UE is transmitted only in the paging sub-channel, that is assigned to the UE by higher layers, see [15]. The assignment of UEs to paging sub-channels is independent of the assignment of UEs to page indicators.

#### 67.2.2.1 PCH/PICH Association

As depicted in figure 2132, a paging block consists of one PICH block and one PCH block. If a paging indicator in a certain PICH block is set to '1' it is an indication that UEs associated with this paging indicator shall read their corresponding paging sub-channel within the same paging block. The value $N_{GAP}$>0 of frames between the end of the PICH block and the beginning of the PCH block is configured by higher layers.

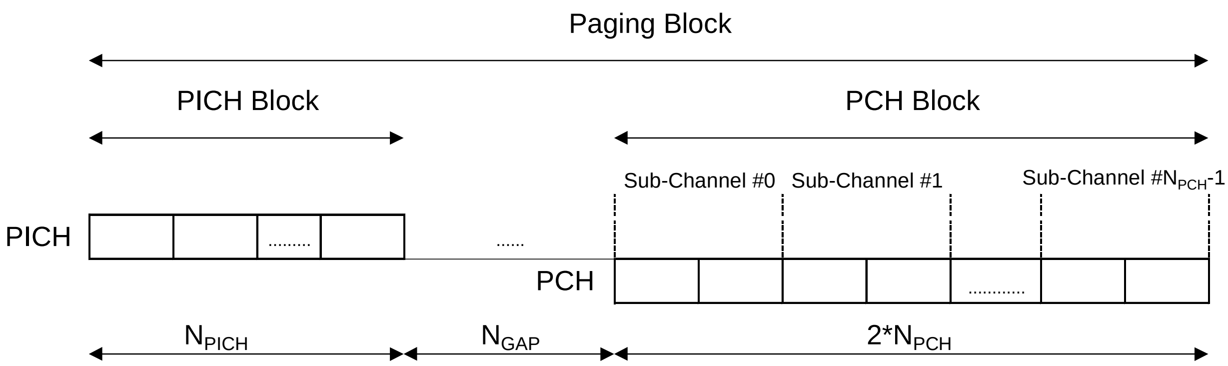



**Figure 2132: Paging Sub-Channels and Association of PICH and PCH blocks**

### 67.2.3 The Forward Channel (FACH)

The FACH is mapped onto one or several S-CCPCHs. The location of the FACH is indicated on the BCH and both, capacity and location can be changed, if required. FACH may or may not be power controlled.

### 67.2.4 The Random Access Channel (RACH)

The RACH has intraslot interleaving only and is mapped onto PRACH. The same slot may be used for PRACH by more than one cell. Multiple transmissions using different spreading codes may be received in parallel. More than one slot per frame may be administered for the PRACH. The location of slots allocated to PRACH is broadcast on the BCH. The PRACH uses open loop power control. The details of the employed open loop power control algorithm may be different from the corresponding algorithm on other channels.

### 67.2.5 The Uplink Shared Channel (USCH)

The uplink shared channel is mapped on one or several PUSCH, see subclause 5.5.

### 6~~7~~.2.6 The Downlink Shared Channel (DSCH)

The downlink shared channel is mapped on one or several PDSCH, see subclause 5.6.

### 6~~7~~.2.7 The High Speed Downlink Shared Channel (HS-DSCH)

The high speed downlink shared channel is mapped on one or several HS-PDSCH, see subclause 5.3.9.

#### 6~~7~~.2.7.1 HS-DSCH/HS-SCCH Association and Timing

The HS-DSCH is always associated with one DL DPCH and a number of High Speed Shared Control Channels (HS-SCCH). The number of HS-SCCHs that are associated with an HS-DSCH for one UE can range from a minimum of one HS-SCCH (M=1) to a maximum of four HS-SCCH (M=4). All relevant Layer 1 control information is transmitted in the associated HS-SCCH i.e. the HS-PDSCH does not carry any Layer 1 control information.

The HS-DSCH related time slot information that is carried on the HS-SCCH refers to the next valid HS-PDSCH allocation, which is given by the following limitation: There shall be an offset of $n_{HS\text{-}SCCH} \geq 6$ time slots between the HS-SCCH carrying the HS-DSCH related information and the first indicated HS-PDSCH (in time) for a given UE. The HS-DSCH related time slot information shall not refer to two subsequent radio frames but shall always refer to either the same or the following radio frame, as illustrated in figure 21A~~33~~. Note that the figure only shows the HS-SCCH that carries the HS-DSCH related information for the given UE.

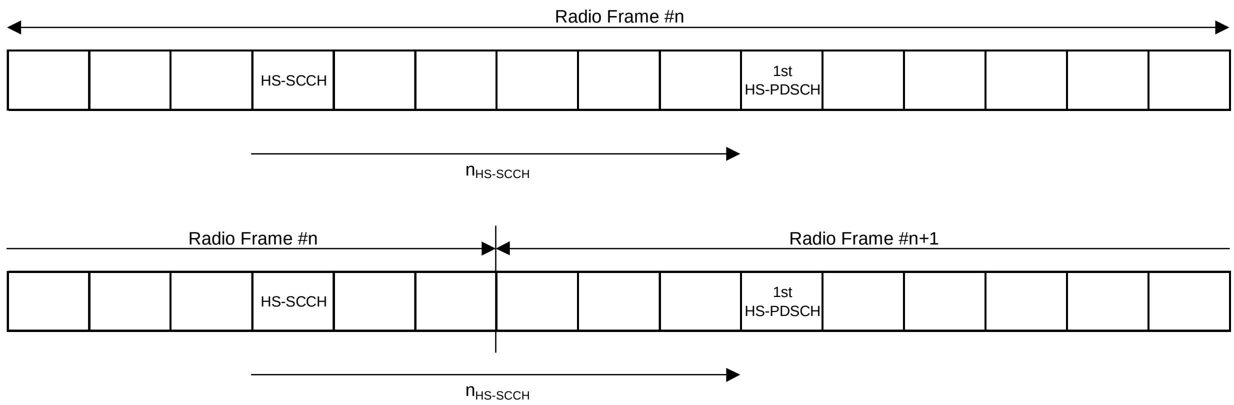



**Figure 21A~~33~~: Timing for HS-SCCH and HS-DSCH for different radio frame configurations for a given UE**

#### 6~~7~~.2.7.2 HS-SCCH/HS-DSCH/HS-SICH Association and Timing

The HS-SCCH is always associated with one HS-SICH. The association between the HS-SCCH in DL and HS-SICH in UL shall be pre-defined by higher layers and is common for all UEs.

The UE shall transmit HS-DSCH related information on the next available associated HS-SICH with the following limitation: There shall be an offset of $n_{HS\text{-}SICH} \geq 19$ time slots between the last allocated HS-PDSCH (in time) and the HS-SICH for the given UE. Hence, the HS-SICH transmission shall be made in the next or next but one radio frame, following the HS-DSCH transmission, as illustrated in figure 21B~~34~~. Note that the figure only shows the HS-SICH that carries the HS-DSCH related information for the given UE.

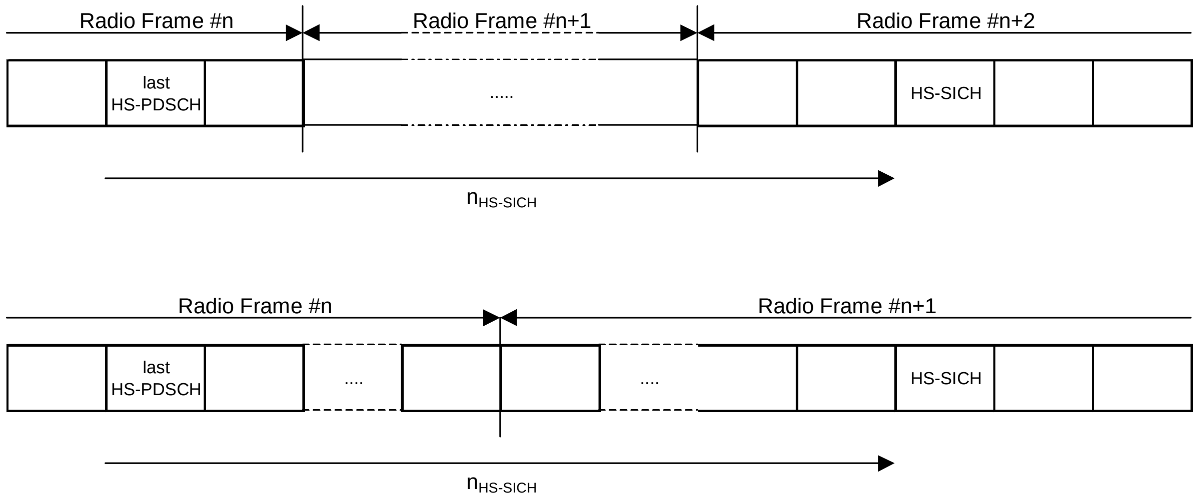



**Figure 21B~~34~~: Timing for HS-DSCH and HS-SICH for different radio frame configurations for a given UE**

# 7~~8~~ Mapping of transport channels to physical channels for the 1.28 Mcps option

This clause describes the way in which the transport channels are mapped onto physical resources, see figure 22~~35~~.

| Transport channels | Physical channels |
|---|---|
| DCH | Dedicated Physical Channel (DPCH) |
| BCH | Primary Common Control Physical Channels (P-CCPCH) |
| PCH | Secondary Common Control Physical Channels(S-CCPCH) |
| FACH | Secondary Common Control Physical Channels(S-CCPCH) |
| | PICH |
| RACH | Physical Random Access Channel (PRACH) |
| USCH | Physical Uplink Shared Channel (PUSCH) |
| DSCH | Physical Downlink Shared Channel (PDSCH) |
| | Down link Pilot Channel (DwPCH) |
| | Up link Pilot Channel (UpPCH) |
| | FPACH |
| HS-DSCH | High Speed Physical Downlink Shared Channel (HS-PDSCH) |
| | Shared Control Channel for HS-DSCH (HS-SCCH) |
| | Shared Information Channel for HS-DSCH (HS-SICH) |

**Figure 22~~35~~: Transport channel to physical channel mapping for 1.28Mcps TDD**

## 7~~8~~.1 Dedicated Transport Channels

The mapping of transport blocks to physical bearers is in principle the same as in 3.84 Mcps TDD but due to the subframe structure the coded bits are mapped onto each of the subframes within the given TTI.

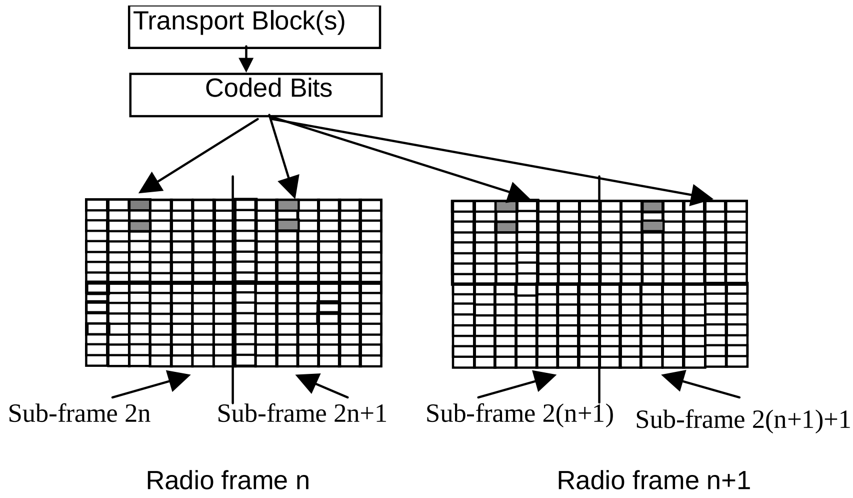



**Figure 23~~36~~ : Mapping of Transport Blocks onto the physical bearer ( TTI= 20ms )**

# 7~~8~~.2 Common Transport Channels

## 7~~8~~.2.1 The Broadcast Channel (BCH)

There are two P-CCPCHs, P-CCPCH 1 and P-CCPCH 2 which are mapped onto timeslot#0 using the channelisation codes $c_{Q=16}^{(k=1)}$ and $c_{Q=16}^{(k=2)}$ with spreading factor 16. The BCH is mapped onto the P-CCPCH1+P-CCPCH2.

The position of the P-CCPCHs is indicated by the relative phases of the bursts in the DwPTS with respect to the P-CCPCHs midamble sequences, see [8]. One special combination of the phase differences of the burst in the DwPTS with respect to the P-CCPCH midamble indicates the position of the P-CCPCH in the multi-frame and the start position of the interleaving period.

## 7~~8~~.2.2 The Paging Channel (PCH)

The mapping of Paging Channels onto S-CCPCHs and the association between PCHs and Paging Indicator Channels is the same as in the 3.84 Mcps TDD option, cf. 6~~7~~.2.2 'The paging Channel' and 6~~7~~.2.2.1 'PCH/PICH Association' respectively.

## 7~~8~~.2.3 The Forward Channel (FACH)

The FACH is mapped onto one or several S-CCPCHs. The location of the FACH is indicated on the BCH and both, capacity and location can be changed, if required. FACH may or may not be power controlled.

## 7~~8~~.2.4 The Random Access Channel (RACH)

The RACH is mapped onto PRACH. More than one slot per frame may be administered for the PRACH. The location of slots allocated to PRACH is broadcast on the BCH. The uplink sync codes (SYNC-UL sequences) used by the UEs for UL synchronisation have a well known association with the P-RACHs, as broadcast on the BCH. On the PRACH, both power control and uplink synchronisation control are used.

## 7~~8~~.2.5 The Uplink Shared Channel (USCH)

The uplink shared channel is mapped onto one or several PUSCH, see subclause 5A~~6~~.3.6 ‘Physical Uplink Shared Channel (PUSCH)’

## 78.2.6 The Downlink Shared Channel (DSCH)

The downlink shared channel is mapped onto one or several PDSCH, see subclause 5A6.3.7 'Physical Downlink Shared Channel (PDSCH)'

## 78.2.7 The High Speed Downlink Shared Channel (HS-DSCH)

The high speed downlink shared channel is mapped on one or several HS-PDSCH, see subclause 5A6.3.9.

### 78.2.7.1 HS-DSCH/HS-SCCH Association and Timing

The HS-DSCH is always associated with one DL DPCH and a number of High Speed Shared Control Channels (HS-SCCH). The number of HS-SCCHs that are associated with an HS-DSCH for one UE can range from a minimum of one HS-SCCH (M=1) to a maximum of four HS-SCCH (M=4). All relevant Layer 1 control information is transmitted in the associated HS-SCCH i.e. the HS-PDSCH does not carry any Layer 1 control information.

The HS-DSCH related time slot information that is carried on the HS-SCCH refers to the next valid HS-PDSCH allocation, which is given by the following limitation: There shall be an offset of $n_{HS\text{-}SCCH} \geq 3$ time slots between the HS-SCCH carrying the HS-DSCH related information and the first indicated HS-PDSCH (in time) for a given UE. DwPTS and UpPTS shall not be taken into account in this limitation. The HS-DSCH related time slot information shall not refer to two subsequent sub-frames but shall always refer to either the same or the following sub-frame, as illustrated in figure 2437. Note that the figure only shows the HS-SCCH that carries the HS-DSCH related information for the given UE and that DwPTS and UpPTS are not considered in this figure.

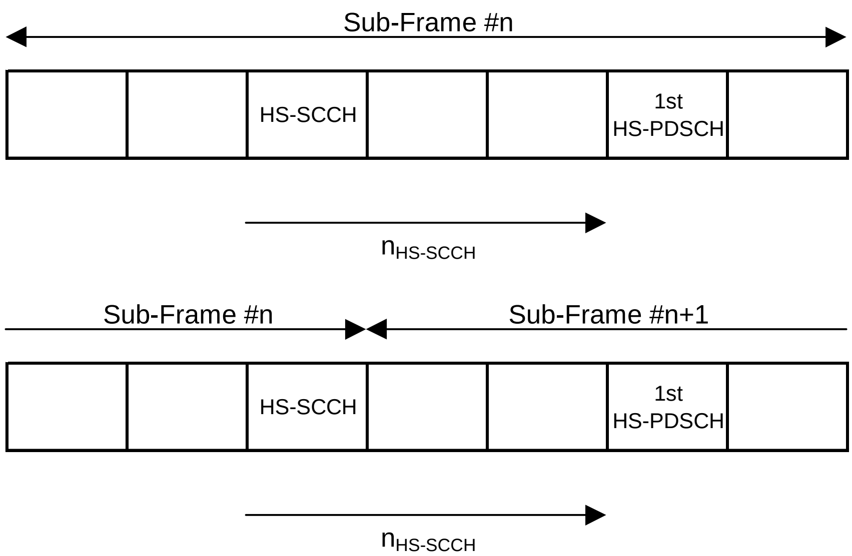



**Figure 2437: Timing for HS-SCCH and HS-DSCH for different radio frame configurations for a given UE**

### 78.2.7.2 HS-SCCH/HS-DSCH/HS-SICH Association and Timing

The HS-SCCH is always associated with one HS-SICH, carrying the ACK/NACK and Channel Quality information (CQI). The association between the HS-SCCH in DL and HS-SICH in UL shall be pre-defined by higher layers and is common for all UEs.

The UE shall transmit HS-DSCH related information on the next available associated HS-SICH with the following limitation: There shall be an offset of $n_{HS\text{-}SICH} \geq 9$ time slots between the last allocated HS-PDSCH (in time) and the HS-SICH for the given UE. DwPTS and UpPTS shall not be taken into account in this limitation. Hence, the HS-SICH transmission shall always be made in the next but one sub-frame, following the HS-DSCH transmission, as illustrated in figure 2538. Note that the figure only shows the HS-SICH that carries the HS-DSCH related information for the given UE and that DwPTS and UpPTS are not considered in this figure.

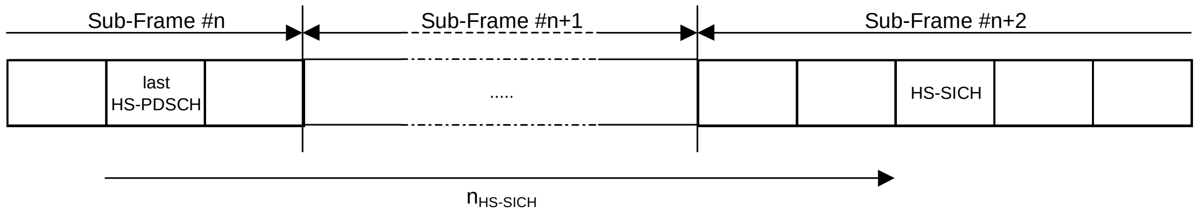



**Figure 2538: Timing for HS-DSCH and HS-SICH for different radio frame configurations for a given UE**

# Annex A (normative): Basic Midamble Codes for the 3.84 Mcps option

## A.1 Basic Midamble Codes for Burst Type 1 and 3

In the case of burst type 1 or 3 (see subclause 5.2.2) the midamble has a length of Lm=512, which is corresponding to:

K'=8; W=57; P=456.

Depending on the possible delay spread cells are configured to use $K_{Cell}$ midambles which are generated from the Basic Midamble Codes (see table A.-1)

- for all k=1,2,...,K; K=2K' or
- for k=1,2,...,K', only, or
- for odd k=1,3,5,...,≤ K', only.

Depending on the cell size midambles for PRACH are generated from the Basic Midamble Codes (see table A.-1)

- for k=1,2,...,K' or
- for odd k=1,3,5,...,≤ K', only.

The cell configuration is broadcast on BCH.

The mapping of these Basic Midamble Codes to Cell Parameters is shown in TS 25.223.

**Table A.-1: Basic Midamble Codes $\mathbf{m}_P$ according to equation (5) from subclause 5.2.3 for case of burst type 1 and 3**

| Code ID | Basic Midamble Codes $m_{PL}$ of length *P*=456 |
|---|---|
| $m_{PL0}$ | 8DF65B01E4650910A4BF89992E48F43860B07FE55FA0028E454EDCD1F0A09A6F029668F55427<br>253FB8A71E5EF2EF360E539C489584413C6DC4 |
| $m_{PL1}$ | 4C63F9BC3FD7B655D5401653BE75E1018DC26D271AADA1CF13FD348386759506270F2F953E9<br>3A44468E0A76605EAE8526225903B1201077602 |
| $m_{PL2}$ | 8522611FFCAEB55A5F07D966036C852E7B15B893B3ABA9672C327380283D168564B8E1200F0E<br>2205AF1BB23A58679899785CFA2A6C131CFDC4 |
| $m_{PL3}$ | F58107E6B777C221999BDE9340E192DC6C31AB8AE85E70AA9BBEB39727435412A5A27C0EF7<br>3AB453ED0D28E5B032B94306EC1304736C91E922 |
| $m_{PL4}$ | 89670985013DFD2223164B68A63BD58C7867E97316742D3ABD6CBDA4FC4E08C0B0CBE44451<br>575C72F887507956BD1F27C466681800B4B016EE |
| $m_{PL5}$ | FCDEF63500D6745CDB962594AF171740241E982E9210FC238C4DD85541F08C1A010F7B3161A<br>7F4DF19BAD916FD308AB1CED2A32538C184E92C |
| $m_{PL6}$ | DB04CE77A5BA7C0E09B6D3551072B11A7A43B6A355C1D6FDCF725D587874999895748DD098<br>32ABC35CEC3008338249612E6FE5005E13B03103 |
| $m_{PL7}$ | D2F61A622D0BA9E448CD29587D398EF8CDC3B6582B6CDD50E9E20BF5FE2B3258041E14D608<br>21DC6725132C22D787CD5D497780D4241E3B420D |
| $m_{PL8}$ | 7318524E62D806FA149ECC5435058A2B74111524B84727FE9A7923B4A1F0D8FCD89208F34BE<br>E5CADEB90130F9954BB30605A98C11045FF173D |
| $m_{PL9}$ | 8E832B4FA1A11E0BF318E84F54725C8052E0D099EF0AF54BC342BEE44976C9F38DE701623C7<br>BF6474DF90D2E2222A4915C8080E7CD3EC84DAC |
| $m_{PL10}$ | CFA5BAC90780876C417933C43103B55699A8AD51164E590AF9DA6AF0C18804E1F74862F00CE<br>7ECC899C85B6ABB0CAD5E50836AD7A39878FE2F |
| $m_{PL11}$ | AD539094A19858A75458F1B98E286A4F7DC3A117083D04724CBE83F34102817C5531329CDB43<br>7FFF712241B644BDF0C1FEC8598A63C2F21BD7 |
| $m_{PL12}$ | BEB8483139529BDE23E42DA6AB8170DD0BFBB30CE28A4502FAF3C8EDA219B9A6D5B849D9C<br>9E4451F74E2408EA046061201E0C1D69CF48F3A94 |
| $m_{PL13}$ | C482462CA7846266060D21688BA00B72E1EC84A3D5B7194C8DA39E21A3CE12BF512C8AAB6A<br>7079F73C0D3E4F40AC555A4BCC453F1DFE3F6C82 |

| Code ID | Basic Midamble Codes $m_{PL}$ of length $P$=456 |
|---|---|
| $m_{PL14}$ | 9663373935FD5C213AC58C0670206683D579D2526C05B0A81030DDF61A221D8A68EAD8D6F7A<br>A0D662C07C6DCD0115A54D39F03F7122B0675AC |
| $m_{PL15}$ | 387397AE5CD3F2B3912C26B8F87CE82CEFEC55507DB08FB0C4CF2FD6858896201ACA726428<br>1D0298440DD3481E5E9DDB24C16F30EB7A22948A |
| $m_{PL16}$ | AFE9266843C892571B6230D808788C63B9065EA3BDFF687B92B8734A8D7099559FEA22C94165<br>76D0C087EB4503E87E356471B330182A24A3E6 |
| $m_{PL17}$ | 6E6C550A4CB74010F6C3E0328651DF421C456D9A5E8AE9D3946C10189D72B579184552EE3E7<br>99970969C870FE8A37B6C4BA890992103486DC0 |
| $m_{PL18}$ | D803CA71B6F99CFB3105D40F4695D61EB0B62E803F79302EE3D2A6BF12EA70D304B181E8B3<br>8B3B74F5022B67EB8109808C62532688C563D4BE |
| $m_{PL19}$ | E599ED48D01772055DBE9D343A4EA5EABE643DA38F06904FC7523B08C4101F021B199AF759A<br>00D9AC298881D79413A77470992A75C771492D0 |
| $m_{PL20}$ | 9F30AC4162CE5D185953705F3D45F026F38E9B5721AEFE07370214D526A2C4B344B508B57BF<br>B2492320C05903C79CBEE08C6E7F218B57E14D6 |
| $m_{PL21}$ | B5971060DA84685B4D042ED0189FAF13C961B2EF61CC164E363B22AAB14AC8AF607906C1C6<br>E04F2054C687AA6741A9E70639857DA02B6FFFFA |
| $m_{PL22}$ | 97135FC2226C4B4A5CBA5FCA3732763B87455F73A1148006F3DF214BD4C936D061E04045160<br>E2CE33B9CD09D08FDE2A37F4E998322B4401D27 |
| $m_{PL23}$ | 4D256D57C861B9791151A78D5299C56D116B6178B2A2D04BB95FB76540AF28341DC6EC4E7E<br>D3BF9E508478D9C8F44914805DA82429E1CF320E |
| $m_{PL24}$ | 858EF5C84CE32D18D9ABA110EEA7474CF0CD70254D2928C3F4DFF6BB3A518587CADA190290<br>78AC90A8336C8178203BE3289E601F07D089CB64 |
| $m_{PL25}$ | 920A8796A511650AEF32F93DD3C39C624E07AE03CE8C96139973F54DCB9803C5164ADB502D<br>4FF561564D607037FCD172921F1982B102C3312C |
| $m_{PL26}$ | 485C5DAE76B360A9C56E20B8422EA3E6ACF07CB093B5587CB0E6A5498A4714081EA98DBCD<br>B0482B26E0D097C03444473D233BEF3C8E440DEBF |
| $m_{PL27}$ | 565A9D54EA789892B024F97E728E8EE112411942C48BD0C5BC8AA457D8DC9941F0F7424B386<br>43FFE6521CD306FBC56FE10F1428D4C245B5606 |
| $m_{PL28}$ | 5AEF2C0C2C378179A1AC36242E6B3EDB72C42D3624437674F8D51260C0898C201837CBA14E9<br>E23D1EF6451C4ACF27AB031F457A8A1BFD148AE |
| $m_{PL29}$ | 87D8FE685417822A23D925307E6C11081ADAC4702BCCD9BE448E78984D109B50DEF5B7C58B<br>C71EA1F0A6826BA8AD1978843E7697F3E416AADA |

| Code ID | Basic Midamble Codes $m_{PL}$ of length $P$=456 |
|---|---|
| $m_{PL30}$ | 84802B72AF27B5BE724D1FB629E0E627BDB0D9061292562F98350C1D0C9D4B9D8E2BF71123C<br>82EBB161003AE9829E07244D78F19926F8847A2 |
| $m_{PL31}$ | 8CCB5128238BCB088E30972D62792AEF02B9BBDDCAD68C9916C00BF91CBE788B0F03851FA<br>AF88605534FD73436C259D270B1013CB14226F658 |
| $m_{PL32}$ | 62F4E6FAC2BF1979CE6854AA2D33534BFB2F946519101A6589131C3640707D40E67ED804AF8<br>736AD213CAF593574190006196 7E8285C27E34C |
| $m_{PL33}$ | 4095E5B4EEAFCDF68A34B267EEA28D8444FA533900F41499E260D2E65C256A52E1DD5861F52<br>27C98E00687D107233F51A1167BCF72FB184654 |
| $m_{PL34}$ | 5630E9A79FCAD303404D9E5A802299162657AAC734761C6E90DA8BCE4F61A763E0BB48D3FE<br>B3F78468C828ABA4828DAD06E0F904CFD40421DC |
| $m_{PL35}$ | CD12B24C0BCA8AAC1FCBF0500A3BC684A180E863D888F2506B48C68ECF17F76CB285991FB<br>A18EB6397211FAD002F482D57A258CD45DE3FF1A6 |
| $m_{PL36}$ | AFCF2A50877286CD3405442730C45514F082D9EC296B367C0F64F04C4E0007DCA9E50BEED5<br>C102126E319ACBC64F1729272F2F72C9397029FE |
| $m_{PL37}$ | 18F89EE8589D20882A72A44DCCDF0050F0A3D88DBA6531614973D26905FDF41E3F779FF0648<br>E8AF1540928511BCF4C25D9C64AF34AC31B8965 |
| $m_{PL38}$ | F890D550F33F032ECDA3A51FED427D634F64EB29AF1332A23CD961258E4BAED040E7B33691<br>8E250EC272A12816B9EBFFA1E0AE401185F08C10 |
| $m_{PL39}$ | ACE5DD61506047E80FB7D41BD3992DF4D7F18EB46CC145C0E9105428C2F8F299141F5D6669<br>1904A7DC2513A3B83994ACB1292246B32818FE9D |
| $m_{PL40}$ | 150680FF900C9B46E1E24D54BE2238CB950A934E5CCDE9BC3939EB51CB0AE202B7D339EEC<br>2018B33A0AB9B63DA5D512D64FB58C0E51A1C82C2 |
| $m_{PL41}$ | 51A579EED2663A002D32D10A0753173612F4D5BA167D1807C61F25C4D42C063682E8E9DD019<br>F79D446A046EB3F75E50FEB228DC52F08E694B6 |
| $m_{PL42}$ | CDC644FE4C0C6897604F9D14D714123BF16FFF0E49F35F674908CA60653702FE27BCCA2A470<br>98453AF8661055C8C549EB6A951A8396AD4B94D |
| $m_{PL43}$ | 750A10366C595373C5001CA3E4239764B1409D602CF6052B39BC6A3255A15FE06C782C4C5F8<br>47026A7E79838A2933A61C77BB6CBF5915B2DA5 |
| $m_{PL44}$ | B7490686D78E409082C4C48FE18D4C35429C20AADF96076B92FC4E85490664753DB0891A0B2<br>7FD849BB7FCA99E3B38F22F8C662852C0D35AA6 |
| $m_{PL45}$ | D86E1B575B47D23DA811806A54C231281F03317830E7BD305D3CAA7D6382A5233104CFD54D2<br>2DF9F34535E5B390D9040CF1375FEA44CEC29E2 |
| $m_{PL46}$ | 828655960C026EC67B683480992AC2ED2C43ABC606F5220C2945F373470BE7ED5BCCF7C1AA<br>0986BBCCC84F11F1658AA568FAA0A60C5F0B5BFA |
| $m_{PL47}$ | D76230E02C8533653AAB99B288AA2ADE25A1C1BF28516C04239240EAF1EFC0B98974B51F886<br>861D8A1E9F5D62CFFEC309F071A9716B325101B |
| $m_{PL48}$ | EA207662865B8A07D69648964DED818EE474A90B94473408871880E63EF0596B9FCFEC3C06B<br>86EA6AD2B06C91672EFB33C70241A5450B59B8A |
| $m_{PL49}$ | 9CB5459549909835FAB22F0D99298C120ACF479F814CCE749079D40688F28101037762F125C7<br>76DA9C5FA1FCE0E76E452F8185354FDCDE94E2 |
| $m_{PL50}$ | 227506304AEC1D6F93569B51FDC3405A0F38194F65BE17163A3CB9827A35AECEA757D020FE2<br>49377ECD561428A38FEED004EC859C272563185 |
| $m_{PL51}$ | 96B9AEC9938910F0E533422A3977519B05CD4AD3909BC15A7502D48D49C124FA192A8E57027<br>CFEB11DF542010603CE5C9FDF8E626D4FBF8CF4 |
| $m_{PL52}$ | A6AAD06E095A9BE0BD9F8A2ED40C3CBDBAE91C700CBB778C8696CC06F3A675C16BDB2918<br>E5F2111005A8727206DC6A9684E05655185C398EEB |
| $m_{PL53}$ | CD168D384A78DA172991AD333EE2A9880905AFE59E2A2A4AC4414C40F82874F98A3CBE7B44<br>F4C7F4710B35FD88AFC0399FAEB070EB9CA4D30A |
| $m_{PL54}$ | 22016CA87AD1549174A8699DD65599697871091457E83E0912E7E77A06531C209394D283D18A<br>38662B73681DD9C5BF330FED978BDA7D487CA8 |
| $m_{PL55}$ | B9401B0843AA6F7827A13BD66C922287E8886C31EB5B90B82B472CCD6DA3D8D4FBF78B8F84<br>96DFA8252B06429D5DD17142F1C908ACCD70EA0C |
| $m_{PL56}$ | E42B9EFDC5D09AC27B3C7DA28D02493A70521223B9D7A76A9D13E9C171017964D16A70C08E<br>AD02C3DC948889C23E365AFCF01BF20B89B0BF5C |
| $m_{PL57}$ | 9DA0180168DB915E9F3597B59312198E1B5CC00D743C2ECB0DBAADA3E35A2465ED1EAA9D7<br>4734D49A313CE4DFF020D0760E3153DC485603943 |
| $m_{PL58}$ | B6C966619ECB98191D719C187C07BD503425650CAA3A2D1F2DF5212B1441D7A0C1D36A4C9C<br>2550240AD17CA43BB3943DFFFBF1E283D81299CC |
| $m_{PL59}$ | DB0E8C41F08A03D477C1AA548799274C4BF3EB68F2636166FDC8D4B1E7132539930297E228B<br>A232BB5C279FA5ECA3AC10E24361AF050A453B8 |
| $m_{PL60}$ | 89BCE2DE2974EEBA833CF32F224C85A2891484478527DB48FA6ECEA84C5E288CC3914CB54A<br>DA0476278750187F68FBEA41017E1E58DF1A5A3D |
| $m_{PL61}$ | 70A457D1314A278625443EEB52520815EC92CEF17417B97440DCB531BC1CE83212F63270418<br>D0FBDE71F6DB9E0EA88772E1E4535B6633E4425 |

| Code ID | Basic Midamble Codes $m_{PL}$ of length *P*=456 |
|---|---|
| $m_{PL62}$ | C388460AD54B36C4452CF0433BD347100ACCC24C79C535AD3E1F23FE0425E93A044C553BFA<br>116E09AA4BB32F13CFA76FBA1BC17520F45EFD44 |
| $m_{PL63}$ | 0BAFCADCDF9AA2846681782CD3B90CA036A863C78EE1507620BC394D0C6804B4C97A15BC9<br>C0D7B79E6892EA1BFF1A0DD9573A9213AB140D0D2 |
| $m_{PL64}$ | 833B0226789A62882FCD27A30885E67872B1A1C2FA484AD498011599DD57E8E2A07A560B4716<br>7AA5F60EF47177DBB1632D5387A2896348640B |
| $m_{PL65}$ | 8F52820323ABA5E6C6B465821B621600B980E59F53A599DA5646BA103214336836CF17E3386C<br>E4FB2BC5F25CCB30CF7F500546828EC8786B8E |
| $m_{PL66}$ | E2E9A29C3C8207B9A4508FD2F667A159F068EEE8D00686F46EA904C3692C1D79DFF1B32E510<br>3720D47B4B58AC35384A26087027E141B3126A8 |
| $m_{PL67}$ | 70E7C39FD2D3AE1DCE341699A544D801A8688A6EE47C5CB3630022147DDC06241FC5337A34<br>8A462B2472DEC5E104DD520ADA5114DB065D4B0D |
| $m_{PL68}$ | 9E3483CAB164BD053C4971D4D87494CC689033D589EF80E5453376E4A8DCC02183B98C36B0<br>FF7DDC0AD07FCE8B4D5164371BD03A2110AD1247 |
| $m_{PL69}$ | 04DA1C649B0608938DAADD3FE920A4F681690C54505429DBDCDCF10067AB5714BCDDFE1F2<br>8692710F794765781C1D233344E119BEE8A8416DC |
| $m_{PL70}$ | 7A18D6D30BDF44410714C3DCA27D8F9EA8A542D87122205640B98313C91AD9A0B993A5A7BC<br>3E035F93B88BBE6D4204BC82A9FA8D4C1A7618CF |
| $m_{PL71}$ | EB9525E10265A48733C8E0E77E459310112A71DCA680F68AC044B64BC0A31D02EEA0F7ACAA<br>AB7F1E574E94FEA2D1301CB14B03263DA8122B76 |
| $m_{PL72}$ | E706C6ED2D6F89153835079BE0C6D45310845EF2F9F6C6AE91B7419810508BA501C0148BF09<br>955BAD90D6391BA8EBA5CEFBD23221CC75143D7 |
| $m_{PL73}$ | DF071A10AC4120CD1431590BEDCFF9483CA7047B19590D035D309240BDB4264E9A3A2761402<br>EC97FD8BC51B4AF32E37FBC47162A2357D18751 |
| $m_{PL74}$ | F0F952B2238139F46D8254D1A2C1C22A16BA71EC0C0C900ED1442452D7F44C798BC65FF4067<br>1B88074BA0B74C6510996EEAC495C5B49C37DEB |
| $m_{PL75}$ | 1C86BD82EDA81FD65418D3837B5552A853791456D93B06C62C650D86CFBEC269AFFD772763<br>064062C03751B9428C6DA2E60383025F9E404B70 |
| $m_{PL76}$ | B390978DD2552C88AABA7838489A6F5A8E9C41E95FFA2215819BF8A5BFE39C8A706CC658E5<br>49E966611B843A1468406C41C09D1560BEDA4F1B |
| $m_{PL77}$ | 1A69EC9D053C7E84BAE7A48CCC71857D0C6B06D1065E3EA4633B133AA022B8104F6EE7C69B<br>6184B746C8822958B0A16686F27C8A0E3B4EFEAD |
| $m_{PL78}$ | C95B2070816DC97C6D8DD2583263E73F9AAAFD13F0548D2EBD835824418F11E54111005FB71<br>3AB234BE412347358281C7DE331EDD21B8BEA52 |
| $m_{PL79}$ | 56D6408399F23C2ED85EE0F68111D69A91A3AD9A732AC57CA08F86CC28B3CF4E4B02EBBA0<br>BCE5CAE5BACC4D52004070797C04093A84BB18DBA |
| $m_{PL80}$ | E662E7043867BE250764DA0596D34A582A619B408B505E6211DD6286E93A37F95B1EA680C0C<br>5F3E777E3F71E8D75495D59043217FC0E222E16 |
| $m_{PL81}$ | 27D5E681C222297AD478A079EF12F1A98F744B66335303322EF8880B931FEBF8322F4302944E<br>80BED468A0A516D410B183D863795992DA7DDB |
| $m_{PL82}$ | 5100336C05F9E5BF35201906C1C588858E0DAF56130DF5554B9AB21CA15311A90290624CD63<br>E03F5EDA49DB7A0C32AB5F1CA427A2D5635FDA5 |
| $m_{PL83}$ | C696DC993BFAEA9A61B781B9C5C3F5CFAA4C8339D8B03A9B0387883D0482A41AC78D652242<br>5959846E561D26A30FF79A205C801A85889736B2 |
| $m_{PL84}$ | D562297561AFF42D3168296C1153E4E39BE7B2EB0348BC704625AA08391235075EE0DE0A79A<br>B03222FEDB27218C56F96EAC2F91CC8FCE64B12 |
| $m_{PL85}$ | DD0B6768FC01CC0A551F8ACC36907129623E975AB8B3FF58037F1859E2FA8C62C2D9D1E850<br>6916029A2C3F8CAD9A26AE2CC652F48800859F5C |
| $m_{PL86}$ | 923920696EB3AB413786C41854822282BB83F6900D33A232D470BE198BBF086067B72613300C<br>593B74251E2F079857ADBBCD86583A9DCAA6DC |
| $m_{PL87}$ | B8EF30C797D8D2C4EF11244F137D806E556A436626D0115A621C92C34D166A68BCEDFA0040<br>DA8FD6F987B1CD5C2AA1C1B045E64475F0F8DABD |
| $m_{PL88}$ | E1887001D414405ED6419E9EE1D1D346D924ED57ADF04B31B7948099976B2D1501A60DFFB28<br>7AD44C8783DF0C1EA5AA5D273D1389C8EA22DCC |
| $m_{PL89}$ | 8C2E379A58AA96748141CA84C35987905F984A49D3AD9BFF7807AC244C16C1DF74343C2E1F2<br>5514F5A0954CFBB3C92E25EF783136844998AC5 |
| $m_{PL90}$ | 78F8A99E0A54E27F51C0726FE7A11EB26B1E29FE65F55AC8AC58011465900B958488A90F6DF<br>614A58431DC8B6C6B9A6F032EE0E0B1306EC4B4 |
| $m_{PL91}$ | 88F7A31B7B20E0F05CA26E729B4F8A1933962D7BD7BE3E1EB130B28C794C0B4D01CADE0900<br>6FF97E80117509733F3A9DC225413A0AE08CA662 |
| $m_{PL92}$ | BE4DFCEAC18905AC8D5DA27A794F88A4D3058D2EFA3B075A819DEAE688EAF8940A653ED71<br>04E7B403D490F0A9030264E1F12B8922C75775E61 |
| $m_{PL93}$ | 5BA4B79FC4550234D8922963BF3537485E3C8745A5DB90D3E2E454B30FF61112F508155B7C2B<br>3C4C628AF846240C2021ACDE547E5A41F666B8 |

| Code ID | Basic Midamble Codes $m_{PL}$ of length $P$=456 |
|---|---|
| $m_{PL94}$ | 00556D35649F7610AB24A43C4F16D6AC0571FD126F11880C5CD72100D730E4E4D6BB73C33F837FAF1072743B249ADA2E09598B1EB23F1180A7 |
| $m_{PL95}$ | 7A0CC9F21BD69CF3023E944545C2176EF0D4F450B765C28359FB8A32137D043D0E5713E67B3F61320985D2C6106605081F87D2296321468A2F |
| $m_{PL96}$ | DA669880995B0671201172BABFF141D5854A245E211879EF3038A7C84170DADBD368455F24653161E7886E15B253F93E3A3C568EFB17CDEB1A |
| $m_{PL97}$ | 4E294E53D1661C1F6F748302A7723DA951C00FDB8BEBBF67A68710BA0F1A255DFB1627059D41A23D3961726DE6FEB10E5D209CC4505B209812 |
| $m_{PL98}$ | 73385DF701414E144768A67EF72924B1653479E962FB1554B7E54BC5284D9B3E41C0C133F878972230721918AA425501B920B204FECE0C7F8A |
| $m_{PL99}$ | F4492160805F258CE592DF4D1200566F81D173458D78EA3ABED79A14AF88170DB1D4A9A5931D2B80C58C27FE17D806E3E6A66CDAAD09F118D4 |
| $m_{PL100}$ | 44D562D9012D8B07B8F44596467C11A163982BB7EAEAC184078B6B8CE46B5D7E17C39CEF576A025491183017FA09931D070B307B86524B03FF |
| $m_{PL101}$ | FCAEEFCC49A13B4FFA12C0CC6A2B90CF4F57D78B1E98294B04675C2F0991661FDC61A452A247F8C29E0284AA21026F368307375AA2C3F1E12C |
| $m_{PL102}$ | C486DF0510DCAD5AB86E178A686D398E11A0ECFAC5A326C10129257E5456B22FB8E147E9190D9929A5DFFE44715FA47D62F04CFC9B1C201414 |
| $m_{PL103}$ | C10AF383DC708E257E15A8AB337BCE684A2F4AC7A22DC2C25C277F8E8D0858E79317CDDD9AA2EA6CBE604D24AC0945026103E7B4126FD361A4 |
| $m_{PL104}$ | A5C60A181148D9A931B2DDDB9D169648BA54F366B4EFAE88F6861909EE0F07C037EE349D0EC59A823286E366CA3943589EEA7F828C3728085F |
| $m_{PL105}$ | 96136AEBD5E28462B0421DF292BA899FFA660D80EA01620D2C7490E5347127884AA3C3D1FF44BCEEF6C29EC589CDEF200C5742C5964F8B2B52 |
| $m_{PL106}$ | 40F63C04ACAD986255D1E16B769A6D4C11A1D075E804BDC0AC61923E9A67F5D7417756328072455F6E22B1C64E06F367D1B0808295C2D90E22 |
| $m_{PL107}$ | F4B82D413578C4888C5F002CF6D0E03778134A860436551FD57537E4CED334B3C9CEBACE615238271717AA762448B86FA53D2074BCE35658A7 |
| $m_{PL108}$ | BCCC92D72C920E685530591FC351743D1E23DE044BF81D32650406113E23ECC757FDE4E386B6E2E7195EE4969717A7BD0812AC312B33A54308 |
| $m_{PL109}$ | 6ED59DE0D44370A861CE2B42CF5E578E764A682AB5777905EE027D7160490EDC6C28989B23805AA697FCD215CB401BC5E4D430624C01B16192 |
| $m_{PL110}$ | DE80C0E273B92CC3C5034F7A20DB3914643C430B425C8B9249EAF73ACE8C3BCF17957242CF534D87A67D4DC0252275262E737F4095450CFA14 |
| $m_{PL111}$ | 9505C4FEF2A397D5059F4729D013292A8321FFFA929ACB0A210D0A13E13061227C44A68FBD8CE6B66CE3D783363CD039AB35EE52603E09B758 |
| $m_{PL112}$ | E8BE90D7F954B14D8002A4CAC20765ABEED80634498C836D79B0F9338DBC17B28F05CF4E79136779E1C55AA30B6215F890882887B3B53C23E2 |
| $m_{PL113}$ | 9F4B622C1358AE5468DC31E4B2CA320E5E20458C1DE5405BF4F9AD7D45A5BCAA39EC0626FFFC698C16A009CCCB7A18A64E85E70BA71731BA24 |
| $m_{PL114}$ | B91B2624843CF48299AFC2B1442570B41F28F578530D1E322E0B54282372131C71ACB924E70768A243EEC3200E7A5EBFA77111D9FB07FEA8AE |
| $m_{PL115}$ | 965F42DDA3A4650FE2F5103932B68F166FA424B9F0F7045311D962C2A9F66B9BC6C66FB480F9800354E0C54A72251071422CF1DFC44F94C00C |
| $m_{PL116}$ | 08ADCE48699FC30FA0788073BDAADB9177BBB4C1CED41F93085218364B8BAD8488561EF0FE1B0DDAA403C602494CB35697D62AA0A2B93A64CF |
| $m_{PL117}$ | 9A313BED80B1220D77C8ADA4B2E0B3D284A5120A94B741380923C78D3AD32BC3E71EC6EEA520E9D447D8727697598BB987F17506F482003ABD |
| $m_{PL118}$ | 24C9AD4C14EFEC002A3473FCAB04E492F2E269161A2960BA8AF09FD710B444A40C4E8B138418E62301E91FBA97AFDC58759A76D00F676736C7 |
| $m_{PL119}$ | 6514C7733711CE4942CD2123AB37186EB7FECB7E78ABB28744864942FCF4C0F810054AF55B1042EB53064F0857C61D85B2CF0D2DC5826AF22F |
| $m_{PL120}$ | B2C80CDC83E48C36BC6FDAB8661208EAD392F3A0571BE41DFAD765E744932ADEA50061E66C05498A5381B2A1F1B446587089DC4E4A2DF03D82 |
| $m_{PL121}$ | 639368BA75CC709A3D9F28EDA237E32C2017A9BF1E382045B9426AEE0A4049DCB4E1D7EBE4647B855212824557497CFA039885A3BA42F98F63 |
| $m_{PL122}$ | 6A70DDC17D0C8024B1C853F0C1948561EF32510151BE0C63BCA9171F20217891D1021EE72586CAFF557F8973336913A94A2A699B8740B054B8 |
| $m_{PL123}$ | 2E32E3A35CCD001172CE310B63B4E406126045A0FA3795BE3E3D9B56F72405FC94FD89946818BAECD24A61BABBBE2D23052AB01EF73CA0CF4A |
| $m_{PL124}$ | 829395C35205A480AC1351C25E234BF52D384A3DE1C5138A650A6F82F739757D812D9C38231AB9FD81AA0648B11F6F6113F9312C57624FC746 |
| $m_{PL125}$ | D98FFE19C0AAAAB0571A9075ECDFD3E7373F5255DC669116A8C6913F0123E598F930934C5F6A601C37C529C371A0C391B59AC5A9E286D04011 |

| Code ID | Basic Midamble Codes $m_{PL}$ of length *P*=456 |
|---|---|
| $m_{PL126}$ | C1A108192BCE96C2430A63C189BB33856BE6B8B524703FCB205DAEF37EF544CD43CA09B618<br>1B417398083FF2F781BA4AE89A5CA291DB928D71 |
| $m_{PL127}$ | 42568DF9F61849BF9E7DEE750604BE2E0BC16CC464B1CDE15015E01D6498E9F3E6D6950E58<br>24651F212BA0057CE9529B9CCAB88D8136B8545E |

# A.2 Basic Midamble Codes for Burst Type 2

In the case of burst type 2 (see subclause 5.2.2) the midamble has a length of Lm=256, which is corresponding to:

K'=3; W=64; P=192.

Depending on the possible delay spread cells are configured to use $K_{Cell}$ midambles which are generated from the Basic Midamble Codes (see table A.-2)

- for all k=1,2,...,K; K=2K' or
- for k=1,2,...,K', only.

The cell configuration is broadcast on BCH.

The mapping of these Basic Midamble Codes to Cell Parameters is shown in TS 25.223.

**Table A.-2: Basic Midamble Codes $\mathbf{m}_P$ according to equation (5) from subclause 5A6.2.3 for case of burst type 2**

| Code ID | Basic Midamble Codes $m_{PS}$ of length *P*=192 |
|---|---|
| $m_{PS0}$ | 5D253744435A24EF0ECC21F43AA5B8144FBDB348C746080C |
| $m_{PS1}$ | 9D7174187201B5CE0136B7A6D85D39A9DD8D4B00E23835E4 |
| $m_{PS2}$ | AE90B477C294E55D28467476C6011029CDE29B7325DF0683 |
| $m_{PS3}$ | BC8A44125F823E51E568641EC12A6C68EAFDFA2350E3233C |
| $m_{PS4}$ | 898B7317B830D207C9BC7B521D5715680824DC08347B2943 |
| $m_{PS5}$ | 466C7482C8827655BC13F479C7C1417290679A9841297C4A |
| $m_{PS6}$ | AC0734C27C7DC1B818A8492744290DFE866B0EBA62B0B56E |
| $m_{PS7}$ | 0A92106325B15A8C15FC3764724CE67A5056D50A77F9360E |
| $m_{PS8}$ | AE69F62E23035083E6094B89493D33E06FDB6532D473A280 |
| $m_{PS9}$ | B485D4E3614C9C373EA1365FA6FA890E9844084EBA90EB0C |
| $m_{PS10}$ | 66182885E2D28360D2FEAB842C65304FFC956CE8DC8A90C7 |
| $m_{PS11}$ | CC30A9B0A742FCC1E9A408415368391F1299AEA3CB6509FE |
| $m_{PS12}$ | 673928915886947F464FDDAAD29A07D182328EBC5839089A |
| $m_{PS13}$ | 4418861C14D62B46EE6D70D4BF05A3ED801A01BD6CDC5235 |
| $m_{PS14}$ | DAD62DC88F52F2D140062C2330BE6540E6F86192322AFB04 |
| $m_{PS15}$ | A2122BAF24529CEA9855FB43CE40923E7CA7B30D92E40702 |
| $m_{PS16}$ | 6C44AB41E11F54B0929DF65673BD231F92A380132D9F1712 |
| $m_{PS17}$ | 1DC2742E756CDA6421340D0087DD087A615E4B8688CB2F75 |
| $m_{PS18}$ | 2E0105328B56E9E07D9B5A62F38B08AF8D8C2817B54F3302 |
| $m_{PS19}$ | 88315EC30A94CA4EDB2C77079D9BD810A2E280B50DABB213 |
| $m_{PS20}$ | 440E0093D28CB2B2B0A95D18CEB4AB934C33FA45C1CFC7B0 |
| $m_{PS21}$ | CC9BF85D41A96A6EC314F9611D5E1C0672556C8850801BB4 |
| $m_{PS22}$ | 1ABEA04C99BC26972715F01957C0B6B959CC71CD88120817 |
| $m_{PS23}$ | EC5A33DA0BA4470442C5CB324A8E47B0A9F7968FC8108EE8 |
| $m_{PS24}$ | F82086290271DB446B5B1DC15D9BE96414B19B3D5E0F540C |
| $m_{PS25}$ | 11A1A790D6958FD3A9157DF1E05D1378248CA201EBCC7592 |
| $m_{PS26}$ | AA8564882231907BCE78092DC6C9DD4F5A0E4A34AFCFB809 |
| $m_{PS27}$ | 912EE2238212F87BC7CDA7F30441ED184A6AA954EC4D20C8 |
| $m_{PS28}$ | 2D200D8B8891B804673E380A1AF5AB875986E29D37D3FDC9 |
| $m_{PS29}$ | 75E086B6C818423491BF9D6365C52FD1C5E42A576E268170 |
| $m_{PS30}$ | 50ADBF27DA2A3701470186B699118E16DDB0D10F705607B1 |
| $m_{PS31}$ | 656C0692B4E22023590A906D2A74DFD471C883A7B1E0B3A2 |
| $m_{PS32}$ | C21FDACD09A3CDCE74C4794010A3E45769B142505C56A0E6 |
| $m_{PS33}$ | CD9392A87C2D4D7CE5801CDDA8A76339B6F900F008B290E2 |

| Code ID | Basic Midamble Codes $m_{PS}$ of length $P$=192 |
|---|---|
| $m_{PS34}$ | 956426FEFD8B8D52073E87984E10C4D255064E1372C04A24 |
| $m_{PS35}$ | C4F4D6DF1B754AD6063FD10C331C1428ABB27B0700134B94 |
| $m_{PS36}$ | B65548082B34E9FAF43F33C4070F79099758CFD41B491A11 |
| $m_{PS37}$ | C8317EA111A82B04E78B88B864B1EF5D711BBEB4A0527036 |
| $m_{PS38}$ | 8FB7AD1188E8D1A5219845013672560FD38904E70537403B |
| $m_{PS39}$ | B41A324E0D80AA0598A8D391C1D7FFC82B4A075218E98EC3 |
| $m_{PS40}$ | 49A6350A62E208B011E86528B9A481A0E76D723F6675FF82 |
| $m_{PS41}$ | C344C8C23C42A7B7442E6022E95AE4B08A4BFA786F35F911 |
| $m_{PS42}$ | 28F430CF67D69C9DF60E25656413BC5F932A022DB1406C44 |
| $m_{PS43}$ | 2FA5D70CF0FED4213F32116051450391C2A627D9B670C428 |
| $m_{PS44}$ | 959537D988FDD4F1360B4E84701AE5409229C30EDF8BC404 |
| $m_{PS45}$ | CDD2E0450F9EC12F81391AD4633CB29F315B4A0A890A9A22 |
| $m_{PS46}$ | 158776A20B4B82C563EC08F086830EA66DBD2DCCB4DF6026 |
| $m_{PS47}$ | 431FCACBE48208975950342709D11F19AD5FB047F3B440C9 |
| $m_{PS48}$ | 86B141AC571BA6B42653B12FF04D4F0E6C81F3EB608660A2 |
| $m_{PS49}$ | 86D297ABD34E8510F6CDB0EA617F1F1051C8799117B02211 |
| $m_{PS50}$ | 80B2D9530B34E781311D95CFA3857F277CC07014D324AF5A |
| $m_{PS51}$ | 2B607B93FD8B45601C1E574E14CFC6912C22AEC1045ADC49 |
| $m_{PS52}$ | D234C5C45E105A837E6DD74BC4E534523A20317BA0625A29 |
| $m_{PS53}$ | 768CCDB3E2A7A2B863128382590946B25472BE2BFFC40641 |
| $m_{PS54}$ | 3DA38212E0A987EE1F665D4E13C2AA4446E00A76C948A073 |
| $m_{PS55}$ | 09173135E4A2CFC8F2678750AB5257110906F013587BDE82 |
| $m_{PS56}$ | 522E070B266F35E99C1F3C42D2017F8E415550492B72F086 |
| $m_{PS57}$ | D63E4BD805262A3DEF05C7D86C422E5048921E5531784132 |
| $m_{PS58}$ | 564AF806E28131611E5F884229265D446A50E1E488EAFBBA |
| $m_{PS59}$ | A2603E009D3D30147727B750C35C62299AF754D3E4A54E1C |
| $m_{PS60}$ | 938504B02599D33E28246E4271C375AE81A3BBE8D3F8A920 |
| $m_{PS61}$ | 461516B2CAC6FC42A4B707CC6073BBE573C014892C811776 |
| $m_{PS62}$ | 29186DE4CCAAB2CD0100BB19EA595879D63F0F0CFA881AA5 |
| $m_{PS63}$ | A064B449CB784A91B803369CDC5EF61A670AAAC044BA3E68 |
| $m_{PS64}$ | 8719C454D88FF5149DB943CB6CADA01D0B9664B357A18203 |
| $m_{PS65}$ | A27EC68720F00A714AA2C45A7EF232286984D7B193F5C916 |
| $m_{PS66}$ | AC8361676AB424E48F0789082B0CD2EFB8D2E627D041DD66 |
| $m_{PS67}$ | ABA1BEB0064733A0620906BF2B29C95883F069D7E4C35D39 |
| $m_{PS68}$ | 9E22EEDED47D92CA1D0B7530EC6062287BD83A04874AE00C |
| $m_{PS69}$ | 0BADEF288B20F5686C5DE3A71219AC2172054326BE831696 |
| $m_{PS70}$ | 953801EB2AF58C2F80E49A6CC46085CB554243E3B3BBEC8C |
| $m_{PS71}$ | 333A504C51C8FAC5025994565C3F600F154F64FAEF4EA484 |
| $m_{PS72}$ | A6583E19647662005474153A6F8DD88A473853E94B720CE7 |
| $m_{PS73}$ | 90ACAF707D18AF34F5848C58166830AF620ACDC1B2DFDDA8 |
| $m_{PS74}$ | 39C5C598A374EA82F3F83378258248DAD3808812DD0E74BB |
| $m_{PS75}$ | F79525DE694629346D73F6256CC0F140F82603197AAA1844 |
| $m_{PS76}$ | B8C2A8F139097699A693022E78588D4058DB0A65FF52F813 |
| $m_{PS77}$ | 449B50C2A52996FA5A828A907F30F9F460EE3D99930DF890 |
| $m_{PS78}$ | 62CEC9574D30184BCB4F94EECF0CC23D2D2A8D0003F0AA33 |
| $m_{PS79}$ | B56D258889703F76A0738EE3A7D355994159A4851833E198 |
| $m_{PS80}$ | 65894AA54C0F6C9A206521C9FC379A8AAF6E621C03CF849C |
| $m_{PS81}$ | 2D47F3414E30CC02C6835D95C9BA204488F0FFCB4852677D |
| $m_{PS82}$ | 12BE4DD8B906B584010F8A330AB67B278E8642FA33D51B68 |
| $m_{PS83}$ | BC928A90A4B10906CAEE638BF768E08542F48F1676006DF0 |
| $m_{PS84}$ | 30C544E437C8ADA143566CD1BC4E9E7BA84139A08505C2F4 |
| $m_{PS85}$ | 84FD5B05506192B753FBA2C719B584E0EDA01814999867D2 |
| $m_{PS86}$ | 191F14DD00034E03AB5BB4342F1138B2CD33784E60CFD75A |
| $m_{PS87}$ | B8ACE7990B6A98A80A61162C4D2D5F88F24E8F7DE4207590 |
| $m_{PS88}$ | EC1DBE72E8EED0C61054FC2695422AC0AD2D888265B21AB0 |
| $m_{PS89}$ | 9A1B4CA467AB7E082AF4278E44D177EA78424508C23E8B08 |
| $m_{PS90}$ | 999EE541C608164AC975214F3A37A677FC2CA03E2C2A4B20 |
| $m_{PS91}$ | 1BDCC20265031432917A2EB828FB356A22DF9CB609C0F8F3 |
| $m_{PS92}$ | EB4A81859C93338B8A1B87C02C815AE09D765F6F2249B958 |
| $m_{PS93}$ | E6A5D1629F4CF09A1F280DE0C480D4C73B26ADE321A50AEE |
| $m_{PS94}$ | BAAB7286DD24C80B15A7958039B904F1CA83C310C8C7AFF2 |
| $m_{PS95}$ | 12220F72619E983717C68FFE1C4148F2354B7B1955B65620 |
| $m_{PS96}$ | A198706E24FAA08BD09EE392414816038E667BB34307D6B2 |

| **Code ID** | **Basic Midamble Codes $m_{PS}$ of length *P*=192** |
|---|---|
| $m_{PS97}$ | 30B3493B4C035881A7A722E4546527AAE787FA2C0893AC46 |
| $m_{PS98}$ | 5A7318126522843DCB7F00A2D9F9BA8F88963E4152BC923C |
| $m_{PS99}$ | 844844B0CACAB702C332CE2692B4166F4B0C63E62BF151BF |
| $m_{PS100}$ | B82973895264103136 92F861DC60DA86A23607F7DDE24755 |
| $m_{PS101}$ | 6C1144CF8BC01538D655D29ED62DE6E74A3180EC905BF1E0 |
| $m_{PS102}$ | E9DB3221FACFC5C88691A7013EF09672A130D52C3413AAE2 |
| $m_{PS103}$ | 2FD0508615EC4CD4BF18ADD46D777078869130C8921A4F0E |
| $m_{PS104}$ | 40911B4E0525AC874228F6EF642E59154730CB187C7E417A |
| $m_{PS105}$ | 2034C6A027D4D850F5184AA64C3153231F4651B616BBFCF9 |
| $m_{PS106}$ | 57833235451525A1DFA213FCE0B419B6494BC7B99F488410 |
| $m_{PS107}$ | 6DC3D57F2E39158D036825F8804810D77CA1ECA610ECD894 |
| $m_{PS108}$ | F5C50DE43AA7B731CAB7683524021701F97650499A7070E4 |
| $m_{PS109}$ | F2184D2699785442E09FA22CC2D60A5A13FFF22AE660A470 |
| $m_{PS110}$ | EF0029DE0D79207205458CF4D7328E81A93518D93C9A74BD |
| $m_{PS111}$ | 9D6D8992482FB885AA5E878C3BA2045538B09886C23CDC2D |
| $m_{PS112}$ | C0A5AB67D1CEA126F6476C75443F0A11CBE749412EF03104 |
| $m_{PS113}$ | 1853A5C20CDF968C5A180D8EB5E72BF15517D06680D98412 |
| $m_{PS114}$ | 8CEA1223227ADF37D0DAAB320906E1C79029F480D25181A7 |
| $m_{PS115}$ | 5561038E96A658EF3EC665612FF92B064065D1ACC1F54812 |
| $m_{PS116}$ | C55A6263F08D664A1E53584560DFF5E611640D8281D9A843 |
| $m_{PS117}$ | 4386A8EA59124D043F29056A4598735A4FC7BC11119B90C1 |
| $m_{PS118}$ | D6571B20668BED50BD7C80388C162632BCB069AA67C7FC22 |
| $m_{PS119}$ | 4F9F09ABBC1391EC2CCA5359FB52250E533BF04324154106 |
| $m_{PS120}$ | 662659F42188C9453F6E6DF00C579627045DA1461A3A0EA5 |
| $m_{PS121}$ | 8DCC9274C0C2A9BA6096BF27FACA542CD01CA8653D60A80F |
| $m_{PS122}$ | 5C1210A1E50E505F6B73C90156C9D9F19AE2310BBD820DF0 |
| $m_{PS123}$ | B1E0A7CE26202E223D4FC06D5C9BBA4E5F6D98204D2D5286 |
| $m_{PS124}$ | DB506776958E34552F7E60E4B400D836153218F918E22FA6 |
| $m_{PS125}$ | ECAA60300439B2360B2AC3C43FB6241ACDE5055B295FA71C |
| $m_{PS126}$ | BF1E6D9AA9CA4AC092BE60500C77D0DC7A6A236520F86722 |
| $m_{PS127}$ | 051C5FA122845A30B4EC306B38016B45667C7754F92F13A0 |

# A.3 Association between Midambles and Channelisation Codes

The following mapping schemes apply for the association between midambles and channelisation codes if no midamble is allocated by higher layers. Secondary channelisation codes are marked with a *. These associations apply both for UL and DL.

## A.3.1 Association for Burst Type 1/3 and $K_{Cell}$ =16 Midambles

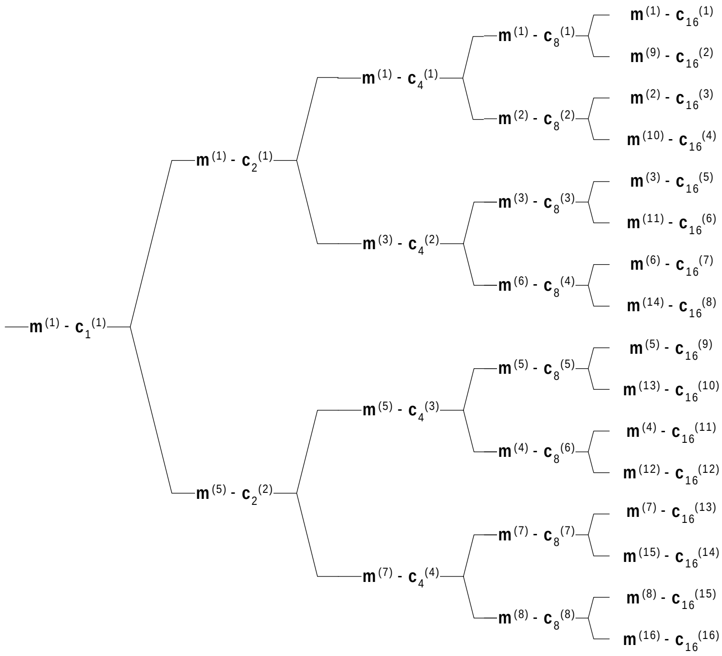



**Figure A.-1: Association of Midambles to Spreading Codes for Burst Type 1/3 and $K_{Cell}$ =16**

## A.3.2 Association for Burst Type 1/3 and $K_{Cell}$ =8 Midambles

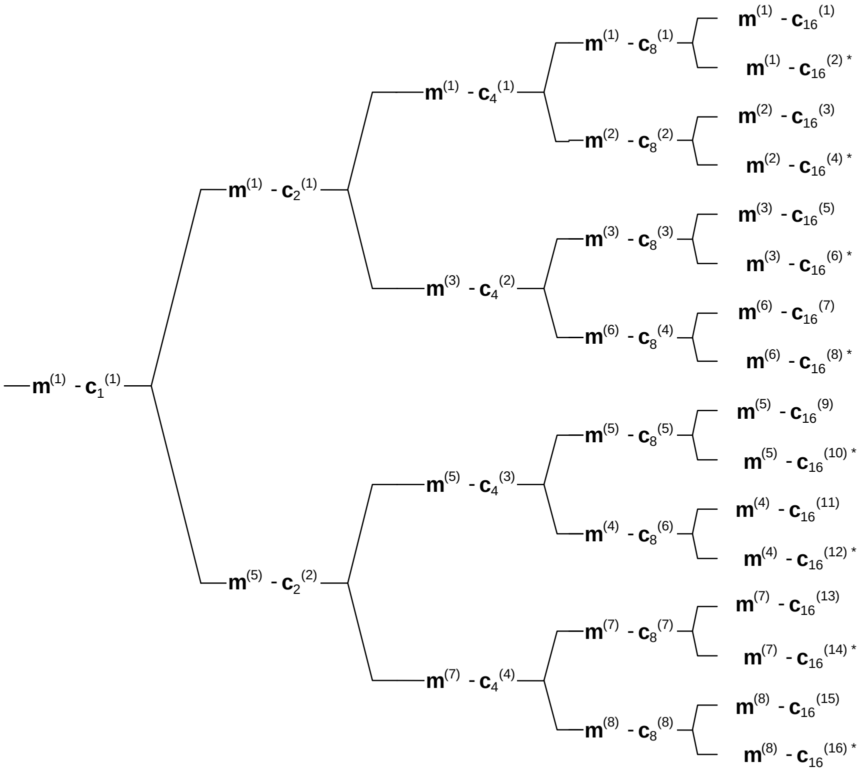



**Figure A.-2: Association of Midambles to Spreading Codes for Burst Type 1/3 and $K_{Cell}$ =8**

## A.3.3 Association for Burst Type 1/3 and $K_{Cell}$ =4 Midambles

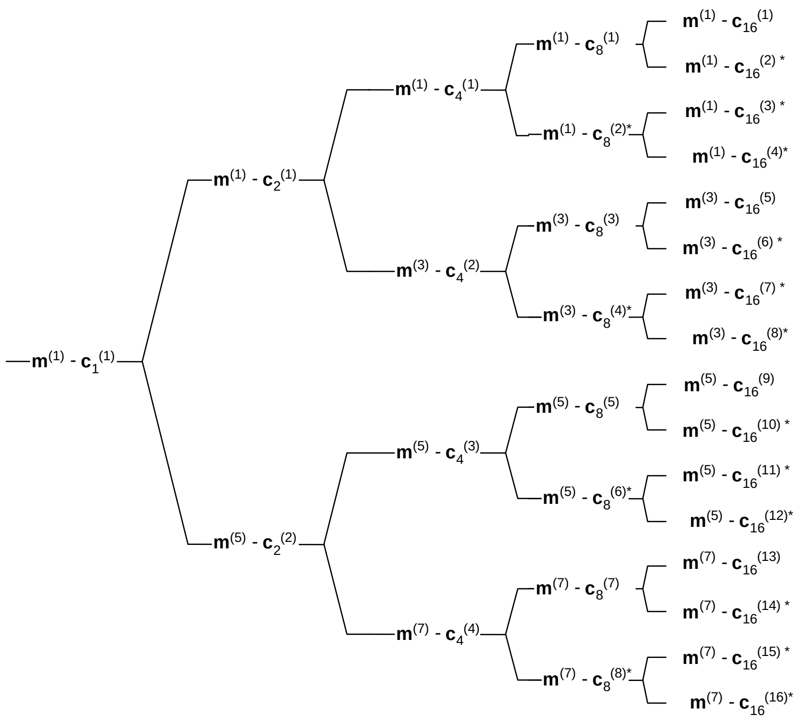



**Figure A.-3: Association of Midambles to Spreading Codes for Burst Type 1/3 and $K_{Cell}$ =4**

## A.3.4 Association for Burst Type 2 and $K_{Cell}$ =6 Midambles

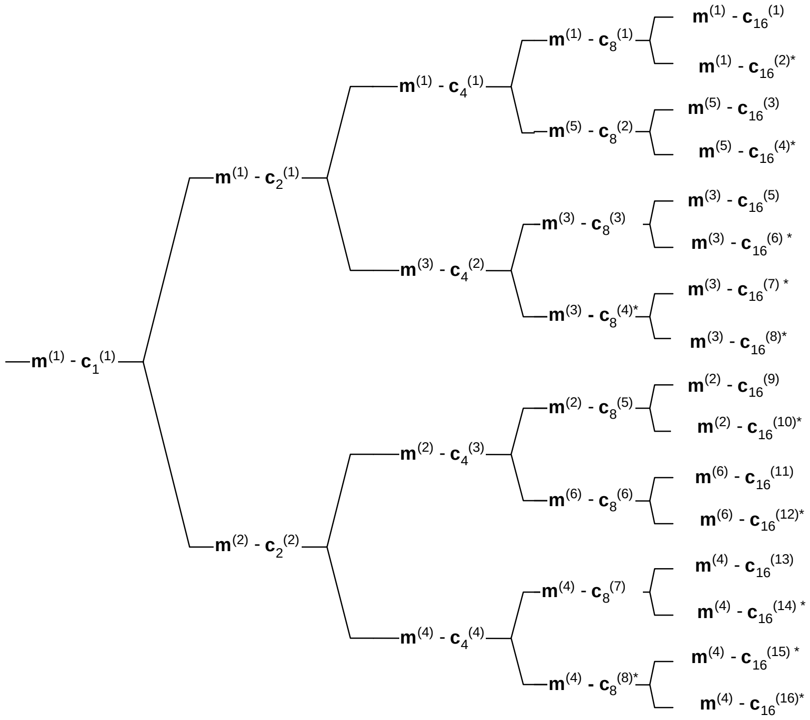



**Figure A.-4: Association of Midambles to Spreading Codes for Burst Type 2 and $K_{Cell}$ =6**

## A.3.5 Association for Burst Type 2 and $K_{Cell}$ =3 Midambles

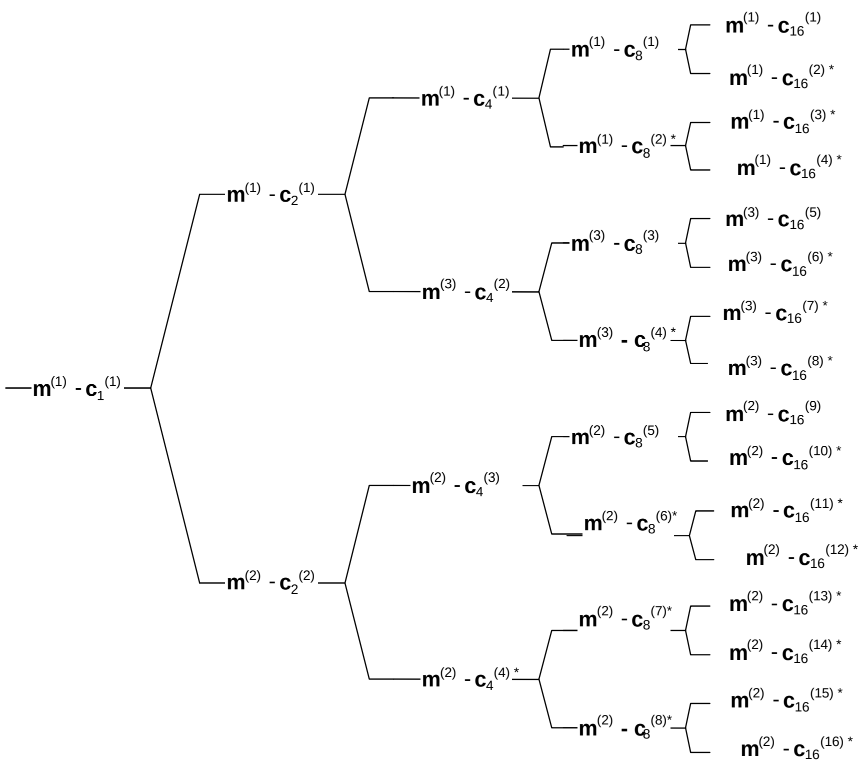



**Figure A.-5: Association of Midambles to Spreading Codes for Burst Type 2 and $K_{Cell}$ =3**

Note that the association for burst type 2 can be derived from the association for burst type 1 and 3, using the following table:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Burst Type 1/3 | m(1) | m(2) | m(3) | m(4) | m(5) | m(6) | m(7) | m(8) |
| Burst Type 2 | m(1) | m(5) | m(3) | m(6) | m(2) | m(4) | - | - |

# Annex AAB (normative): Basic Midamble Codes for the 1.28 Mcps option

## AAB.1 Basic Midamble Codes

The midamble has a length of $L_m$=144, which is corresponding to:

K=2, 4, 6, 8, 10, 12, 14, 16, $W = \left\lfloor \frac{P}{K} \right\rfloor$, P=128

Note: that $\lfloor x \rfloor$ denotes the largest integer number less or equal to *x*.

Depending on the possible delay spread cells are configured to use midambles which are generated from the Basic Midamble Codes (see table AAB.1). The cell configuration is broadcast on BCH.

The mapping of these Basic Midamble Codes to Cell Parameters is shown in [8].

**Table AA~~B~~.1: Basic Midamble Codes $m_p$ according to equation (5) from subclause 5A~~6~~.2.3**

| Code ID | Basic Midamble Codes $m_P$ of length P=128 |
|---|---|
| $m_{P0}$ | B2AC420F7C8DEBFA69505981BCD028C3 |
| $m_{P1}$ | 0C2E988E0DBA046643F57B0EA6A435E2 |
| $m_{P2}$ | D5CEC680C36A4454135F86DD37043962 |
| $m_{P3}$ | E150D08CAC2A00FF9B32592A631CF85B |
| $m_{P4}$ | E0A9C3A8F6E40329B2F2943246003D44 |
| $m_{P5}$ | FE22658100A3A683EA759018739BD690 |
| $m_{P6}$ | B46062F89BB2A1139D76A1EF32450DA0 |
| $m_{P7}$ | EE63D75CC099092579400D956A90C3E0 |
| $m_{P8}$ | D9C0E040756D427A2611DAA35E6CD614 |
| $m_{P9}$ | EB56D03A498EC4FEC98AE220BC390450 |
| $m_{P10}$ | F598703DB0838112ED0BABB98642B665 |
| $m_{P11}$ | A0BC26A992D4558B9918986C14861EFF |
| $m_{P12}$ | 541350D109F1DD68099796637B824F88 |
| $m_{P13}$ | 892D344A962314662F01F9455F7BC302 |
| $m_{P14}$ | 49F270E29CCD742A40480DD4215E1632 |
| $m_{P15}$ | 6A5C0410C6C39AA04E77423C355926DE |
| $m_{P16}$ | 797661553820310 3D4DBCC219B16A9E1 |
| $m_{P17}$ | A6C3C3175845400BD2B738C43EE2645F |
| $m_{P18}$ | A0FD56258D228642C6F641851C3751ED |
| $m_{P19}$ | EFA48C3FC84AC625783C6C9510A2269A |
| $m_{P20}$ | 62A8EB1A420334B23396E8D76BC19740 |
| $m_{P21}$ | 9E96235699D5D41C9816C921023BC741 |
| $m_{P22}$ | 4362AE4CAE0DCC32D60A3FED1341A848 |
| $m_{P23}$ | 454C068E6C4F190942E0904B95D61DFB |
| $m_{P24}$ | 607FEEA6E2E99206718A49C0D6A25034 |
| $m_{P25}$ | E1D1BCDA39A09095B5C81645103A077C |
| $m_{P26}$ | 994B445E558344DE211C8286DDD3D1A3 |
| $m_{P27}$ | C152332735814176389 06ADB61FDCA3C |
| $m_{P28}$ | 8B79A274D542F096FB1388098230F8A1 |
| $m_{P29}$ | DF58AC1C5F44B2A40266385CE1DA5640 |
| $m_{P30}$ | B5949A1CC69962C464401D05FF5C1A7A |
| $m_{P31}$ | 85AC489841ED3EAA2D83BBB0039CC707 |
| $m_{P32}$ | AE371CC144BC95923CA8108D8B49FE82 |
| $m_{P33}$ | 7F188484A649D1C22BDA1F09D49B5117 |
| $m_{P34}$ | ADAA3C657089DEF7C0284903A491C9B0 |
| $m_{P35}$ | C3F96893C7504DC3B51488604AF64F4C |
| $m_{P36}$ | B4002F5AE0CE8623AC979D368E9148C1 |
| $m_{P37}$ | 0EEBCC0C795C02A106C24ABB36D08C6E |
| $m_{P38}$ | 4B0F537E384A893F58971580D9894433 |
| $m_{P39}$ | 08E0035AB29B7ECC53C15DAA0687CC8F |
| $m_{P40}$ | 8611ACBC4C82781D77654EE862506D60 |
| $m_{P41}$ | 63315261A8F1CB02549802DBFD197C07 |
| $m_{P42}$ | 9A2609A434F43E7DCADC0E22B2EF4012 |
| $m_{P43}$ | F4C9F0A127A88461209ABF8C69CE4D00 |
| $m_{P44}$ | C79124EE3FFC28C5C4524D2B01670D42 |
| $m_{P45}$ | C91985C4FED53D09361914354BA80E79 |
| $m_{P46}$ | 82AA517260779ECFF26212C1A10BDC29 |
| $m_{P47}$ | 561DE2040ACB458E0DBD354E43E111D9 |
| $m_{P48}$ | 2E58C7202D17392BC1235782CEFABB09 |
| $m_{P49}$ | C4FAA121C698047650F6503126A577C1 |
| $m_{P50}$ | E7B75206A9B410E44346E0DAE842A23C |
| $m_{P51}$ | 3F8B1C32682B28D098D3805ED130EA7F |
| $m_{P52}$ | 8D5FC2C1C6715F824B401434C8D4BB82 |
| $m_{P53}$ | 0B2A43453ACC028FE6EB6E1CB0740B59 |
| $m_{P54}$ | BC56948FC700BA4883262EE73E12D82A |
| $m_{P55}$ | 558D136710272912FA4F183D1189A7FD |
| $m_{P56}$ | 5709E7F82DC6500B7B12A3072D182645 |
| $m_{P57}$ | 86D4F161C844AE5E20EE39FD5493B044 |
| $m_{P58}$ | 8729B6EDC382B152185885F013DAE222 |
| $m_{P59}$ | 154C45B50720F4C362C14C77FE8335A1 |
| $m_{P60}$ | C6A0962890351F4EB802DE43A7662C9E |

| | |
|---|---|
| $m_{P61}$ | D19D69D6B380B4B22457CB80033519F0 |
| $m_{P62}$ | C7D89509FB0DAE9255998E0A00C2B262 |
| $m_{P63}$ | DFD481C652C0C905D61D66F1732C4AA2 |
| $m_{P64}$ | 06C848619AF1D6C910A8EAC4B622FC06 |
| $m_{P65}$ | 0635E29D4E7AC8ABC189890241F45ECA |
| $m_{P66}$ | B272B020586AAD7B093AC2F459076638 |
| $m_{P67}$ | B608ACE46E1A6BC96181EEDD88B54140 |
| $m_{P68}$ | 0A516092B3ED7849B168AFE223B8670E |
| $m_{P69}$ | D1A658C5009E04D0D7D5E9205EE663E8 |
| $m_{P70}$ | AC316DC39B91EB60B1AABD8280740432 |
| $m_{P71}$ | E3F06825476A026CD287625E514519FC |
| $m_{P72}$ | A56D092080DDE8994F387C175CC56833 |
| $m_{P73}$ | 15EA799DE587C506D0CD99A408217B05 |
| $m_{P74}$ | A59C020BAB9AF6D3F813C391CA244CD2 |
| $m_{P75}$ | 74B0101EB9F3167434B94BABC8378882 |
| $m_{P76}$ | CE752975C8DA9B0100386DB82A8C3D20 |
| $m_{P77}$ | BBB38DCDB1E9118570AC147DC05241A4 |
| $m_{P78}$ | 944ABBF0866098101F6971731AB2E986 |
| $m_{P79}$ | 2BB147B2A30C68B4853F90481A166EB6 |
| $m_{P80}$ | 444840ACCF3F23C45B56D7704BF18283 |
| $m_{P81}$ | 87604F7450D1AD188C452981A5C7FC9B |
| $m_{P82}$ | 8C3842EBC948A65BC4C8B387F11B7090 |
| $m_{P83}$ | 10B4767D071CF5DB2288E4029576135A |
| $m_{P84}$ | 6F07AAB697CD0089572C6B062E2018E4 |
| $m_{P85}$ | D3D65B442057E613A8655060C8D29E27 |
| $m_{P86}$ | 5EDA330514C604BF4E0894E09EC57A74 |
| $m_{P87}$ | B0899CD094060724DED82AE85F18A43A |
| $m_{P88}$ | B2D999B86DF902BC25015CAE3A0823C4 |
| $m_{P89}$ | C23CD40F04242B92D46EED82CD9A9A18 |
| $m_{P90}$ | D22DDCC5CB82960125DD24655F3C8788 |
| $m_{P91}$ | 54987218FBD99AE4340FD4C9458E9850 |
| $m_{P92}$ | BE4341822997A7B11EA1E8A1A2767005 |
| $m_{P93}$ | 255200FBA6EE48E6DE0A82B0461B8D0F |
| $m_{P94}$ | 6FBD58A663932423503690CF9C171701 |
| $m_{P95}$ | D215033A4AA87EC1C232BAC7EDA09370 |
| $m_{P96}$ | CA0959B01AE48E80204F1E4A3F29CE55 |
| $m_{P97}$ | 582043413B9B825903E3A3545ED59463 |
| $m_{P98}$ | 5016541922971C703D16E284CBDF633B |
| $m_{P99}$ | 7347EF160A1733CA98D43608A83A920B |
| $m_{P100}$ | 908B22AD433CCA00B3FD47C691F1A290 |
| $m_{P101}$ | BB22A272FC6923DF1B43BA4118806570 |
| $m_{P102}$ | 0FA75C87474836B47DC7624D61193802 |
| $m_{P103}$ | A22EBA0658A4D0FF1E9CA5030A65CC06 |
| $m_{P104}$ | 6C9C51CA15F1F4981F4C46180A6A6697 |
| $m_{P105}$ | 4C847ACF8BC15359C405322851C9BDE2 |
| $m_{P106}$ | C1D29499C0082C9DE473ED15B14D63E0 |
| $m_{P107}$ | 7E85ECC98AC761005076C5572869A431 |
| $m_{P108}$ | D8F11121595B8F49F78A7039E44126A0 |
| $m_{P109}$ | 1A0BC814445FD71C8E5B1A9163ED2059 |
| $m_{P110}$ | A7591F27F8B0C00C68CC41697954FA04 |
| $m_{P111}$ | 6CA2CE595E7406D79C4840183D41B9D0 |
| $m_{P112}$ | C093D3CC701FC20E66F5AB22516C5460 |
| $m_{P113}$ | D0E0CDE9B595546B96C4F8066B469020 |
| $m_{P114}$ | E99F743A451431C8B427054A4E6F2007 |
| $m_{P115}$ | C0D21A344A2C07DF2A6EBE6250C7B91E |
| $m_{P116}$ | F031223E282CF7A4D8EF174A908668AE |
| $m_{P117}$ | E4BD244AC16C55C7137FB068FD44280C |
| $m_{P118}$ | C44920DE2028F19FC2AAB36A0DCFDAD0 |
| $m_{P119}$ | 3FA7054E77135250699E6C8A11600742 |
| $m_{P120}$ | D5740B4D8870C1C5B5A214C4266FC537 |
| $m_{P12}1$ | F0B7942D43BB6F38446442EB8126AB80 |
| $m_{P122}$ | 83DB9534EAD6238FA8968798CDF04848 |
| $m_{P123}$ | EB9663CDDC2B291690703125BABCB800 |
| $m_{P124}$ | 84D547225D4BBD20DEF1A583240C6E0F |

| | |
|---|---|
| $m_{P125}$ | B51F6A771838BE934724AEA6A2669802 |
| $m_{P126}$ | D92AC05E10496794BBDC115233B1C068 |
| $m_{P127}$ | D3ACF0078EDA9856BBB0AF8651132103 |

# AA~~B~~.2 Association between Midambles and Channelisation Codes

The following mapping schemes apply for the association between midambles and channelisation codes if no midamble is allocated by higher layers. Secondary channelisation codes are marked with *. These associations apply for both UL and DL.

## AA~~B~~.2.1 Association for K=16 Midambles

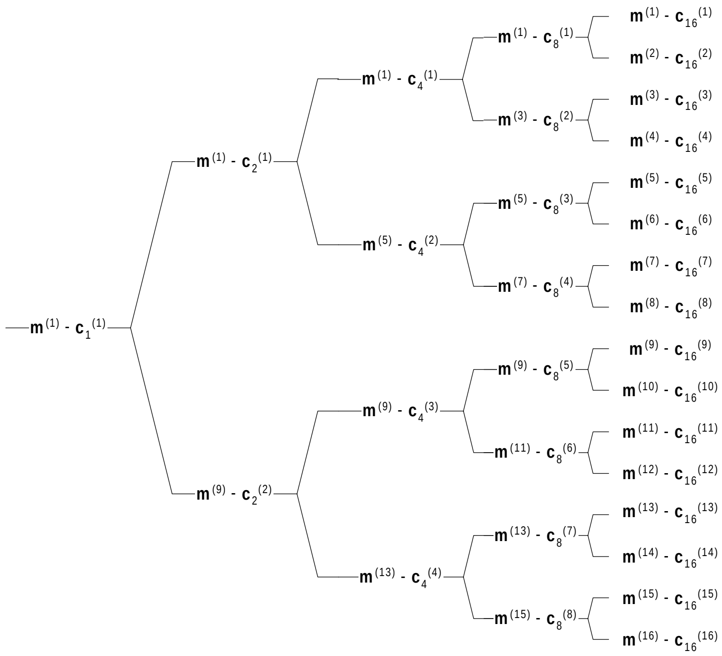



**Figure AA.1~~B.2.1~~: Association of Midambles to Spreading Codes for K=16**

## AAB.2.2 Association for K=14 Midambles

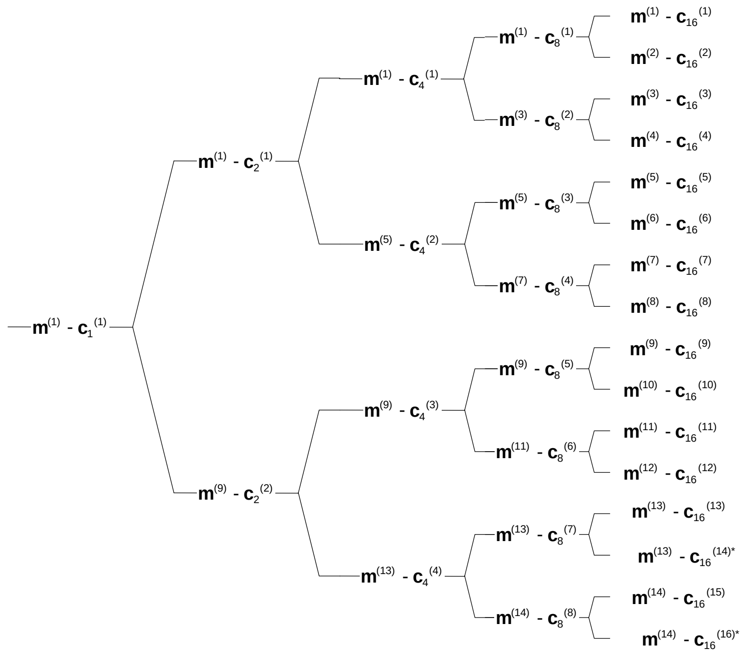



**Figure AA.2B.2.2: Association of Midambles to Spreading Codes for K=14**

## AAB.2.3 Association for K=12 Midambles

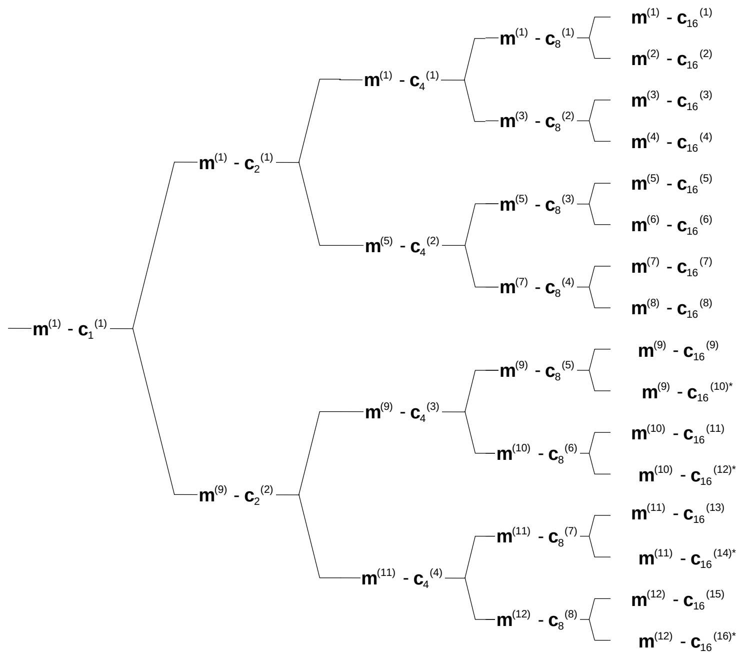



**Figure AA.3B.2.3: Association of Midambles to Spreading Codes for K=12**

## AA~~B~~.2.4 Association for K=10 Midambles

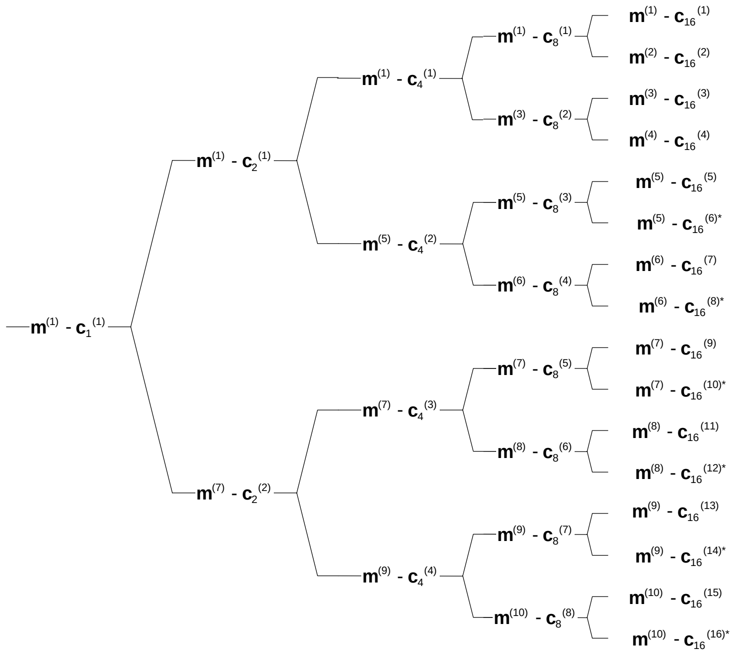



**Figure AA.4~~B.2.4~~: Association of Midambles to Spreading Codes for K=10**

## AA~~B~~.2.5 Association for K=8 Midambles

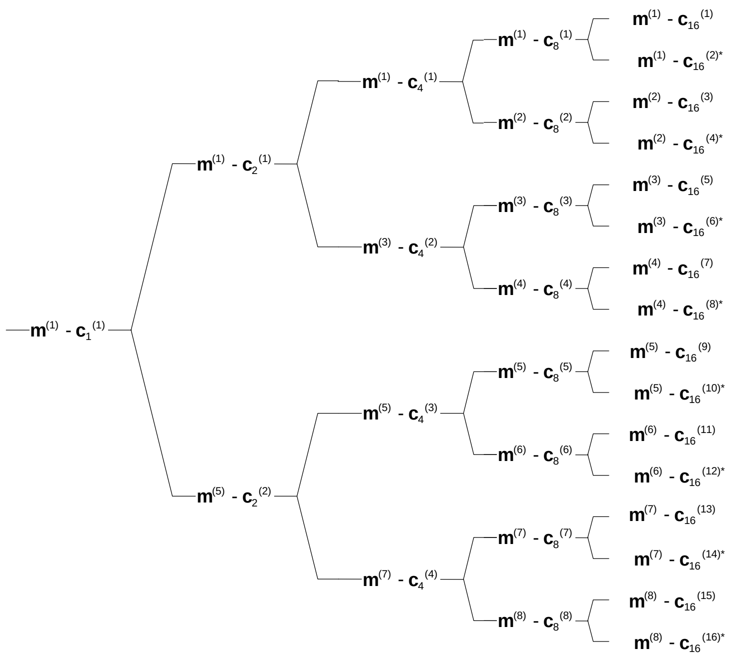



**Figure AA.5~~B.2.5~~: Association of Midambles to Spreading Codes for K=8**

## AA~~B~~.2.6 Association for K=6 Midambles

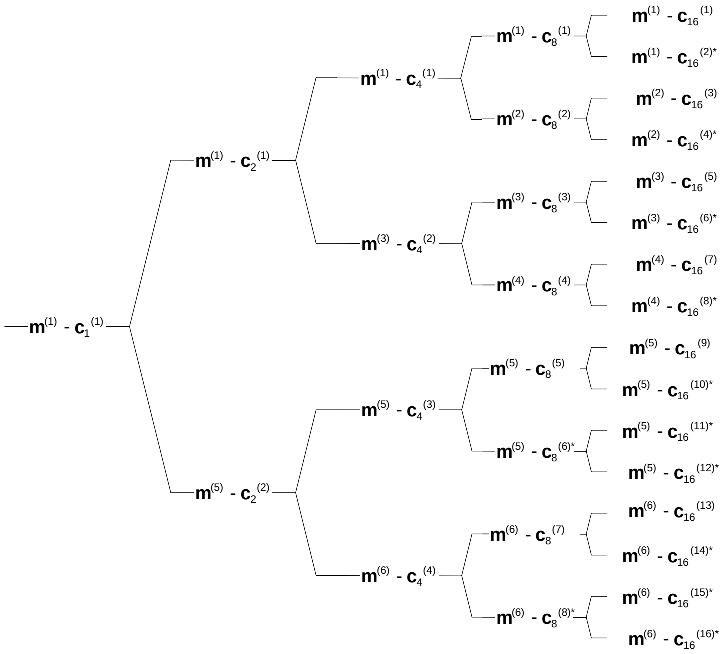



**Figure AA.6~~B.2.6~~: Association of Midambles to Spreading Codes for K=6**

## AA~~B~~.2.7 Association for K=4 Midambles

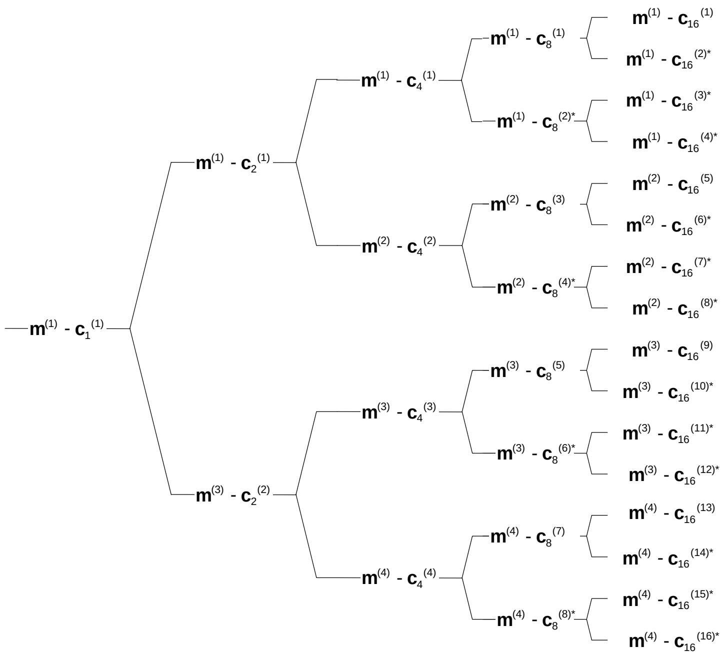



**Figure AA.7~~B.2.7~~: Association of Midambles to Spreading Codes for K=4**

## AAB.2.8 Association for K=2 Midambles

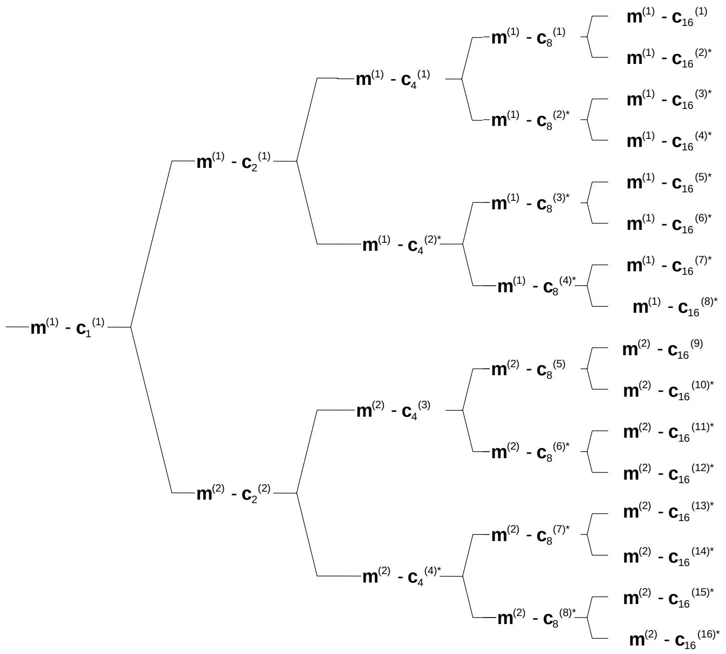



**Figure AA.8B.2.8: Association of Midambles to Spreading Codes for K=2**

# Annex B~~C~~ (normative): Signalling of the number of channelisation codes for the DL common midamble case for 3.84Mcps TDD

The following mapping schemes shall apply for the association between the number of channelisation codes employed in a timeslot and the use of a particular midamble shift in the DL common midamble case. In the following tables the presence of a particular midamble shift is indicated by '1'. Midamble shifts marked with '0' are left unused. Mapping schemes B~~C~~.4, B~~C~~.5 and B~~C~~.6 are not applicable to beacon timeslots where a P-CCPCH is present, because the default midamble allocation scheme is applied to these timeslots. Note that in mapping schemes B~~C~~.4, B~~C~~.5 and B~~C~~.6, the fixed and pre-allocated channelisation code for the beacon channel is included into the number of indicated channelisation codes.

## B~~C~~.1 Mapping scheme for Burst Type 1 and $K_{Cell}$ =16 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | m7 | M8 | m9 | m10 | m11 | m12 | m13 | m14 | m15 | m16 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 code |
| 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 10 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 11 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 12 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 13 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 14 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 15 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 16 codes |

## B~~C~~.2 Mapping scheme for Burst Type 1 and $K_{Cell}$ =8 Midambles

| M1 | m2 | m3 | m4 | m5 | m6 | m7 | m8 | |
|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 code or 9 codes |
| 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 2 codes or 10 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 3 codes or 11 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 4 codes or 12 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 5 codes or 13 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 6 codes or 14 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 7 codes or 15 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 8 codes or 16 codes |

## B~~C~~.3 Mapping scheme for Burst Type 1 and $K_{Cell}$ =4 Midambles

| m1 | m3 | m5 | m7 | |
|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 1 or 5 or 9 or 13 codes |
| 0 | **1** | 0 | 0 | 2 or 6 or 10 or 14 codes |
| 0 | 0 | **1** | 0 | 3 or 7 or 11 or 15 codes |
| 0 | 0 | 0 | **1** | 4 or 8 or 12 or 16 codes |

## B~~C~~.4 Mapping scheme for beacon timeslots and $K_{Cell}$ =16 Midambles

| m1 | m2 | m3 | M4 | m5 | m6 | m7 | M8 | m9 | m10 | m11 | M12 | m13 | m14 | m15 | m16 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 code (see note 1) |
| **1** | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 codes (SCTD applied to beacon in this time slot, see note 2) |
| **1** | $x^{(*)}$ | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 codes |
| **1** | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 codes (SCTD not applied to beacon in this time slot) or 14 codes |
| **1** | $x^{(*)}$ | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 codes or 15 codes |
| **1** | $x^{(*)}$ | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 codes or 16 codes |
| **1** | $x^{(*)}$ | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 codes |
| **1** | $x^{(*)}$ | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 codes |
| **1** | $x^{(*)}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 7 codes |
| **1** | $x^{(*)}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 8 codes |
| **1** | $x^{(*)}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 9 codes |
| **1** | $x^{(*)}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 10 codes |
| **1** | $x^{(*)}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 11 codes |
| **1** | $x^{(*)}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 12 codes |

(*) For the case of SCTD applied to beacon, midamble shift 2 is used by the diversity antenna.

Note 1: If only one code is present in a beacon time slot, this code is a beacon channel and the beacon channel is the only channel in this slot, by default. Therefore, only the beacon midamble(s) shall be used.

Note 2: If SCTD is applied to the beacon and only two codes are present in a beacon time slot, the beacon channel is the only channel in this slot, by default. Therefore, only the beacon midambles shall be used.

## B~~C~~.5 Mapping scheme for beacon timeslots and $K_{Cell}$ =8 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | m7 | M8 | |
|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 code (see note 1) |
| **1** | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 2 codes (SCTD applied to beacon in this time slot, see note 2) |
| **1** | x(*) | **1** | 0 | 0 | 0 | 0 | 0 | 7 or 13 codes |
| **1** | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 2 (SCTD not applied to beacon in this time slot) or 8 or 14 codes |
| **1** | x(*) | 0 | 0 | **1** | 0 | 0 | 0 | 3 or 9 or 15 codes |
| **1** | x(*) | 0 | 0 | 0 | **1** | 0 | 0 | 4 or 10 or 16 codes |
| **1** | x(*) | 0 | 0 | 0 | 0 | **1** | 0 | 5 codes or 11 codes |
| **1** | x(*) | 0 | 0 | 0 | 0 | 0 | **1** | 6 codes or 12 codes |

(*) For the case of SCTD applied to beacon, midamble shift 2 is used by the diversity antenna.

Note 1: If only one code is present in a beacon time slot, this code is a beacon channel and the beacon channel is the only channel in this slot, by default. Therefore, only the beacon midamble(s) shall be used.

Note 2: If SCTD is applied to beacon and only two codes are present in a beacon time slot, the beacon channel is the only channel in this slot, by default. Therefore, only the beacon midambles shall be used.

## B~~C~~.6 Mapping scheme for beacon timeslots and $K_{Cell}$ =4 Midambles

| m1 | m3 | m5 | m7 | |
|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 1code (see note 1) |
| **1** | **1** | 0 | 0 | 4 or 7 or 10 or 13 or 16 codes |
| **1** | 0 | **1** | 0 | 2 or 5 or 8 or 11 or 14 codes |
| **1** | 0 | 0 | **1** | 3 or 6 or 9 or 12 or 15 codes |

Note 1: If only one code is present in a beacon time slot, this code is a beacon channel and the beacon channel is the only channel in this slot, by default. Therefore, only the beacon midamble shall be used.

## B~~C~~.7 Mapping scheme for Burst Type 2 and $K_{Cell}$ =6 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | |
|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 1 or 7 or 13 codes |
| 0 | **1** | 0 | 0 | 0 | 0 | 2 or 8 or 14 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 3 or 9 or 15 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 4 or 10 or 16 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 5 or 11 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 6 or 12 codes |

# BC.8 Mapping scheme for Burst Type 2 and $K_{Cell}$ =3 Midambles

| m1 | m2 | m3 | |
|---|---|---|---|
| **1** | 0 | 0 | 1 or 4 or 7 or 10 or 13 or 16 codes |
| 0 | **1** | 0 | 2 or 5 or 8 or 11 or 14 codes |
| 0 | 0 | **1** | 3 or 6 or 9 or 12 or 15 codes |

# Annex BA~~D~~ (normative): Signalling of the number of channelisation codes for the DL common midamble case for 1.28Mcps TDD

The following mapping schemes shall apply for the association between the number of channelisation codes employed in a timeslot and the use of a particular midamble shift in the DL common midamble case. In the following tables the presence of a particular midamble shift is indicated by ‘1’. Midamble shifts marked with ‘0’ are left unused.

## BA~~D~~.1 Mapping scheme for K=16 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | M7 | M8 | m9 | m10 | m11 | m12 | M13 | m14 | m15 | m16 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 code |
| 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 10 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 11 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 12 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 13 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 14 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 15 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 16 codes |

## BA~~D~~.2 Mapping scheme for K=14 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | M7 | M8 | m9 | m10 | m11 | m12 | M13 | m14 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 or 15 code(s) |
| 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 or 16 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 8 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 9 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 10 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 11 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 12 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 13 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 14 codes |

# BAD.3 Mapping scheme for K=12 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | M7 | M8 | m9 | m10 | m11 | m12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 or 13 code(s) |
| 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 or 14 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 or 15 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 or 16 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 6 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 7 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 8 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 9 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 10 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 11 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 12 codes |

# BAD.4 Mapping scheme for K=10 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | M7 | M8 | m9 | m10 | |
|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 or 11 code(s) |
| 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 or 12 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 or 13codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 4 or 14 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 5 or 15 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 6 or 16 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 7 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 8 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 9 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 10 codes |

# BAD.5 Mapping scheme for K=8 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | m7 | m8 | |
|---|---|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 or 9 code(s) |
| 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 2 or 10 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 3 or 11 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 0 | 0 | 4 or 12 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 0 | 0 | 5 or 13 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 0 | 0 | 6 or 14 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | 7 or 15 codes |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 8 or 16 codes |

# BAD.6 Mapping scheme for K=6 Midambles

| m1 | m2 | m3 | m4 | m5 | m6 | |
|---|---|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 0 | 0 | 1 or 7 or 13 code(s) |
| 0 | **1** | 0 | 0 | 0 | 0 | 2 or 8 or 14 codes |
| 0 | 0 | **1** | 0 | 0 | 0 | 3 or 9 or 15 codes |
| 0 | 0 | 0 | **1** | 0 | 0 | 4 or 10 or 16 codes |
| 0 | 0 | 0 | 0 | **1** | 0 | 5 or 11 codes |
| 0 | 0 | 0 | 0 | 0 | **1** | 6 or 12 codes |

# BAD.7 Mapping scheme for K=4 Midambles

| m1 | m2 | m3 | m4 | |
|---|---|---|---|---|
| **1** | 0 | 0 | 0 | 1 or 5 or 9 or 13 code(s) |
| 0 | **1** | 0 | 0 | 2 or 6 or 10 or 14 codes |
| 0 | 0 | **1** | 0 | 3 or 7 or 11 or 15 codes |
| 0 | 0 | 0 | **1** | 4 or 8 or 12 or 16 codes |

# BAD.8 Mapping scheme for K=2 Midambles

| m1 | m2 | |
|---|---|---|
| **1** | 0 | 1 or 3 or 5 or 7 or 9 or 11 or 13 or 15 code(s) |
| 0 | **1** | 2 or 4 or 6 or 8 or 10 or 12 or 14 or 16 codes |

# Annex C~~E~~ (informative): CCPCH Multiframe Structure for the 3.84 Mcps option

In the following figures C.1 to C.3 some examples for Multiframe Structures on Primary and Secondary CCPCH are given. The figures show the placement of Common Transport Channels on the Common Control Physical Channels. Additional S-CCPCH capacity can be allocated on other codes and timeslots of course, e.g. FACH capacity is related to overall cell capacity and can be configured according to the actual needs. Channel capacities in the annex are derived using bursts with long midambles (Burst format 1). Every TrCH-box in the figures is assumed to be valid for two frames (see row 'Frame #'), i.e. the transport channels in CCPCHs have an interleaving time of 20msec.

The actual CCPCH Multiframe Scheme used in the cell is described and broadcast on BCH. Thus the system information structure has its roots in this particular transport channel and allocations of other Common Channels can be handled this way, i.e. by pointing from BCH.

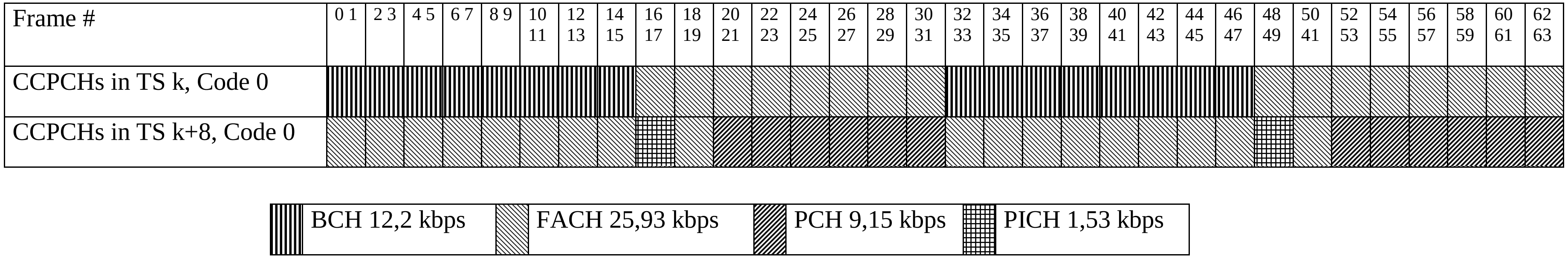



**Figure C.1: Example for a multiframe structure for CCPCHs and PICH that is repeated every 64th frame**

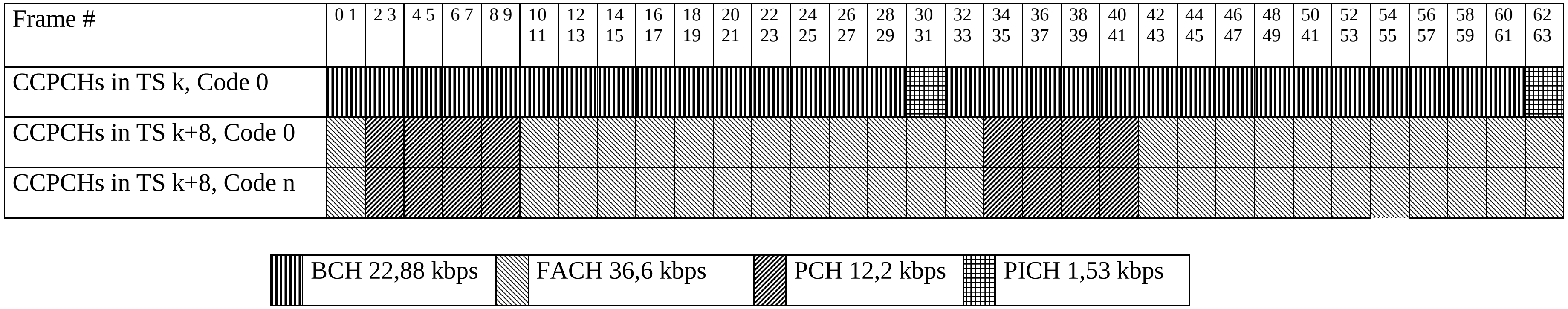



**Figure C.2: Example for a multiframe structure for CCPCHs and PICH that is repeated every 64th frame, n=1…7**

# Annex CA~~F~~ (informative): CCPCH Multiframe Structure for the 1.28 Mcps option

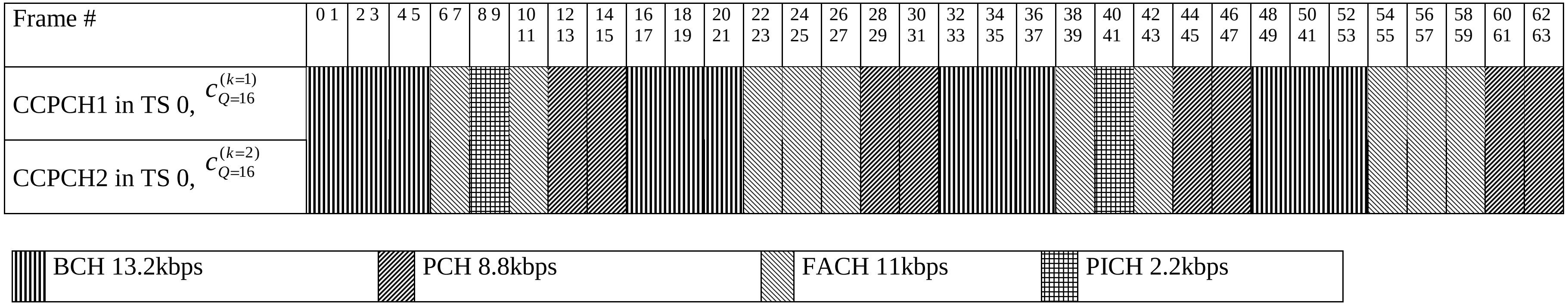



**Figure CA~~F~~.1: Example for a multiframe structure for CCPCHs and PICH that is repeated every 64th frame (128 sub-frame)**

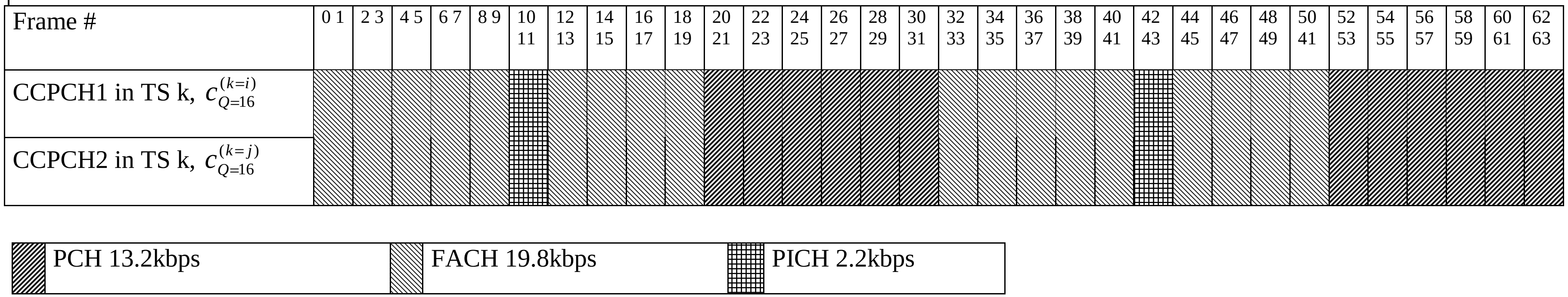



**Figure CA~~F~~.2: Example for a multiframe structure for S-CCPCHs and PICH that is repeated every 64th frame, i,j=1…16 (i≠j),k≠0, 1,(128 sub-frame)**

# Annex CB~~G~~ (informative): Examples of the association of UL TPC commands to UL uplink time slots for 1.28 Mcps TDD

In the following two examples of the association of UL TPC commands to UL time slots and CCTrCHs are shown (see 5A~~6~~.2.2.2):

**Table CB~~G~~.1 Two examples of the association of UL TPC commands to UL uplink time slots with NULslot=3**

Case 1: $N_{UL\_TPCsymbols}$=2; Case 2: $N_{UL\_TPCsymbols}$=4

| Sub-Frame Number | Case 1 (2 UL TPC symbols) | | The order of the served UL time slot and CCTrCH pairs (UL time slot and CCTrCH number) | Case 2 (4 UL TPC symbols) | |
|---|---|---|---|---|---|
| | The order of UL TPC symbols | | | The order of UL TPC symbols | |
| SFN'=0 | (1st $UL_{pos}$=0) | 0 | 0 (TS3) | 0 | (1st $UL_{pos}$=0) |
| | | 1 | 1 (TS4) | 1 | |
| | | | 2 (TS5) | 2 | |
| | | | 0 (TS3) | 3 | |
| SFN'=1 | (1st $UL_{pos}$=2) | 0 | 0 (TS3) | 0 | (1st $UL_{pos}$=1) |
| | | 1 | 1 (TS4) | 1 | |
| | | | 2 (TS5) | 2 | |
| | | | 0 (TS3) | 3 | |
| | | | 1 (TS4) | | |
| SFN'=2 | (1st $UL_{pos}$=1) | 0 | 0 (TS3) | 0 | (1st $UL_{pos}$=2) |
| | | 1 | 1 (TS4) | 1 | |
| | | | 2 (TS5) | 2 | |
| | | | 0 (TS3) | 3 | |
| | | | 1 (TS4) | | |
| | | | 2 (TS5) | | |
| . . . | . . . | | . . . | . . . | |

# Annex CC~~H~~ (informative): Examples of the association of UL SS commands to UL uplink time slots

In the following two examples of the association of UL SS commands to UL uplink time slots are shown (see 5A~~6~~.2.2.3):

**Table CC~~H~~.1 Two examples of the association of UL SS commands to UL uplink time slots with $N_{ULslot}$=3**

Case 1: $N_{SSsymbols}$=2; Case 2: $N_{SSsymbols}$=4

| Sub-Frame Number | Case 1 (2 UL SS symbols) | | The order of the served UL time slot (UL time slot number) | Case 2 (4 UL SS symbols) | |
|---|---|---|---|---|---|
| | The order of UL SS symbols | | | The order of UL SS symbols | |
| SFN'=0 | (1st $UL_{pos}$=0) | 0 | 0 (TS3) | 0 | (1st $UL_{pos}$=0) |
| | | 1 | 1 (TS4) | 1 | |
| | | | 2 (TS5) | 2 | |
| | | | 0 (TS3) | 3 | |
| SFN'=1 | (1st $UL_{pos}$=2) | 0 | 0 (TS3) | 0 | (1st $UL_{pos}$=1) |
| | | 1 | 1 (TS4) | 1 | |
| | | | 2 (TS5) | 2 | |
| | | | 0 (TS3) | 3 | |
| | | | 1 (TS4) | | |
| SFN'=2 | (1st $UL_{pos}$=1) | 0 | 0 (TS3) | 0 | (1st $UL_{pos}$=2) |
| | | 1 | 1 (TS4) | 1 | |
| | | | 2 (TS5) | 2 | |
| | | | 0 (TS3) | 3 | |
| | | | 1 (TS4) | | |
| | | | 2 (TS5) | | |
| . . . | . . . | | . . . | . . . | |

# Annex DI (informative): Change history

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 14/01/00 | RAN_05 | RP-99591 | - | | Approved at TSG RAN #5 and placed under Change Control | - | 3.0.0 |
| 14/01/00 | RAN_06 | RP-99691 | 001 | 02 | Primary and Secondary CCPCH in TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99691 | 002 | 02 | Removal of Superframe for TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99691 | 006 | - | Corrections to TS25.221 | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99691 | 007 | 1 | Clarifications for Spreading in UTRA TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99691 | 008 | - | Transmission of TFCI bits for TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99691 | 009 | - | Midamble Allocation in UTRA TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99690 | 010 | - | Introduction of the timeslot formats to the TDD specifications | 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-000067 | 003 | 2 | Cycling of cell parameters | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000067 | 011 | - | Correction of Midamble Definition for TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000067 | 012 | - | Introduction of the timeslot formats for RACH to the TDD specifications | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000067 | 013 | - | Paging Indicator Channel reference power | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000067 | 014 | 1 | Removal of Synchronisation Case 3 in TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000067 | 015 | 1 | Signal Point Constellation | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000067 | 016 | - | Association between Midambles and Channelisation Codes | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000067 | 017 | - | Removal of ODMA from the TDD specifications | 3.1.1 | 3.2.0 |
| 26/06/00 | RAN_08 | RP-000271 | 018 | 1 | Removal of the reference to ODMA | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000271 | 019 | - | Editorial changes in transport channels section | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000271 | 020 | 1 | TPC transmission for TDD | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000271 | 021 | - | Editorial modification of 25.221 | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000271 | 023 | - | Clarifications on TxDiversity for UTRA TDD | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000271 | 024 | - | Clarifications on PCH and PICH in UTRA TDD | 3.2.0 | 3.3.0 |
| 23/0900 | RAN_09 | RP-000344 | 022 | 1 | Correction to midamble generation in UTRA TDD | 3.3.0 | 3.4.0 |
| 23/0900 | RAN_09 | RP-000344 | 026 | 2 | Some corrections for TS25.221 | 3.3.0 | 3.4.0 |
| 23/0900 | RAN_09 | RP-000344 | 028 | - | Terminology regarding the beacon function | 3.3.0 | 3.4.0 |
| 23/0900 | RAN_09 | RP-000344 | 030 | 1 | TDD Access Bursts for HOV | 3.3.0 | 3.4.0 |
| 23/0900 | RAN_09 | RP-000344 | 031 | 1 | Number of codes signalling for the DL common midamble case | 3.3.0 | 3.4.0 |
| 15/12/00 | RAN_10 | RP-000542 | 034 | - | Correction on TFCI & TPC Transmission | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000542 | 035 | 1 | Clarifications on Midamble Associations | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000542 | 036 | - | Clarification on PICH power setting | 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-010062 | 033 | 2 | Correction to SCH section | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010062 | 037 | 1 | Bit Scrambling for TDD | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010062 | 039 | 1 | Corrections of PUSCH and PDSCH | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010062 | 040 | - | Alteration of SCH offsets to avoid overlapping Midamble | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010062 | 041 | - | Clarifications & Corrections for TS25.221 | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010062 | 045 | 1 | Corrections on the PRACH and clarifications on the midamble generation and the behaviour in case of an invalid TFI combination on the DCHs | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010062 | 046 | - | Clarification of TFCI transmission | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010062 | 048 | - | Corrections to Table 5.b “Timeslot formats for the Uplink” | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010073 | 042 | 2 | Introduction of the Physical Node B Synchronization Channel | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010071 | 043 | 1 | Inclusion of 1.28Mcps TDD in TS 25.221 | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010072 | 044 | - | Correction of beacon characteristics due to IPDLs | 3.5.0 | 4.0.0 |
| 15/06/01 | RAN_12 | RP-010336 | 051 | - | Clarification of Midamble Usage in TS25.221 | 4.0.0 | 4.1.0 |
| 15/06/01 | RAN_12 | RP-010336 | 053 | - | Addition to the abbreviation list, correction of references to tables and figures | 4.0.0 | 4.1.0 |
| 15/06/01 | RAN_12 | RP-010342 | 049 | - | Correction of spelling in definition of beacon characteristics | 4.0.0 | 4.1.0 |
| 15/06/01 | RAN_12 | RP-010342 | 055 | - | Correction of Note for PDSCH signalling methods | 4.0.0 | 4.1.0 |
| 21/09/01 | RAN_13 | RP-010522 | 057 | - | TFCI Terminology | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010522 | 063 | - | Clarification of notations in TS25.221 and TS25.223 | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010522 | 062 | - | Addition and correction of the reference | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010528 | 058 | 1 | Corrections for TS 25.221 | 4.1.0 | 4.2.0 |
| 14/12/01 | RAN_14 | RP-010741 | 065 | 1 | Transmit Diversity for P-CCPCH and PICH | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010741 | 067 | - | Clarification of midamble transmit power in TS25.221 | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010746 | 059 | - | Bit Scrambling for 1.28 Mcps TDD | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010746 | 068 | - | Transmit Diversity for P-CCPCH and PICH | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010746 | 069 | - | Corrections of reference numbers in TS 25.221 | 4.2.0 | 4.3.0 |
| 08/03/02 | RAN_15 | RP-020049 | 071 | 2 | Clarification of spreading for UL physical channels | 4.3.0 | 4.4.0 |
| 08/03/02 | RAN_15 | RP-020049 | 073 | 1 | Common midamble allocation for beacon time slot | 4.3.0 | 4.4.0 |
| 08/03/02 | RAN_15 | RP-020049 | 075 | 3 | Correction to a transmission of paging indicators bits | 4.3.0 | 4.4.0 |

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 08/03/02 | RAN_15 | RP-020058 | 076 | 1 | CR to include HSDPA in TS25.221 | 4.3.0 | 5.0.0 |
| 07/06/02 | RAN_16 | RP-020434 | 080 | 2 | Clarification of shared channel functionality for TDD | 5.0.0 | 5.1.0 |
| 07/06/02 | RAN_16 | RP-020313 | 082 | - | Clarification of shared channel functionality for TDD | 5.0.0 | 5.1.0 |
| 07/06/02 | RAN_16 | RP-020317 | 081 | - | TxDiversity for HSDPA in TDD | 5.0.0 | 5.1.0 |
| 19/09/02 | RAN_17 | RP-020559 | 092 | 1 | Corrections to channelisation code mapping for 1.28 Mcps TDD | 5.1.0 | 5.2.0 |
| 19/09/02 | RAN_17 | RP-020576 | 094 | - | Correction to S-CCPCH description for 1.28 Mcps TDD | 5.1.0 | 5.2.0 |
| 19/09/02 | RAN_17 | RP-020579 | 104 | 2 | Corrections to transmit diversity mode for TDD beacon-function physical channels | 5.1.0 | 5.2.0 |
| 19/09/02 | RAN_17 | RP-020569 | 090 | 1 | Corrections to channelisation code mappings for 3.84 Mcps TDD | 5.1.0 | 5.2.0 |
| 19/09/02 | RAN_17 | RP-020572 | 097 | 2 | Corrections to transmit diversity mode for TDD beacon-function physical channels | 5.1.0 | 5.2.0 |
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**3GPP TSG-RAN1 Meeting #29**
**Shanghai, China, 5 – 8 November 2002**

***R1-02-1390***

*CR-Form-v7*

# CHANGE REQUEST

| | | | | | | |
|---|---|---|---|---|---|---|
| ⌘ | **25.222** | **CR** | **106** | ⌘ **rev** | **-** | ⌘ Current version: **4.5.0** ⌘ |

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

***Proposed change affects:*** UICC apps⌘ [ ] ME [X] Radio Access Network [X] Core Network [ ]

| | | | |
|---|---|---|---|
| ***Title:*** ⌘ | Editorial modification to the section numberings | | |
| ***Source:*** ⌘ | TSG RAN WG1 | | |
| ***Work item code:*** ⌘ | TEI4 | ***Date:*** ⌘ | 29/10/2002 |
| ***Category:*** ⌘ | **D** | ***Release:*** ⌘ | Rel-4 |
| | *Use one of the following categories:*<br>***F*** *(correction)*<br>***A*** *(corresponds to a correction in an earlier release)*<br>***B*** *(addition of feature),*<br>***C*** *(functional modification of feature)*<br>***D*** *(editorial modification)*<br>Detailed explanations of the above categories can be found in 3GPP TR 21.900. | | *Use one of the following releases:*<br>*2 (GSM Phase 2)*<br>*R96 (Release 1996)*<br>*R97 (Release 1997)*<br>*R98 (Release 1998)*<br>*R99 (Release 1999)*<br>*Rel-4 (Release 4)*<br>*Rel-5 (Release 5)*<br>*Rel-6 (Release 6)* |

| | |
|---|---|
| ***Reason for change:*** ⌘ | The numbering used is not consistent with TS21.801. |
| ***Summary of change:*** ⌘ | The sections, figures, and tables numberings are adjusted to follow the guidlines given in TS21.801. |
| ***Consequences if not approved:*** ⌘ | Confusion and misunderstanding, not consistent with specification guidelines and the rest of the document. |

| | | | | |
|---|---|---|---|---|
| ***Clauses affected:*** ⌘ | All the document | | | |
| | **Y** | **N** | | |
| ***Other specs affected:*** ⌘ | | **X** | Other core specifications | ⌘ |
| | | **X** | Test specifications | |
| | | **X** | O&M Specifications | |
| ***Other comments:*** ⌘ | | | | |

## How to create CRs using this form:

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

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

# Contents

# Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

# 1 Scope

The present document describes multiplexing, channel coding and interleaving for UTRA Physical Layer TDD mode.

# 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 25.202: "UE capabilities".

[2] 3GPP TS 25.211: "Transport channels and physical channels (FDD)".

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

[4] 3GPP TS 25.213: "Spreading and modulation (FDD)".

[5] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[6] 3GPP TS 25.215: "Physical layer – Measurements (FDD)".

[7] 3GPP TS 25.221: "Transport channels and physical channels (TDD)".

[9] 3GPP TS 25.223: "Spreading and modulation (TDD)".

[10] 3GPP TS 25.224: "Physical layer procedures (TDD)".

[11] 3GPP TS 25.225: "Measurements".

[12] 3GPP TS 25.331: "RRC Protocol Specification".

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

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

**TrCH number:** The transport channel number identifies a TrCH in the context of L1. The L3 transport channel identity (TrCH ID) maps onto the L1 transport channel number. The mapping between the transport channel number and the TrCH ID is as follows: TrCH 1 corresponds to the TrCH with the lowest TrCH ID, TrCH 2 corresponds to the TrCH with the next lowest TrCH ID and so on.

## 3.2 Symbols

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

$\lceil x \rceil$ round towards ∞, i.e. integer such that $x \le \lceil x \rceil < x+1$
$\lfloor x \rfloor$ round towards -∞, i.e. integer such that $x-1 < \lfloor x \rfloor \le x$

| | |
|---|---|
| $\lvert x \rvert$ | absolute value of $x$ |

Unless otherwise is explicitly stated when the symbol is used, the meaning of the following symbols are:

| | |
|---|---|
| $i$ | TrCH number |
| $j$ | TFC number |
| $k$ | Bit number |
| $l$ | TF number |
| $m$ | Transport block number |
| $n$ | Radio frame number |
| $p$ | PhCH number |
| r | Code block number |
| $I$ | Number of TrCHs in a CCTrCH. |
| $C_i$ | Number of code blocks in one TTI of TrCH $i$. |
| $F_i$ | Number of radio frames in one TTI of TrCH $i$. |
| $M_i$ | Number of transport blocks in one TTI of TrCH $i$. |
| $N_{TCFI\ code\ word}$ | Number of TFCI code word bits after TFCI encoding |
| $P$ | Number of PhCHs used for one CCTrCH. |
| $PL$ | Puncturing Limit. Signalled from higher layers |
| $RM_i$ | Rate Matching attribute for TrCH $i$. Signalled from higher layers. |

Temporary variables, i.e. variables used in several (sub)clauses with different meaning.

x, X
y, Y
z, Z

# 3.3 Abbreviations

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

| | |
|---|---|
| <ACRONYM> | <Explanation> |
| ARQ | Automatic Repeat on Request |
| BCH | Broadcast Channel |
| BER | Bit Error Rate |
| BS | Base Station |
| BSS | Base Station Subsystem |
| CBR | Constant Bit Rate |
| CCCH | Common Control Channel |
| CCTrCH | Coded Composite Transport Channel |
| CDMA | Code Division Multiple Access |
| CFN | Connection Frame Number |
| CRC | Cyclic Redundancy Check |
| DCA | Dynamic Channel Allocation |
| DCCH | Dedicated Control Channel |
| DCH | Dedicated Channel |
| DL | Downlink |
| DRX | Discontinuous Reception |
| DSCH | Downlink Shared Channel |
| DTX | Discontinuous Transmission |
| FACH | Forward Access Channel |
| FDD | Frequency Division Duplex |
| FDMA | Frequency Division Multiple Access |
| FEC | Forward Error Control |
| FER | Frame Error Rate |
| GF | Galois Field |
| JD | Joint Detection |
| L1 | Layer 1 |
| L2 | Layer 2 |
| LLC | Logical Link Control |
| MA | Multiple Access |
| MAC | Medium Access Control |

| | |
|---|---|
| MS | Mobile Station |
| MT | Mobile Terminated |
| NRT | Non-Real Time |
| OVSF | Orthogonal Variable Spreading Factor |
| PC | Power Control |
| PCCC | Parallel Concatenated Convolutional Code |
| PCH | Paging Channel |
| PhCH | Physical Channel |
| PI | Paging Indicator (value calculated by higher layers) |
| $P_q$ | Paging Indicator (indicator set by physical layer) |
| QoS | Quality of Service |
| QPSK | Quaternary Phase Shift Keying |
| RACH | Random Access Channel |
| RF | Radio Frequency |
| RLC | Radio Link Control |
| RRC | Radio Resource Control |
| RRM | Radio Resource Management |
| RSC | Recursive Systematic Convolutional Coder |
| RT | Real Time |
| RU | Resource Unit |
| SCCC | Serial Concatenated Convolutional Code |
| SCH | Synchronization Channel |
| SNR | Signal to Noise Ratio |
| TCH | Traffic channel |
| TDD | Time Division Duplex |
| TDMA | Time Division Multiple Access |
| TFC | Transport Format Combination |
| TFCI | Transport Format Combination Indicator |
| TPC | Transmit Power Control |
| TrBk | Transport Block |
| TrCH | Transport Channel |
| TTI | Transmission Time Interval |
| UE | User Equipment |
| UL | Uplink |
| UMTS | Universal Mobile Telecommunications System |
| USCH | Uplink Shared Channel |
| UTRA | UMTS Terrestrial Radio Access |
| VBR | Variable Bit Rate |

# 4 Multiplexing, channel coding and interleaving

## 4.1 General

Data stream from/to MAC and higher layers (Transport block / Transport block set) is encoded/decoded to offer transport services over the radio transmission link. Channel coding scheme is a combination of error detection, error correcting (including rate matching), and interleaving and transport channels mapping onto/splitting from physical channels.

In the UTRA-TDD mode, the total number of basic physical channels (a certain time slot one spreading code on a certain carrier frequency) per frame is given by the maximum number of time slots and the maximum number of CDMA codes per time slot.

## 4.2 Transport channel coding/multiplexing

Figure 1 illustrates the overall concept of transport-channel coding and multiplexing. Data arrives to the coding/multiplexing unit in form of transport block sets, once every transmission time interval. The transmission time interval is transport-channel specific from the set {5 ms(*1), 10 ms, 20 ms, 40 ms, 80 ms}.

Note: (*1) may be applied for PRACH for 1.28 Mcps TDD

The following coding/multiplexing steps can be identified:

- add CRC to each transport block (see subclause 4.2.1);
- TrBk concatenation / Code block segmentation (see subclause 4.2.2);
- channel coding (see subclause 4.2.3) ;
- radio frame size equalization (see subclause 4.2.4);
- interleaving (two steps, see subclauses 4.2.5 and 4.2.10);
- radio frame segmentation (see subclause 4.2.6);
- rate matching (see subclause 4.2.7);
- multiplexing of transport channels (see subclause 4.2.8);
- bit scrambling (see subclause 4.2.9);
- physical channel segmentation (see subclause 4.2.10);
- sub-frame segmentation(see subclause 4.2.11A~~12~~ only for 1.28Mcps TDD)
- mapping to physical channels (see subclause 4.2.12~~13~~).

The coding/multiplexing steps for uplink and downlink are shown in figures 1 and 1A~~2~~.

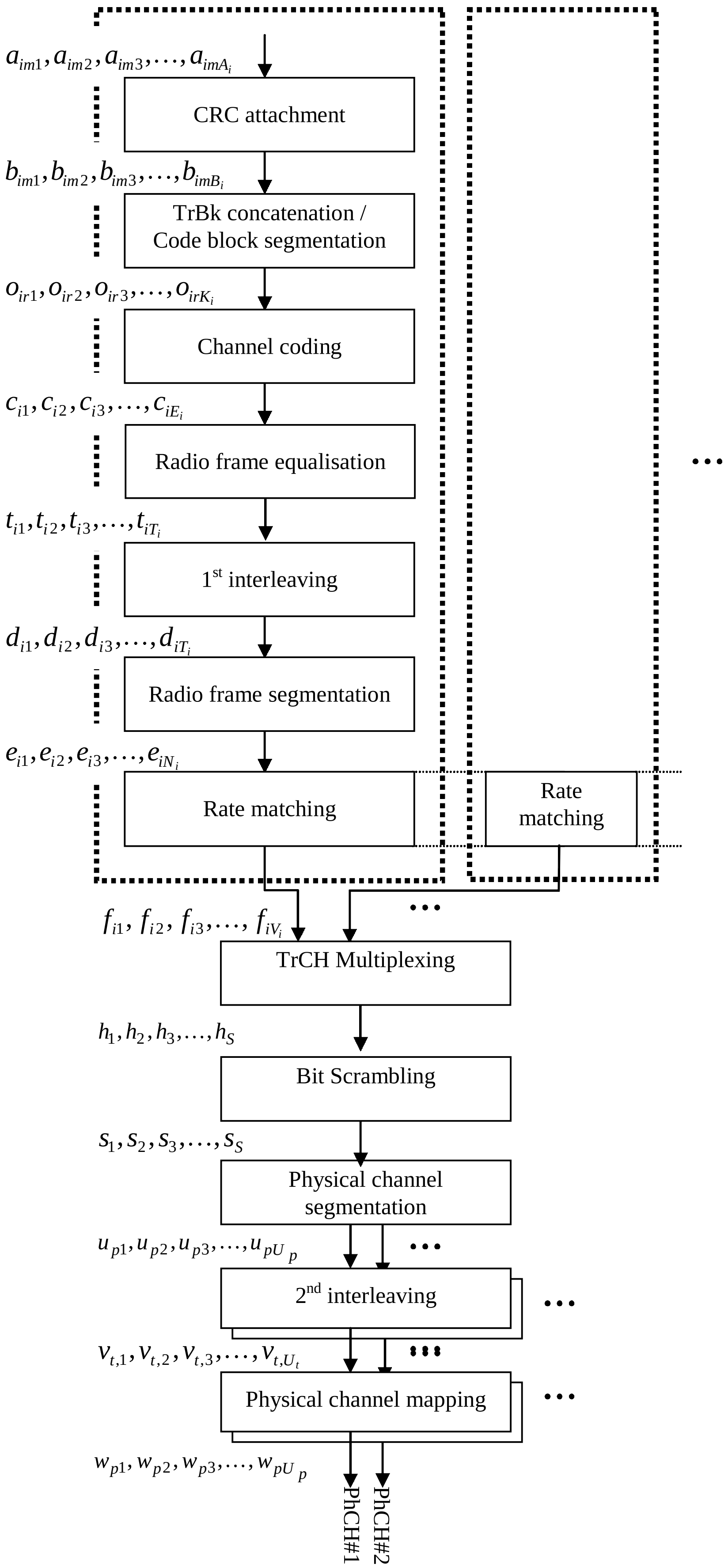


**Figure 1: Transport channel multiplexing structure for uplink and downlink for 3.84Mcps TDD**

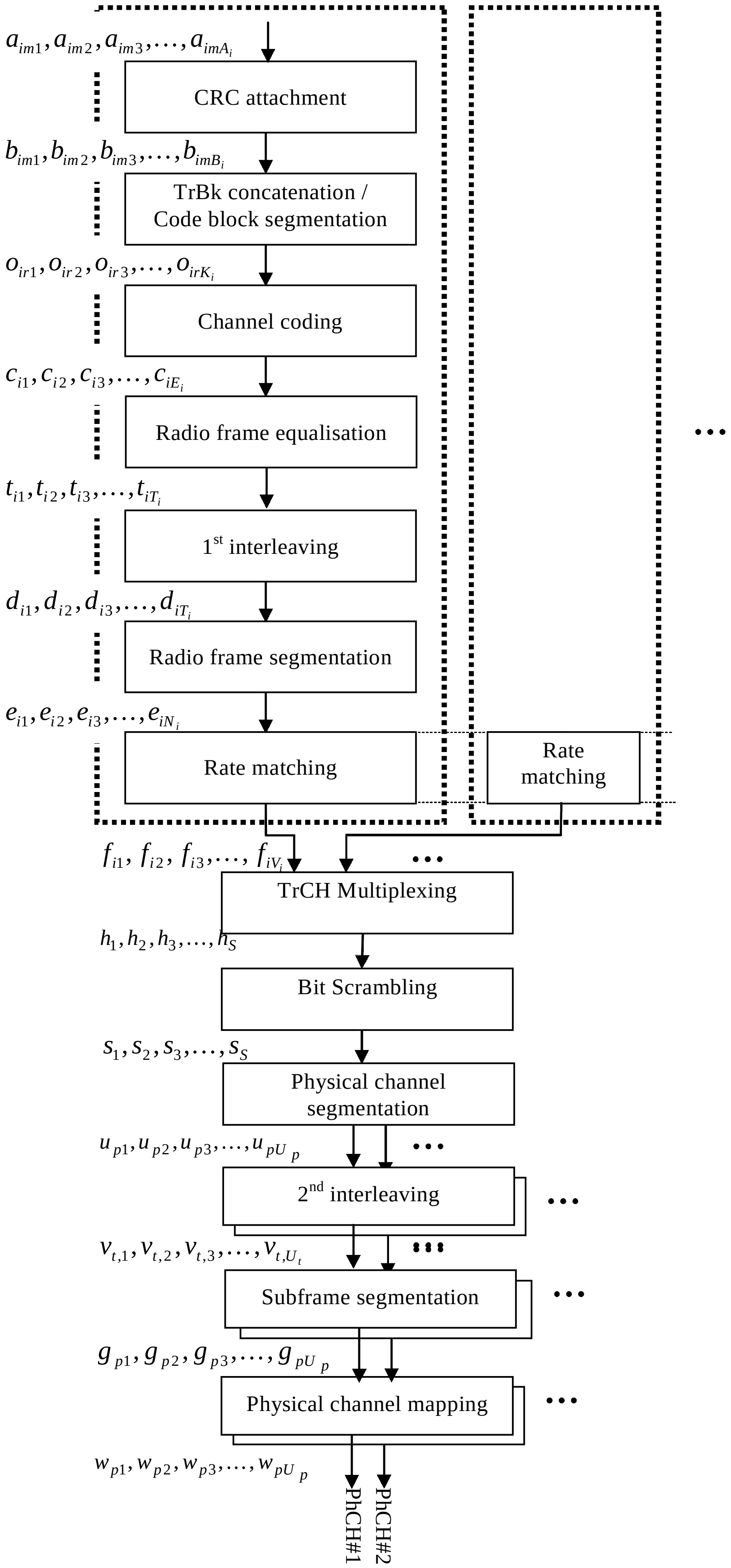


**Figure 1A2: Transport channel multiplexing structure for uplink and downlink of 1.28Mcps TDD**

Primarily, transport channels are multiplexed as described above, i.e. into one data stream mapped on one or several physical channels. However, an alternative way of multiplexing services is to use multiple CCTrCHs (Coded Composite Transport Channels), which corresponds to having several parallel multiplexing chains as in figures 1 and 1A2, resulting in several data streams, each mapped to one or several physical channels.

## 4.2.1 CRC attachment

Error detection is provided on transport blocks through a Cyclic Redundancy Check (CRC). The size of the CRC is 24, 16, 12, 8 or 0 bits and it is signalled from higher layers what CRC size that should be used for each transport channel.

### 4.2.1.1 CRC calculation

The entire transport block is used to calculate the CRC parity bits for each transport block. The parity bits are generated by one of the following cyclic generator polynomials:

$g_{CRC24}(D) = D^{24} + D^{23} + D^{6} + D^{5} + D + 1$

$g_{CRC16}(D) = D^{16} + D^{12} + D^{5} + 1$

$g_{CRC12}(D) = D^{12} + D^{11} + D^{3} + D^{2} + D + 1$

$g_{CRC8}(D) = D^{8} + D^{7} + D^{4} + D^{3} + D + 1$

Denote the bits in a transport block delivered to layer 1 by $a_{im1}, a_{im2}, a_{im3}, \ldots, a_{imA_i}$ , and the parity bits by $p_{im1}, p_{im2}, p_{im3}, \ldots, p_{imL_i}$ . $A_i$ is the size of a transport block of TrCH $i$, $m$ is the transport block number, and $L_i$ is the number of parity bits. $L_i$ can take the values 24, 16, 12, 8, or 0 depending on what is signalled from higher layers.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_{im1}D^{A_i+23} + a_{im2}D^{A_i+22} + \ldots + a_{imA_i}D^{24} + p_{im1}D^{23} + p_{im2}D^{22} + \ldots + p_{im23}D^{1} + p_{im24}$$

yields a remainder equal to 0 when divided by $g_{CRC24}(D)$, polynomial:

$$a_{im1}D^{A_i+15} + a_{im2}D^{A_i+14} + \ldots + a_{imA_i}D^{16} + p_{im1}D^{15} + p_{im2}D^{14} + \ldots + p_{im15}D^{1} + p_{im16}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, polynomial:

$$a_{im1}D^{A_i+11} + a_{im2}D^{A_i+10} + \ldots + a_{imA_i}D^{12} + p_{im1}D^{11} + p_{im2}D^{10} + \ldots + p_{im11}D^{1} + p_{im12}$$

yields a remainder equal to 0 when divided by $g_{CRC12}(D)$ and the polynomial:

$$a_{im1}D^{A_i+7} + a_{im2}D^{A_i+6} + \ldots + a_{imA_i}D^{8} + p_{im1}D^{7} + p_{im2}D^{6} + \ldots + p_{im7}D^{1} + p_{im8}$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

If no transport blocks are input to the CRC calculation ($M_i = 0$), no CRC attachment shall be done. If transport blocks are input to the CRC calculation ($M_i \neq 0$) and the size of a transport block is zero ($A_i = 0$), CRC shall be attached, i.e. all parity bits equal to zero.

### 4.2.1.2 Relation between input and output of the CRC attachment block

The bits after CRC attachment are denoted by $b_{im1}, b_{im2}, b_{im3}, \ldots, b_{imB_i}$ , where $B_i = A_i + L_i$. The relation between $a_{imk}$ and $b_{imk}$ is:

$b_{imk} = a_{imk}$  $k = 1, 2, 3, \ldots, A_i$

$b_{imk} = p_{im(L_i+1-(k-A_i))}$  $k = A_i + 1, A_i + 2, A_i + 3, \ldots, A_i + L_i$

### 4.2.2 Transport block concatenation and code block segmentation

All transport blocks in a TTI are serially concatenated. If the number of bits in a TTI is larger than the maximum size of a code block, then code block segmentation is performed after the concatenation of the transport blocks. The maximum size of the code blocks depends on whether convolutional, turbo coding or no coding is used for the TrCH.

#### 4.2.2.1 Concatenation of transport blocks

The bits input to the transport block concatenation are denoted by $b_{im1}, b_{im2}, b_{im3}, \ldots, b_{imB_i}$ where $i$ is the TrCH number, $m$ is the transport block number, and $B_i$ is the number of bits in each block (including CRC). The number of transport blocks on TrCH $i$ is denoted by $M_i$. The bits after concatenation are denoted by $x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$, where $i$ is the TrCH number and $X_i=M_iB_i$. They are defined by the following relations:

$x_{ik} = b_{i1k}$ $\quad k = 1, 2, \ldots, B_i$

$x_{ik} = b_{i,2,(k-B_i)}$ $\quad k = B_i + 1, B_i + 2, \ldots, 2B_i$

$x_{ik} = b_{i,3,(k-2B_i)}$ $\quad k = 2B_i + 1, 2B_i + 2, \ldots, 3B_i$

…

$x_{ik} = b_{i,M_i,(k-(M_i-1)B_i)}$ $\quad k = (M_i - 1)B_i + 1, (M_i - 1)B_i + 2, \ldots, M_iB_i$

#### 4.2.2.2 Code block segmentation

Segmentation of the bit sequence from transport block concatenation is performed if $X_i>Z$. The code blocks after segmentation are of the same size. The number of code blocks on TrCH $i$ is denoted by $C_i$. If the number of bits input to the segmentation, $X_i$, is not a multiple of $C_i$, filler bits are added to the beginning of the first block. If turbo coding is selected and $X_i < 40$, filler bits are added to the beginning of the code block. The filler bits are transmitted and they are always set to 0. The maximum code block sizes are:

- convolutional coding: $Z = 504$;
- turbo coding: $Z = 5114$;
- no channel coding: $Z$ = *unlimited*.

The bits output from code block segmentation, for $C_i \neq 0$, are denoted by $o_{ir1}, o_{ir2}, o_{ir3}, \ldots, o_{irK_i}$, where $i$ is the TrCH number, $r$ is the code block number, and $K_i$ is the number of bits per code block.

Number of code blocks:

$$C_i = \begin{cases} \lceil X_i / Z \rceil & \text{when } Z \neq \textit{unlimited} \\ 0 & \text{when } Z = \textit{unlimited} \text{ and } X_i = 0 \\ 1 & \text{when } Z = \textit{unlimited} \text{ and } X_i \neq 0 \end{cases}$$

Number of bits in each code block (applicable for $C_i \neq 0$ only):

if $X_i < 40$ and Turbo coding is used, then

$K_i = 40$

else

$K_i = \lceil X_i / C_i \rceil$

end if

Number of filler bits: $Y_i = C_iK_i - X_i$

for $k$ = 1 to $Y_i$ -- Insertion of filler bits

$$o_{i1k} = 0$$

end for

for $k$ = $Y_i$+1 to $K_i$

$$o_{i1k} = x_{i,(k-Y_i)}$$

end for

$r$ = 2 -- Segmentation

while $r \leq C_i$

for $k$ = 1 to $K_i$

$$o_{irk} = x_{i,(k+(r-1)\cdot K_i - Y_i)}$$

end for

r = r+1

end while

### 4.2.3 Channel coding

Code blocks are delivered to the channel coding block. They are denoted by $o_{ir1}, o_{ir2}, o_{ir3}, \ldots, o_{irK_i}$ , where $i$ is the TrCH number, $r$ is the code block number, and $K_i$ is the number of bits in each code block. The number of code blocks on TrCH $i$ is denoted by $C_i$. After encoding the bits are denoted by $y_{ir1}, y_{ir2}, y_{ir3}, \ldots, y_{irY_i}$ , where $Y_i$ is the number of encoded bits. The relation between $o_{irk}$ and $y_{irk}$ and between $K_i$ and $Y_i$ is dependent on the channel coding scheme.

The following channel coding schemes can be applied to transport channels:

- convolutional coding;
- turbo coding;
- no coding.

Usage of coding scheme and coding rate for the different types of TrCH is shown in tables 1 and 1A~~2~~. The values of $Y_i$ in connection with each coding scheme:

- convolutional coding with rate 1/2: $Y_i = 2*K_i + 16$; rate 1/3: $Y_i = 3*K_i + 24$;
- turbo coding with rate 1/3: $Y_i = 3*K_i + 12$;
- no coding: $Y_i = K_i$.

**Table 1: Usage of channel coding scheme and coding rate for 3.84Mcps TDD**

| Type of TrCH | Coding scheme | Coding rate |
|---|---|---|
| BCH | Convolutional coding | 1/2 |
| PCH | | |
| RACH | | |
| DCH, DSCH, FACH, USCH | | 1/3, 1/2 |
| | Turbo coding | 1/3 |
| | No coding | |

**Table 1A~~2~~: Usage of channel coding scheme and coding rate for 1.28Mcps TDD**

| Type of TrCH | Coding scheme | Coding rate |
|---|---|---|
| BCH | Convolutional coding | 1/3 |
| PCH | | 1/3, 1/2 |
| RACH | | 1/2 |
| DCH, DSCH, FACH, USCH | | 1/3, 1/2 |
| | Turbo coding | 1/3 |
| | No coding | |

### 4.2.3.1 Convolutional coding

Convolutional codes with constraint length 9 and coding rates 1/3 and 1/2 are defined.

The configuration of the convolutional coder is presented in figure 2~~3~~.

Output from the rate 1/3 convolutional coder shall be done in the order output 0, output 1, output 2, output 0, output 1, output 2, output 0,…,output 2. Output from the rate 1/2 convolutional coder shall be done in the order output 0, output 1, output 0, output 1, output 0, …, output 1.

8 tail bits with binary value 0 shall be added to the end of the code block before encoding.

The initial value of the shift register of the coder shall be "all 0" when starting to encode the input bits.

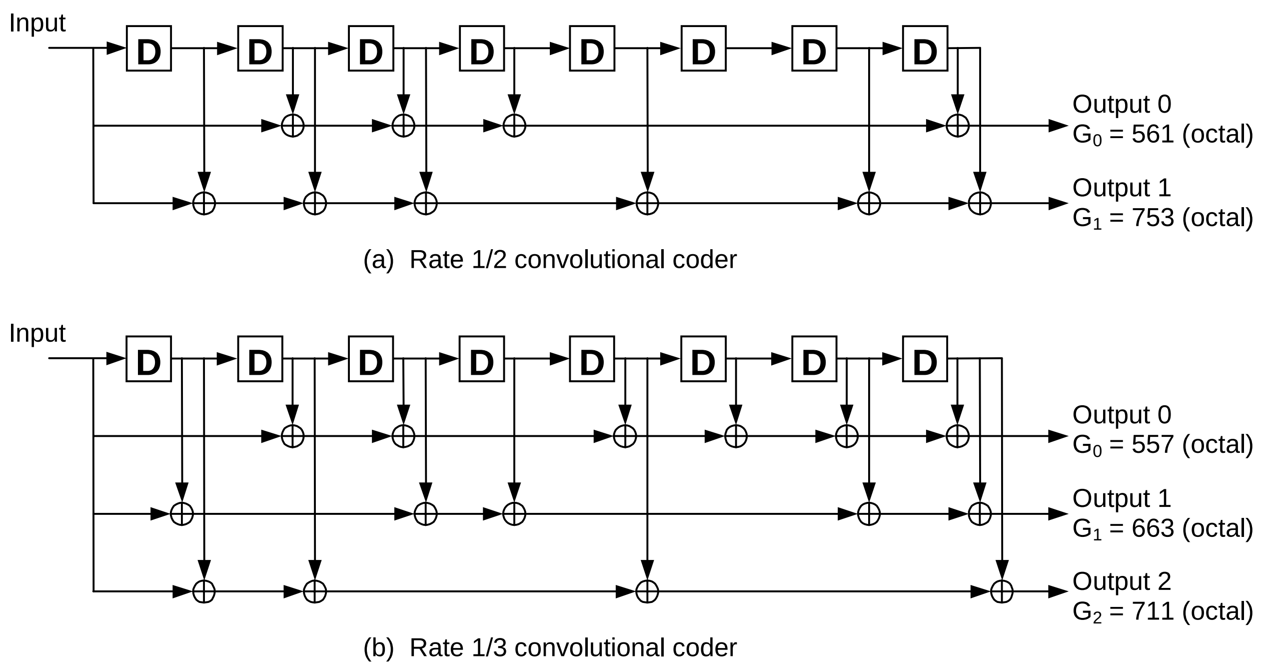


**Figure 2~~3~~: Rate 1/2 and rate 1/3 convolutional coders**

### 4.2.3.2 Turbo coding

#### 4.2.3.2.1 Turbo coder

The scheme of Turbo coder is a Parallel Concatenated Convolutional Code (PCCC) with two 8-state constituent encoders and one Turbo code internal interleaver. The coding rate of Turbo coder is 1/3. The structure of Turbo coder is illustrated in figure 3~~4~~.

The transfer function of the 8-state constituent code for PCCC is:

$$G(D)=\left[1,\frac{g_1(D)}{g_0(D)}\right],$$

where

$$g_0(D) = 1 + D^2 + D^3,$$

$$g_1(D) = 1 + D + D^3.$$

The initial value of the shift registers of the 8-state constituent encoders shall be all zeros when starting to encode the input bits.

Output from the Turbo coder is , Y'(0), X(1), Y(1), Y'(1), etc:

$$x_1, z_1, z'_1, x_2, z_2, z'_2, \ldots, x_K, z_K, z'_K,$$

where $x_1, x_2, \ldots, x_K$ are the bits input to the Turbo coder i.e. both first 8-state constituent encoder and Turbo code internal interleaver, and $K$ is the number of bits, and $z_1, z_2, \ldots, z_K$ and $z'_1, z'_2, \ldots, z'_K$ are the bits output from first and second 8-state constituent encoders, respectively.

The bits output from Turbo code internal interleaver are denoted by $x'_1, x'_2, \ldots, x'_K$, and these bits are to be input to the second 8-state constituent encoder.

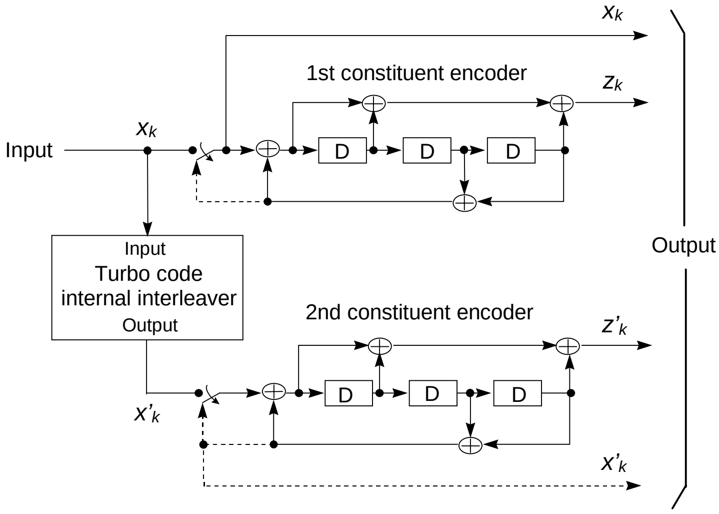


**Figure 34: Structure of rate 1/3 Turbo coder (dotted lines apply for trellis termination only)**

### 4.2.3.2.2 Trellis termination for Turbo coder

Trellis termination is performed by taking the tail bits from the shift register feedback after all information bits are encoded. Tail bits are padded after the encoding of information bits.

The first three tail bits shall be used to terminate the first constituent encoder (upper switch of figure 34 in lower position) while the second constituent encoder is disabled. The last three tail bits shall be used to terminate the second constituent encoder (lower switch of figure 34 in lower position) while the first constituent encoder is disabled.

The transmitted bits for trellis termination shall then be:

$$x_{K+1}, z_{K+1}, x_{K+2}, z_{K+2}, x_{K+3}, z_{K+3}, x'_{K+1}, z'_{K+1}, x'_{K+2}, z'_{K+2}, x'_{K+3}, z'_{K+3}.$$

#### 4.2.3.2.3 Turbo code internal interleaver

The Turbo code internal interleaver consists of bits-input to a rectangular matrix with padding, intra-row and inter-row permutations of the rectangular matrix, and bits-output from the rectangular matrix with pruning. The bits input to the Turbo code internal interleaver are denoted by $x_1, x_2, x_3, \ldots, x_K$, where $K$ is the integer number of the bits and takes one value of $40 \leq K \leq 5114$. The relation between the bits input to the Turbo code internal interleaver and the bits input to the channel coding is defined by $x_k = o_{irk}$ and $K = K_i$.

**The following subclause specific symbols are used in subclauses 4.2.3.2.3.1 to 4.2.3.4.3.3:**

| | |
|---|---|
| $K$ | Number of bits input to Turbo code internal interleaver |
| $R$ | Number of rows of rectangular matrix |
| $C$ | Number of columns of rectangular matrix |
| $p$ | Prime number |
| $v$ | Primitive root |
| $\langle s(j) \rangle_{j \in \{0,1,\cdots,p-2\}}$ | Base sequence for intra-row permutation |
| $q_i$ | Minimum prime integers |
| $r_i$ | Permuted prime integers |
| $\langle T(i) \rangle_{i \in \{0,1,\cdots,R-1\}}$ | Inter-row permutation pattern |
| $\langle U_i(j) \rangle_{j \in \{0,1,\cdots,C-1\}}$ | Intra-row permutation pattern of $i$-th row |
| $i$ | Index of row number of rectangular matrix |
| $j$ | Index of column number of rectangular matrix |
| $k$ | Index of bit sequence |

##### 4.2.3.2.3.1 Bits-input to rectangular matrix with padding

The bit sequence $x_1, x_2, x_3, \ldots, x_K$ input to the Turbo code internal interleaver is written into the rectangular matrix as follows.

(1) Determine the number of rows of the rectangular matrix, $R$, such that:

$$R = \begin{cases} 5, \text{if } (40 \leq K \leq 159) \\ 10, \text{if } ((160 \leq K \leq 200) \text{ or } (481 \leq K \leq 530)) \\ 20, \text{if } (K = \text{any other value}) \end{cases} .$$

The rows of rectangular matrix are numbered 0, 1, …, $R$ - 1 from top to bottom.

(2) Determine the prime number to be used in the intra-permutation, $p$, and the number of columns of rectangular matrix, $C$, such that:

if ($481 \leq K \leq 530$) then

$p = 53$ and $C = p$.

else

Find minimum prime number $p$ from table 2~~3~~ such that

$$K \leq R \times (p+1),$$

and determine $C$ such that

$$C = \begin{cases} p-1 & if \quad K \le R \times (p-1) \\ p & if \quad R \times (p-1) < K \le R \times p \\ p+1 & if \quad R \times p < K \end{cases}.$$

end if

The columns of rectangular matrix are numbered 0, 1, …, $C$ - 1 from left to right.

**Table 23: List of prime number *p* and associated primitive root *v***

| p | v | p | v | p | v | p | v | p | v |
|---|---|---|---|---|---|---|---|---|---|
| 7 | 3 | 47 | 5 | 101 | 2 | 157 | 5 | 223 | 3 |
| 11 | 2 | 53 | 2 | 103 | 5 | 163 | 2 | 227 | 2 |
| 13 | 2 | 59 | 2 | 107 | 2 | 167 | 5 | 229 | 6 |
| 17 | 3 | 61 | 2 | 109 | 6 | 173 | 2 | 233 | 3 |
| 19 | 2 | 67 | 2 | 113 | 3 | 179 | 2 | 239 | 7 |
| 23 | 5 | 71 | 7 | 127 | 3 | 181 | 2 | 241 | 7 |
| 29 | 2 | 73 | 5 | 131 | 2 | 191 | 19 | 251 | 6 |
| 31 | 3 | 79 | 3 | 137 | 3 | 193 | 5 | 257 | 3 |
| 37 | 2 | 83 | 2 | 139 | 2 | 197 | 2 | | |
| 41 | 6 | 89 | 3 | 149 | 2 | 199 | 3 | | |
| 43 | 3 | 97 | 5 | 151 | 6 | 211 | 2 | | |

(3) Write the input bit sequence $x_1, x_2, x_3, \ldots, x_K$ into the $R \times C$ rectangular matrix row by row starting with bit $y_1$ in column 0 of row 0:

$$\begin{bmatrix} y_1 & y_2 & y_3 & \cdots & y_C \\ y_{(C+1)} & y_{(C+2)} & y_{(C+3)} & \cdots & y_{2C} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ y_{((R-1)C+1)} & y_{((R-1)C+2)} & y_{((R-1)C+3)} & \cdots & y_{R\times C} \end{bmatrix}.$$

where $y_k = x_k$ for $k$ = 1, 2, …, $K$ and if $R \times C > K$, the dummy bits are padded such that $y_k = 0 or 1$ for $k = K + 1$, $K + 2$, …, $R \times C$. These dummy bits are pruned away from the output of the rectangular matrix after intra-row and inter-row permutations.

#### 4.2.3.2.3.2 Intra-row and inter-row permutations

After the bits-input to the $R \times C$ rectangular matrix, the intra-row and inter-row permutations for the $R \times C$ rectangular matrix are performed stepwise by using the following algorithm with steps (1) – (6).

(1) Select a primitive root $v$ from table 23 in section 4.2.3.2.3.1, which is indicated on the right side of the prime number $p$.

(2) Construct the base sequence $\langle s(j) \rangle_{j \in \{0,1,\cdots,p-2\}}$ for intra-row permutation as:

$s(j) = (v \times s(j-1)) \bmod p$, $j$ = 1, 2,… ($p$ - 2), and $s(0)$ = 1.

(3) Assign $q_0 = 1$ to be the first prime integer in the sequence $\langle q_i \rangle_{i \in \{0,1,\cdots,R-1\}}$, and determine the prime integer $q_i$ in the sequence $\langle q_i \rangle_{i \in \{0,1,\cdots,R-1\}}$ to be a least prime integer such that g.c.d($q_i$, $p$ - 1) = 1, $q_i > 6$, and $q_i > q_{(i-1)}$ for each $i$ = 1, 2, …, $R$ – 1. Here g.c.d. is greatest common divisor.

(4) Permute the sequence $\langle q_i \rangle_{i \in \{0,1,\cdots,R-1\}}$ to make the sequence $\langle r_i \rangle_{i \in \{0,1,\cdots,R-1\}}$ such that

$r_{T(i)} = q_i$, $i$ = 0, 1, …. , $R$ - 1, where $\langle T(i) \rangle_{i \in \{0,1,\cdots,R-1\}}$ is the inter-row permutation pattern defined as the one of the four kind of patterns, which are shown in table 34, depending on the number of input bits $K$.

**Table 34: Inter-row permutation patterns for Turbo code internal interleaver**

| Number of input bits<br>*K* | Number<br>of rows *R* | Inter-row permutation patterns<br><*T*(0), *T*(1), …, *T*(*R* - 1)> |
|---|---|---|
| ($40 \leq K \leq 159$) | 5 | <4, 3, 2, 1, 0> |
| ($160 \leq K \leq 200$) or ($481 \leq K \leq 530$) | 10 | <9, 8, 7, 6, 5, 4, 3, 2, 1, 0> |
| ($2281 \leq K \leq 2480$) or ($3161 \leq K \leq 3210$) | 20 | <19, 9, 14, 4, 0, 2, 5, 7, 12, 18, 16, 13, 17, 15, 3, 1, 6, 11, 8, 10> |
| *K* = any other value | 20 | <19, 9, 14, 4, 0, 2, 5, 7, 12, 18, 10, 8, 13, 17, 3, 1, 16, 6, 15, 11> |

(5) Perform the $i$-th ($i$ = 0,1, …, $R$ - 1) intra-row permutation as:

if ($C = p$) then

$U_i(j) = s((j \times r_i) \bmod (p-1))$, $j$ = 0, 1, …, ($p$ - 2), and $U_i(p - 1) = 0$,

where $U_i(j)$ is the original bit position of $j$-th permuted bit of $i$-th row.

end if

if ($C = p + 1$) then

$U_i(j) = s((j \times r_i) \bmod (p-1))$, $j$ = 0, 1, …, ($p$ - 2). $U_i(p - 1) = 0$, and $U_i(p) = p$,

where $U_i(j)$ is the original bit position of $j$-th permuted bit of $i$-th row, and

if ($K = R \times C$) then

Exhange $U_{R-1}(p)$ with $U_{R-1}(0)$.

end if

end if

if ($C = p - 1$) then

$U_i(j) = s((j \times r_i) \bmod (p-1)) - 1$, $j$ =0, 1, …, ($p$ - 2),

where $U_i(j)$ is the original bit position of $j$-th permuted bit of $i$-th row.

end if

(6) Perform the inter-row permutation for the rectangular matrix based on the pattern $\langle T(i) \rangle_{i \in \{0,1,\cdots,R-1\}}$,

where $T(i)$ is the original row position of the $i$-th permuted row.

### 4.2.3.2.3.3 Bits-output from rectangular matrix with pruning

After intra-row and inter-row permutations, the bits of the permuted rectangular matrix are denoted by $y'_k$:

$$\begin{bmatrix} y'_1 & y'_{(R+1)} & y'_{(2R+1)} & \cdots y'_{((C-1)R+1)} \\ y'_2 & y'_{(R+2)} & y'_{(2R+2)} & \cdots y'_{((C-1)R+2)} \\ \vdots & \vdots & \vdots & \cdots \quad \vdots \\ y'_R & y'_{2R} & y'_{3R} & \cdots \quad y'_{C \times R} \end{bmatrix}$$

The output of the Turbo code internal interleaver is the bit sequence read out column by column from the intra-row and inter-row permuted $R \times C$ rectangular matrix starting with bit $y'_1$ in row 0 of column 0 and ending with bit $y'_{CR}$ in row $R$ - 1 of column $C$ - 1. The output is pruned by deleting dummy bits that were padded to the input of the rectangular matrix before intra-row and inter row permutations, i.e. bits $y'_k$ that corresponds to bits $y_k$ with $k > K$ are removed from the output. The bits output from Turbo code internal interleaver are denoted by $x'_1$, $x'_2$, …, $x'_K$, where $x'_1$ corresponds to the bit $y'_k$ with smallest index $k$ after pruning, $x'_2$ to the bit $y'_k$ with second smallest index $k$ after pruning, and so on. The number of bits output from Turbo code internal interleaver is $K$ and the total number of pruned bits is:

$R \times C - K$.

#### 4.2.3.3 Concatenation of encoded blocks

After the channel coding for each code block, if $C_i$ is greater than 1, the encoded blocks are serially concatenated so that the block with lowest index $r$ is output first from the channel coding block, otherwise the encoded block is output from channel coding block as it is. The bits output are denoted by $c_{i1}, c_{i2}, c_{i3}, \ldots, c_{iE_i}$, where $i$ is the TrCH number and $E_i = C_iY_i$. The output bits are defined by the following relations:

$$c_{ik} = y_{i1k} \quad k = 1, 2, \ldots, Y_i$$

$$c_{ik} = y_{i,2,(k-Y_i)} \quad k = Y_i + 1, Y_i + 2, \ldots, 2Y_i$$

$$c_{ik} = y_{i,3,(k-2Y_i)} \quad k = 2Y_i + 1, 2Y_i + 2, \ldots, 3Y_i$$

…

$$c_{ik} = y_{i,C_i,(k-(C_i-1)Y_i)} \quad k = (C_i - 1)Y_i + 1, (C_i - 1)Y_i + 2, \ldots, C_iY_i$$

If no code blocks are input to the channel coding ($C_i = 0$), no bits shall be output from the channel coding, i.e. $E_i = 0$.

### 4.2.4 Radio frame size equalisation

Radio frame size equalisation is padding the input bit sequence in order to ensure that the output can be segmented in $F_i$ data segments of same size as described in the subclause 4.2.6.

The input bit sequence to the radio frame size equalisation is denoted by $c_{i1}, c_{i2}, c_{i3}, \ldots, c_{iE_i}$, where $i$ is TrCH number and $E_i$ the number of bits. The output bit sequence is denoted by $t_{i1}, t_{i2}, t_{i3}, \ldots, t_{iT_i}$, where $T_i$ is the number of bits. The output bit sequence is derived as follows:

$t_{ik} = c_{ik}$, for k = 1… $E_i$ and

$t_{ik} = \{0, 1\}$ for k= $E_i$ +1… $T_i$, if $E_i < T_i$

where

$T_i = F_i * N_i$ and

$N_i = \lceil E_i / F_i \rceil$ is the number of bits per segment after size equalisation.

### 4.2.5 1st interleaving

The 1st interleaving is a block interleaver with inter-column permutations. The input bit sequence to the block interleaver is denoted by $x_{i,1}, x_{i,2}, x_{i,3}, \ldots, x_{i,X_i}$, where $i$ is TrCH number and $X_i$ the number of bits. Here $X_i$ is guaranteed to be an integer multiple of the number of radio frames in the TTI. The output bit sequence from the block interleaver is derived as follows:

1) select the number of columns C1 from table 4~~5~~ depending on the TTI. The columns are numbered 0, 1, …, C1 - 1 from left to right.

2) determine the number of rows of the matrix, R1 defined as

   R1 = $X_i$ / C1.

The rows of the matrix are numbered 0, 1, …, R1 - 1 from top to bottom.

3) write the input bit sequence into the R1 × C1 matrix row by row starting with bit $x_{i,1}$ in column 0 of row 0 and ending with bit $x_{i,(\mathrm{R1}\times\mathrm{C1})}$ in column C1 - 1 of row R1 – 1:

$$\begin{bmatrix} x_{i,1} & x_{i,2} & x_{i,3} & \ldots & x_{i,\mathrm{C1}} \\ x_{i,(\mathrm{C1}+1)} & x_{i,(\mathrm{C1}+2)} & x_{i,(\mathrm{C1}+3)} & \ldots & x_{i,(2\times\mathrm{C1})} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ x_{i,((\mathrm{R1}-1)\times\mathrm{C1}+1)} & x_{i,((\mathrm{R1}-1)\times\mathrm{C1}+2)} & x_{i,((\mathrm{R1}-1)\times\mathrm{C1}+3)} & \ldots & x_{i,(\mathrm{R1}\times\mathrm{C1})} \end{bmatrix}$$

4) Perform the inter-column permutation for the matrix based on the pattern $\langle \mathrm{P1}_{\mathrm{C1}}(j)\rangle_{j\in\{0,1,\ldots,\mathrm{C1}-1\}}$ shown in table 45, where $\mathrm{P1}_{\mathrm{C1}}(j)$ is the original column position of the *j*-th permuted column. After permutation of the columns, the bits are denoted by $y_{i,k}$:

$$\begin{bmatrix} y_{i,1} & y_{i,(\mathrm{R1}+1)} & y_{i,(2\times\mathrm{R1}+1)} & \ldots & y_{i,((\mathrm{C1}-1)\times\mathrm{R1}+1)} \\ y_{i,2} & y_{i,(\mathrm{R1}+2)} & y_{i,(2\times\mathrm{R1}+2)} & \ldots & y_{i,((\mathrm{C1}-1)\times\mathrm{R1}+2)} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ y_{i,\mathrm{R1}} & y_{i,(2\times\mathrm{R1})} & y_{i,(3\times\mathrm{R1})} & \ldots & y_{i,(\mathrm{C1}\times\mathrm{R1})} \end{bmatrix}$$

5) Read the output bit sequence $y_{i,1}, y_{i,2}, y_{i,3}, \ldots, y_{i,(\mathrm{C1}\times\mathrm{R1})}$ of the block interleaver column by column from the inter-column permuted R1 × C1 matrix. Bit $y_{i,1}$ corresponds to row 0 of column 0 and bit $y_{i,(\mathrm{R1}\times\mathrm{C1})}$ corresponds to row R1 - 1 of column C1 - 1.

**Table 45 Inter-column permutation patterns for 1st interleaving**

| TTI | Number of columns C1 | Inter-column permutation patterns <$\mathrm{P1}_{\mathrm{C1}}(0)$, $\mathrm{P1}_{\mathrm{C1}}(1)$, …, $\mathrm{P1}_{\mathrm{C1}}(\mathrm{C1}-1)$> |
|---|---|---|
| 5ms(*1), 10 ms | 1 | <0> |
| 20 ms | 2 | <0,1> |
| 40 ms | 4 | <0,2,1,3> |
| 80 ms | 8 | <0,4,2,6,1,5,3,7> |

(*1) can be used for PRACH for 1.28 Mcps TDD

### 4.2.5.1 Relation between input and output of 1st interleaving

The bits input to the 1st interleaving are denoted by $t_{i,1}, t_{i,2}, t_{i,3}, \ldots, t_{i,T_i}$, where *i* is the TrCH number and $T_i$ the number of bits. Hence, $x_{i,k} = t_{i,k}$ and $X_i = T_i$.

The bits output from the 1st interleaving are denoted by $d_{i,1}, d_{i,2}, d_{i,3}, \ldots, d_{i,T_i}$, and $d_{i,k} = y_{i,k}$.

## 4.2.6 Radio frame segmentation

When the transmission time interval is longer than 10 ms, the input bit sequence is segmented and mapped onto consecutive $F_i$ radio frames. Following radio frame size equalisation the input bit sequence length is guaranteed to be an integer multiple of $F_i$.

The input bit sequence is denoted by $x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$ where *i* is the TrCH number and $X_i$ is the number bits. The $F_i$ output bit sequences per TTI are denoted by $y_{i,n_i1}, y_{i,n_i2}, y_{i,n_i3}, \ldots, y_{i,n_iY_i}$ where $n_i$ is the radio frame number in current TTI and $Y_i$ is the number of bits per radio frame for TrCH *i*. The output sequences are defined as follows:

$$y_{i,n_ik} = x_{i,((n_i-1)Y_i)+k}, \quad n_i = 1\ldots F_i,\ k = 1\ldots Y_i$$

where

$Y_i = (X_i / F_i)$ is the number of bits per segment.

The $n_i$ –th segment is mapped to the $n_i$ –th radio frame of the transmission time interval.

The input bit sequence to the radio frame segmentation is denoted by $d_{i1}, d_{i2}, d_{i3}, \ldots, d_{iT_i}$, where $i$ is the TrCH number and $T_i$ the number of bits. Hence, $x_{ik} = d_{ik}$ and $X_i = T_i$.

The output bit sequence corresponding to radio frame $n_i$ is denoted by $e_{i1}, e_{i2}, e_{i3}, \ldots, e_{iN_i}$, where $i$ is the TrCH number and $N_i$ is the number of bits. Hence, $e_{i,k} = y_{i,n_i k}$ and $N_i = Y_i$.

### 4.2.7 Rate matching

Rate matching means that bits on a TrCH are repeated or punctured. Higher layers assign a rate-matching attribute for each TrCH. This attribute is semi-static and can only be changed through higher layer signalling. The rate-matching attribute is used when the number of bits to be repeated or punctured is calculated.

The number of bits on a TrCH can vary between different transmission time intervals. When the number of bits between different transmission time intervals is changed, bits are repeated to ensure that the total bit rate after TrCH multiplexing is identical to the total channel bit rate of the allocated physical channels.

If no bits are input to the rate matching for all TrCHs within a CCTrCH, the rate matching shall output no bits for all TrCHs within the CCTrCH.

**Notation used in subclause 4.2.7 and subclauses:**

$N_{ij}$ : Number of bits in a radio frame before rate matching on TrCH *i* with transport format combination *j*.

$\Delta N_{i,j}$ : If positive – number of bits to be repeated in each radio frame on TrCH *i* with transport format

If negative – number of bits to be punctured in each radio frame on TrCH *i* with transport format combination *j*.

$RM_i$ : Semi-static rate matching attribute for TrCH *i*. Signalled from higher layers.

$PL$ : Puncturing limit. This value limits the amount of puncturing that can be applied in order to minimise the number of physical channels. Signalled from higher layers. The allowed puncturing in % is actually equal to (1-PL)*100.

$N_{data,j}$ : Total number of bits that are available for a CCTrCH in a radio frame with transport format combination j.

$P$ : number of physical channels used in the current frame.

$P_{max}$ : maximum number of physical channels allocated for a CCTrCH.

$U_p$ : Number of data bits in the physical channel p with p = 1...P.

$I$ : Number of TrCHs in a CCTrCH.

$Z_{ij}$ : Intermediate calculation variable.

$F_i$ : Number of radio frames in the transmission time interval of TrCH *i*.

$n_i$ : Radio frame number in the transmission time interval of TrCH *i* ($0 \le n_i < F_i$).

$q$ : Average puncturing or repetition distance(normalised to only show the remaining rate matching on top of an integer number of repetitions).

$P1_F(n_i)$ : The column permutation function of the 1st interleaver, $P1_F(x)$ is the original position of column with number x after permutation. P1 is defined on table 45 of section 4.2.5 (note that $P1_F$ self-inverse).

S[n] : The shift of the puncturing or repetition pattern for radio frame $n_i$ when $n = \mathrm{P}1_{F_i}(n_i)$.

$TF_i(j)$ : Transport format of TrCH i for the transport format combination j.

$TFS(i)$ : The set of transport format indexes $l$ for TrCH i.

$e_{ini}$ : Initial value of variable e in the rate matching pattern determination algorithm of subclause 4.2.7.3.

$e_{plus}$ : Increment of variable $e$ in the rate matching pattern determination algorithm of subclause 4.2.7.3.

$e_{minus}$ : Decrement of variable $e$ in the rate matching pattern determination algorithm of subclause 4.2.7.3.

$b$ : Indicates systematic and parity bits.

$b$=1: Systematic bit. $X(t)$ in subclause 4.2.3.2.1.

$b$=2: 1st parity bit (from the upper Turbo constituent encoder). $Y(t)$ in subclause 4.2.3.2.1.

$b$=3: 2nd parity bit (from the lower Turbo constituent encoder). $Y'(t)$ in subclause 4.2.3.2.1.

### 4.2.7.1 Determination of rate matching parameters

The following relations, defined for all TFC $j$, are used when calculating the rate matching pattern:

$$Z_{0,j} = 0$$

$$Z_{i,j} = \left\lfloor \frac{\left(\left(\sum_{m=1}^{i} RM_m \times N_{m,j}\right) \times N_{data,j}\right)}{\sum_{m=1}^{I} RM_m \times N_{m,j}} \right\rfloor \quad \text{for all i = 1 ... } I \text{ (1)}$$

$$\Delta N_{i,j} = Z_{i,j} - Z_{i-1,j} - N_{i,j} \quad \text{for all i = 1 ... } I$$

Puncturing can be used to minimise the required transmission capacity. The maximum amount of puncturing that can be applied is 1-PL, PL is signalled from higher layers. The possible values for $N_{data}$ depend on the number of physical channels $P_{max}$, allocated to the respective CCTrCH, and on their characteristics (spreading factor, length of midamble and TFCI code word, usage of TPC and multiframe structure), which is given in [7].

For each physical channel an individual minimum spreading factor $Sp_{min}$ is transmitted by means of the higher layers. Denote the number of data bits in each physical channel by $U_{p,Sp}$ , where $p$ indicates the sequence number $1 \le p \le P_{max}$ and $Sp$ indicates the spreading factor with the possible values {$16, 8, 4, 2, 1$} of this physical channel. The index $p$ is described in section 4.2.12~~13~~ with the following modifications: spreading factor ($Q$) is replaced by the minimum spreading factor $Sp_{min}$ and $k$ is replaced by the channelization code index at $Q= Sp_{min}$. Then, for $N_{data}$ one of the following values in ascending order can be chosen:

$$\left\{U_{1,S1_{\min}}, U_{1,S1_{\min}} + U_{2,S2_{\min}}, U_{1,S1_{\min}} + U_{2,S2_{\min}} + \ldots + U_{P_{\max},(SP_{\max})_{\min}}\right\}$$

Optionally, if indicated by higher layers for the UL the UE shall vary the spreading factor autonomously, so that $N_{data}$ is one of the following values in ascending order:

$$\left\{U_{1,16}, \ldots, U_{1,S1_{\min}}, U_{1,S1_{\min}} + U_{2,16}, \ldots, U_{1,S1_{\min}} + U_{2,S2_{\min}}, \ldots, U_{1,S1_{\min}} + U_{2,S2_{\min}} + \ldots + U_{P_{\max},16}, \ldots, U_{1,S1_{\min}} + U_{2,S2_{\min}} + \ldots + U_{P_{\max},(SP_{\max})_{\min}}\right\}$$

$N_{data,\,j}$ for the transport format combination j is determined by executing the following algorithm:

$$\text{SET1} = \{\ N_{data} \text{ such that } \left(\min_{1 \le y \le I}\{RM_y\}\right) \times N_{data} - PL \times \sum_{x=1}^{I} RM_x \times N_{x,j} \text{ is non negative }\}$$

$N_{data,\,j}$ = min SET1

The number of bits to be repeated or punctured, $\Delta N_{i,j}$, within one radio frame for each TrCH i is calculated with the relations given at the beginning of this subclause for all possible transport format combinations j and selected every radio frame. The number of physical channels corresponding to $N_{data, j}$, shall be denoted by P.

If $\Delta N_{i,j} = 0$ then the output data of the rate matching is the same as the input data and the rate matching algorithm of subclause 4.2.7.3 does not need to be executed.

Otherwise, the rate matching pattern is calculated with the algorithm described in subclause 4.2.7.3. For this algorithm the parameters $e_{ini}$, $e_{plus}$, $e_{minus}$, and $X_i$ are needed, which are calculated according to the equations in subclauses 4.2.7.1.1 and 4.2.7.1.2.

#### 4.2.7.1.1 Uncoded and convolutionally encoded TrCHs

$a = 2$

$\Delta N_i = \Delta N_{i,j}$

$X_i = N_{i,j}$

$R = \Delta N_{i,j} \bmod N_{i,j}$ -- note: in this context $\Delta N_{i,j} \bmod N_{i,j}$ is in the range of 0 to $N_{i,j}$-1 i.e. -1 mod 10 = 9.

if $R \neq 0$ and $2 \times R \leq N_{i,j}$

then $q = \lceil N_{i,j} / R \rceil$

else

$q = \lceil N_{i,j} / (R - N_{i,j}) \rceil$

endif

NOTE 1: q is a signed quantity.

If q is even

then $q' = q + \gcd(|q|, F_i) / F_i$ -- where gcd ($|q|$, $F_i$) means greatest common divisor of $|q|$ and $F_i$

NOTE 2: q' is not an integer, but a multiple of 1/8.

else

$q' = q$

endif

for x = 0 to $F_i$-1

$S[|\lfloor x \times q' \rfloor| \bmod F_i] = (|\lfloor x * q' \rfloor| \text{ div } F_i)$

end for

$e_{ini} = (a \times S[P1_{Fi}(n_i)] \times |\Delta N_i| + 1) \bmod (a \times N_{i,j})$

$e_{plus} = a \times X_i$

$e_{minus} = a \times |\Delta N_i|$

puncturing for $\Delta N_i < 0$, repetition otherwise.

#### 4.2.7.1.2 Turbo encoded TrCHs

If repetition is to be performed on turbo encoded TrCHs, i.e. $\Delta N_{i,j} > 0$, the parameters in subclause 4.2.7.1.1 are used.

If puncturing is to be performed, the parameters below shall be used. Index *b* is used to indicate systematic (*b*=1), 1st parity (*b*=2), and 2nd parity bit (*b*=3).

a = 2 when $b$=2

a = 1 when $b$=3

$$\Delta N_i = \begin{cases} \lfloor \Delta N_{i,j}/2 \rfloor, & b=2 \\ \lceil \Delta N_{i,j}/2 \rceil, & b=3 \end{cases}$$

If $\Delta N_i$ is calculated as 0 for $b$=2 or $b$=3, then the following procedure and the rate matching algorithm of subclause 4.2.7.3 don't need to be performed for the corresponding parity bit stream.

$X_i = \lfloor N_{i,j}/3 \rfloor$ ,

$q = \lfloor X_i / |\Delta N_i| \rfloor$

if(q ≤ 2)

for $r$=0 to $F_i$-1

S[(3×$r$+b-1) mod $F_i$] = $r$ mod 2;

end for

else

if q is even

then q′ = q – $gcd$(q, $F_i$)/ $F_i$ -- where $gcd$ (q, $F_i$) means greatest common divisor of q and $F_i$

NOTE: q′ is not an integer, but a multiple of 1/8.

else q′ = q

endif

for $x$=0 to $F_i$ –1

r = $\lceil x \times q' \rceil$ mod $F_i$;

S[(3×r+b-1) mod $F_i$] = $\lceil x \times q' \rceil$ div $F_i$;

endfor

endif

For each radio frame, the rate-matching pattern is calculated with the algorithm in subclause 4.2.7.3, where:

$X_i$ is as above,

$e_{ini}$ = (a×S[P1 $F_i$ ($n_i$)]×·|$\Delta N_i$| + $X_i$) mod (a×$X_i$), if $e_{ini}$ = 0 then $e_{ini}$ = a×$X_i$

$e_{plus}$ = a×$X_i$

$e_{minus}$ = a×|$\Delta N_i$|

### 4.2.7.2 Bit separation and collection for rate matching

The systematic bits of turbo encoded TrCHs shall not be punctured, the other bits may be punctured. The systematic bits, first parity bits, and second parity bits in the bit sequence input to the rate matching block are therefore separated into three sequences.

The first sequence contains:

- All of the systematic bits that are from turbo encoded TrCHs.

- From 0 to 2 first and/or second parity bits that are from turbo encoded TrCHs. These bits come into the first sequence when the total number of bits in a block after radio frame segmentation is not a multiple of three.
- Some of the systematic, first parity and second parity bits that are for trellis termination.

The second sequence contains:

- All of the first parity bits that are from turbo encoded TrCHs, except those that go into the first sequence when the total number of bits is not a multiple of three.
- Some of the systematic, first parity and second parity bits that are for trellis termination.

The third sequence contains:

- All of the second parity bits that are from turbo encoded TrCHs, except those that go into the first sequence when the total number of bits is not a multiple of three.
- Some of the systematic, first parity and second parity bits that are for trellis termination.

The second and third sequences shall be of equal length, whereas the first sequence can contain from 0 to 2 more bits. Puncturing is applied only to the second and third sequences.

The bit separation function is transparent for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition. The bit separation and bit collection are illustrated in figures 45 and 56.

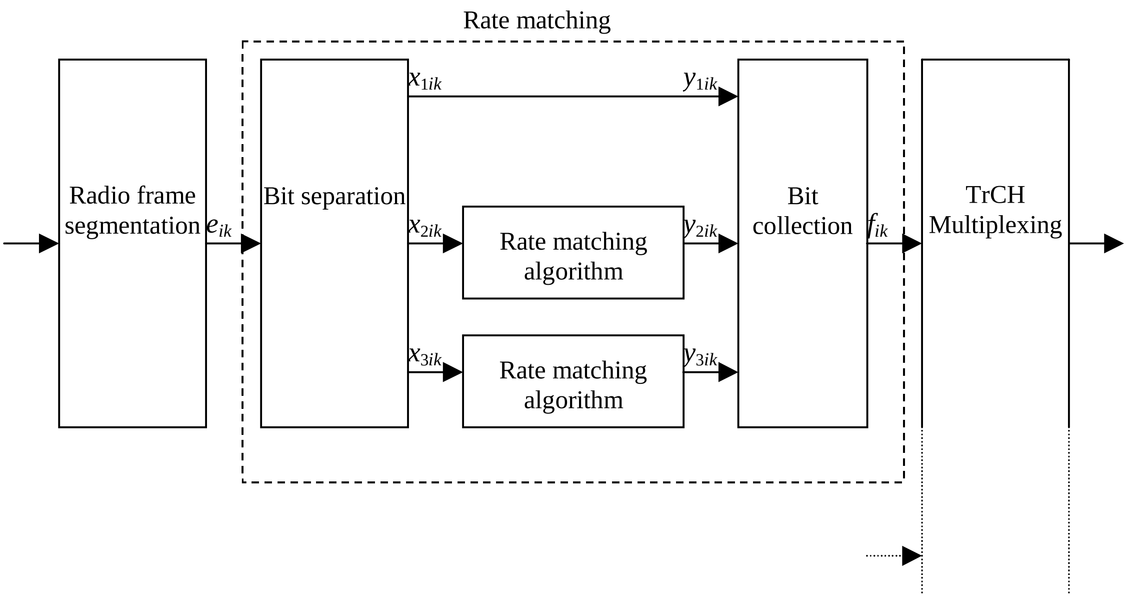


**Figure 45: Puncturing of turbo encoded TrCHs**

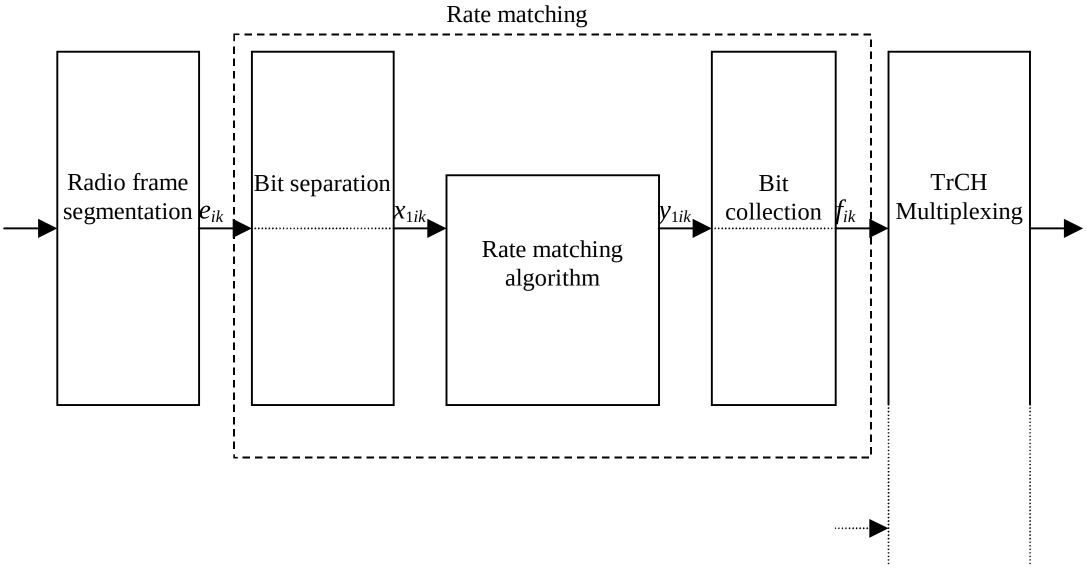


**Figure 5~~6~~: Rate matching for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition**

The bit separation is dependent on the 1st interleaving and offsets are used to define the separation for different TTIs. $b$ indicates the three sequences defined in this section, with $b$=1 indicating the first sequence, $b$ = 2 the second one, and $b$ = 3 the third one.

The offsets $\alpha_b$ for these sequences are listed in table 5~~6~~.

**Table 5~~6~~: TTI dependent offset needed for bit separation**

| TTI (ms) | $\alpha_1$ | $\alpha_2$ | $\alpha_3$ |
|---|---|---|---|
| 10, 40 | 0 | 1 | 2 |
| 20, 80 | 0 | 2 | 1 |

The bit separation is different for different radio frames in the TTI. A second offset is therefore needed. The radio frame number for TrCH $i$ is denoted by $n_i$. and the offset by $\beta_{n_i}$.

**Table 6~~7~~: Radio frame dependent offset needed for bit separation**

| TTI (ms) | $\beta_0$ | $\beta_1$ | $\beta_2$ | $\beta_3$ | $\beta_4$ | $\beta_5$ | $\beta_6$ | $\beta_7$ |
|---|---|---|---|---|---|---|---|---|
| 10 | 0 | NA | NA | NA | NA | NA | NA | NA |
| 20 | 0 | 1 | NA | NA | NA | NA | NA | NA |
| 40 | 0 | 1 | 2 | 0 | NA | NA | NA | NA |
| 80 | 0 | 1 | 2 | 0 | 1 | 2 | 0 | 1 |

### 4.2.7.2.1 Bit separation

The bits input to the rate matching are denoted by $e_{i,1}, e_{i,2}, e_{i,3}, \ldots, e_{i,N_i}$, where $i$ is the TrCH number and $N_i$ is the number of bits input to the rate matching block. Note that the transport format combination number $j$ for simplicity has been left out in the bit numbering, i.e. $N_i$=$N_{ij}$. The bits after separation are denoted by $x_{b,i,1}, x_{b,i,2}, x_{b,i,3}, \ldots, x_{b,i,X_i}$. For turbo encoded TrCHs with puncturing, $b$ indicates the three sequences defined in section 4.2.7.2, with $b$=1 indicating the first sequence, and so forth. For all other cases $b$ is defined to be 1. $X_i$ is the number of bits in each separated bit sequence. The relation between $e_{i,k}$ and $x_{b,i,k}$ is given below.

For turbo encoded TrCHs with puncturing:

$$x_{1,i,k} = e_{i,3(k-1)+1+(\alpha_1+\beta_{n_i}) \bmod 3} \qquad k = 1, 2, 3, \ldots, X_i \qquad X_i = \lfloor N_i / 3 \rfloor$$

$x_{1,i,\lfloor N_i/3 \rfloor+k} = e_{i,3\lfloor N_i/3 \rfloor+k}$ $k = 1, \ldots, N_i \bmod 3$ Note: When ($N_i$ mod 3) = 0 this row is not needed.

$x_{2,i,k} = e_{i,3(k-1)+1+(\alpha_2+\beta_{n_i}) \bmod 3}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = \lfloor N_i/3 \rfloor$

$x_{3,i,k} = e_{i,3(k-1)+1+(\alpha_3+\beta_{n_i}) \bmod 3}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = \lfloor N_i/3 \rfloor$

For uncoded TrCHs, convolutionally encoded TrCHs, and turbo encoded TrCHs with repetition:

$x_{1,i,k} = e_{i,k}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = N_i$

#### 4.2.7.2.2 Bit collection

The bits $x_{b,i,k}$ are input to the rate matching algorithm described in subclause 4.2.7.3. The bits output from the rate matching algorithm are denoted $y_{b,i,1}, y_{b,i,2}, y_{b,i,3}, \ldots, y_{b,i,Y_i}$.

Bit collection is the inverse function of the separation. The bits after collection are denoted by $z_{b,i,1}, z_{b,i,2}, z_{b,i,3}, \ldots, z_{b,i,Y_i}$. After bit collection, the bits indicated as punctured are removed and the bits are then denoted by $f_{i,1}, f_{i,2}, f_{i,3}, \ldots, f_{i,V_i}$, where $i$ is the TrCH number and $V_i = N_{i,j}+\Delta N_{i,j}$. The relations between $y_{b,i,k}$, $z_{b,i,k}$, and $f_{i,k}$ are given below.

For turbo encoded TrCHs with puncturing ($Y_i$=$X_i$):

$z_{i,3(k-1)+1+(\alpha_1+\beta_{n_i}) \bmod 3} = y_{1,i,k}$ $k = 1, 2, 3, \ldots, Y_I$

$z_{i,3\lfloor N_i/3 \rfloor+k} = y_{1,i,\lfloor N_i/3 \rfloor+k}$ $k = 1, \ldots, N_i \bmod 3$ Note: When ($N_i$ mod 3) = 0 this row is not needed.

$z_{i,3(k-1)+1+(\alpha_2+\beta_{n_i}) \bmod 3} = y_{2,i,k}$ $k = 1, 2, 3, \ldots, Y_i$

$z_{i,3(k-1)+1+(\alpha_3+\beta_{n_i}) \bmod 3} = y_{3,i,k}$ $k = 1, 2, 3, \ldots, Y_i$

After the bit collection, bits $z_{i,k}$ with value $\delta$, where $\delta \notin \{0, 1\}$, are removed from the bit sequence. Bit $f_{i,1}$ corresponds to the bit $z_{i,k}$ with smallest index $k$ after puncturing, bit $f_{i,2}$ corresponds to the bit $z_{i,k}$ with second smallest index $k$ after puncturing, and so on.

For uncoded TrCHs, convolutionally encoded TrCHs, and turbo encoded TrCHs with repetition:

$z_{i,k} = y_{1,i,k}$ $k = 1, 2, 3, \ldots, Y_i$

When repetition is used, $f_{i,k}$=$z_{i,k}$ and $Y_i$=$V_i$.

When puncturing is used, $Y_i$=$X_i$ and bits $z_{i,k}$ with value $\delta$, where $\delta \notin \{0, 1\}$, are removed from the bit sequence. Bit $f_{i,1}$ corresponds to the bit $z_{i,k}$ with smallest index $k$ after puncturing, bit $f_{i,2}$ corresponds to the bit $z_{i,k}$ with second smallest index $k$ after puncturing, and so on.

### 4.2.7.3 Rate matching pattern determination

The bits input to the rate matching are denoted by $x_{i,1}, x_{i,2}, x_{i,3}, \ldots, x_{i,X_i}$, where $i$ is the TrCH and $X_i$ is the parameter given in subclauses 4.2.7.1.1 and 4.2.7.1.2.

NOTE: The transport format combination number j for simplicity has been left out in the bit numbering.

The rate matching rule is as follows:

if puncturing is to be performed

$e = e_{ini}$ -- initial error between current and desired puncturing ratio

m = 1 -- index of current bit

do while m <= $X_i$

$e = e - e_{minus}$ -- update error

if e <= 0 then -- check if bit number m should be punctured

set bit $x_{i,m}$ to $\delta$ where $\delta \notin \{0, 1\}$

$e = e + e_{plus}$ -- update error

end if

m = m + 1 -- next bit

end do

else

e = $e_{ini}$ -- initial error between current and desired puncturing ratio

m = 1 -- index of current bit

do while m <= $X_i$

$e = e - e_{minus}$ -- update error

do while e <= 0 -- check if bit number m should be repeated

repeat bit $x_{i,m}$

$e = e + e_{plus}$ -- update error

end do

m = m + 1 -- next bit

end do

end if

A repeated bit is placed directly after the original one.

### 4.2.8 TrCH multiplexing

Every 10 ms, one radio frame from each TrCH is delivered to the TrCH multiplexing. These radio frames are serially multiplexed into a coded composite transport channel (CCTrCH). If the TTI is smaller than 10ms, then no TrCH multiplexing is performed.

The bits input to the TrCH multiplexing are denoted by $f_{i,1}, f_{i,2}, f_{i,3}, \dots, f_{i,V_i}$, where *i* is the TrCH id number and $V_i$ is the number of bits in the radio frame of TrCH *i*. The number of TrCHs is denoted by *I*. The bits output from TrCH multiplexing are denoted by $h_1, h_2, h_3, \dots, h_S$, where *S* is the number of bits, i.e. $S = \sum_i V_i$. The TrCH multiplexing is defined by the following relations:

$h_k = f_{1,k}$   $k = 1, 2, \dots, V_1$

$h_k = f_{2,(k-V_1)}$   $k = V_1+1, V_1+2, \dots, V_1+V_2$

$h_k = f_{3,(k-(V_1+V_2))}$   $k = (V_1+V_2)+1, (V_1+V_2)+2, \dots, (V_1+V_2)+V_3$

…

$$h_k = f_{I,(k-(V_1+V_2+\ldots+V_{I-1}))} \qquad k = (V_1+V_2+\ldots+V_{I-1})+1,\ (V_1+V_2+\ldots+V_{I-1})+2,\ \ldots,\ (V_1+V_2+\ldots+V_{I-1})+V_I$$

## 4.2.9 Bit Scrambling

The bits output from the TrCH multiplexer are scrambled in the bit scrambler. The bits input to the bit scrambler are denoted by $h_1, h_2, h_3, \ldots, h_S$ , where $S$ is the number of bits input to the bit scrambling block equal to the total number of bits on the CCTrCH. The bits after bit scrambling are denoted $s_1, s_2, s_3, \ldots, s_S$ .

Bit scrambling is defined by the following relation:

$$s_k = h_k \oplus p_k \quad k = 1,2\ldots,S$$

and $p_k$ results from the following operation:

$$p_k = \left(\sum_{i=1}^{16} g_i \cdot p_{k-i}\right) \bmod 2\ ;\ p_k = 0; k < 1\ ;\ p_1 = 1;\ \ g = \{0,0,0,0,0,0,0,0,0,0,1,0,1,1,0,1\}$$

## 4.2.10 Physical channel segmentation

When more than one PhCH is used, physical channel segmentation divides the bits among the different PhCHs. The bits input to the physical channel segmentation are denoted by $s_1, s_2, s_3, \ldots, s_S$ , where S is the number of bits input to the physical channel segmentation block. The number of PhCHs after rate matching is denoted by *P,* as defined in subclause 4.2.7.1.

The bits after physical channel segmentation are denoted $u_{p,1}, u_{p,2}, u_{p,3}, \ldots, u_{p,U_p}$ , where *p* is PhCH number and $U_p$ is the in general variable number of bits in the respective radio frame for each PhCH. The relation between $s_k$ and $u_{p,k}$ is given below.

Bits on first PhCH after physical channel segmentation:

$$u_{1,k} = s_k \qquad k = 1, 2, \ldots, U_1$$

Bits on second PhCH after physical channel segmentation:

$$u_{2,k} = s_{(k+U_1)} \qquad k = 1, 2, \ldots, U_2$$

…

Bits on the $P^{th}$ PhCH after physical channel segmentation:

$$u_{P,k} = s_{(k+U_1+\ldots+U_{P-1})} \qquad k = 1, 2, \ldots, U_P$$

## 4.2.11 2nd interleaving

The 2$^{nd}$ interleaving is a block interleaver and consists of bits input to a matrix with padding, the inter-column permutation for the matrix and bits output from the matrix with pruning. The 2nd interleaving can be applied jointly to all data bits transmitted during one frame, or separately within each timeslot, on which the CCTrCH is mapped. The selection of the 2nd interleaving scheme is controlled by higher layer.

#### 4.2.11.1 Frame related 2nd interleaving

In case of frame related 2nd interleaving, the bits input to the block interleaver are denoted by $x_1, x_2, x_3, \ldots, x_U$ , where $U$ is the total number of bits after TrCH multiplexing transmitted during the respective radio frame with $S = U = \sum_p U_p$ .

The relation between $x_k$ and the bits $u_{p,k}$ in the respective physical channels is given below:

$x_k = u_{1,k}$ $\quad k = 1, 2, \ldots, U_1$

$x_{(k+U_1)} = u_{2,k}$ $\quad k = 1, 2, \ldots, U_2$

…

$x_{(k+U_1+\ldots+U_{P-1})} = u_{P,k}$ $\quad k = 1, 2, \ldots, U_P$

The following steps have to be performed once for each CCTrCH:

(1) Assign C2 = 30 to be the number of columns of the matrix. The columns of the matrix are numbered 0, 1, 2, …, C2 - 1 from left to right.

(2) Determine the number of rows of the matrix, R2, by finding minimum integer R2 such that:

$U \leq \text{R2} \times \text{C2}$.

The rows of rectangular matrix are numbered 0, 1, 2, …, R2 - 1 from top to bottom.

(3) Write the input bit sequence $x_1, x_2, x_3, \ldots, x_U$ into the R2 $\times$ C2 matrix row by row starting with bit $y_1$ in column 0 of row 0:

$$\begin{bmatrix} y_1 & y_2 & y_3 & \ldots & y_{\text{C2}} \\ y_{(\text{C2}+1)} & y_{(\text{C2}+2)} & y_{(\text{C2}+3)} & \ldots & y_{(2\times\text{C2})} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ y_{((\text{R2}-1)\times\text{C2}+1)} & y_{((\text{R2}-1)\times\text{C2}+2)} & y_{((\text{R2}-1)\times\text{C2}+3)} & \ldots & y_{(\text{R2}\times\text{C2})} \end{bmatrix}$$

where $y_k = x_k$ for $k$ = 1, 2, …, $U$ and if R2 × C2 > $U$, the dummy bits are padded such that $y_k$ = 0 or 1 for $k$ = $U$ + 1, $U$ + 2, …, R2 × C2. These dummy bits are pruned away from the output of the matrix after the inter-column permutation.

(4) Perform the inter-column permutation for the matrix based on the pattern $\langle \text{P}2(j) \rangle_{j\in\{0,1,\ldots,\text{C2}-1\}}$ that is shown in table 78, where $\text{P}_2(j)$ is the original column position of the $j$-th permuted column. After permutation of the columns, the bits are denoted by $y'_k$ .

$$\begin{bmatrix} y'_1 & y'_{(\text{R2}+1)} & y'_{(2\times\text{R2}+1)} & \ldots & y'_{((\text{C2-1})\times\text{R2}+1)} \\ y'_2 & y'_{(\text{R2}+2)} & y'_{(2\times\text{R2}+2)} & \ldots & y'_{((\text{C2-1})\times\text{R2}+2)} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ y'_{\text{R2}} & y'_{(2\times\text{R2})} & y'_{(3\times\text{R2})} & \ldots & y'_{(\text{C2}\times\text{R2})} \end{bmatrix}$$

(5) The output of the block interleaver is the bit sequence read out column by column from the inter-column permuted R2 $\times$ C2 matrix. The output is pruned by deleting dummy bits that were padded to the input of the matrix before the inter-column permutation, i.e. bits $y'_k$ that corresponds to bits $y_k$ with $k > U$ are removed from the output. The bits at the output of the block interleaver are denoted by $z_1, z_2, \ldots, z_U$ , where $z_1$

corresponds to the bit $y'_k$ with smallest index $k$ after pruning, $z_2$ to the bit $y'_k$ with second smallest index $k$ after pruning, and so on.

The bits $z_1, z_2, \ldots, z_U$ shall be segmented as follows:

$u_{1,k} = z_k$ $\quad k = 1, 2, \ldots, U_1$

$u_{2,k} = z_{(k+U_1)}$ $\quad k = 1, 2, \ldots, U_2$

…

$u_{P,k} = z_{(k+U_1+\ldots+U_{P-1})}$ $\quad k = 1, 2, \ldots, U_P$

The bits after frame related 2nd interleaving are denoted by $v_{t,1}, v_{t,2}, \ldots, v_{t,U_t}$, where $t$ refers to the timeslot sequence number and $U_t$ is the number of bits transmitted in this timeslot during the respective radio frame.

Let $T$ be the number of time slots in a CCTrCH during the respective radio frame (where for 1.28Mcps TDD, the respective radio frame includes subframes 1 and 2), and $t = 1, \ldots, T$. The physical layer shall assign the time slot sequence number $t$ in ascending order of the allocated time slots in the CCTrCH in the respective radio frame. In time slot $t$, $R_t$ refers to the number of physical channels within the respective time slot and $r = 1, \ldots, R_t$. The relation between $r$ and $t$ and the physical channel sequence number $p$ as detailed in 4.2.134.2.12.1 is given by:

$$p = r \qquad t = 1$$

$$p = R_1 + R_2, \ldots, R_{t-1} + r \qquad 1 < t \le T$$

Defining the relation $u_{t,r,k} = u_{p,k}$ and denoting $U_{tr}$ as the number of bits for physical channel $r$ in time slot $t$, the relation between $v_{t,k}$ and $u_{t,r,k}$ is given below:

$v_{t,k} = u_{t,1,k}$ $\quad k = 1, 2, \ldots, U_{t1}$

$v_{t,(k+U_{t1})} = u_{t,2,k}$ $\quad k = 1, 2, \ldots, U_{t2}$

…

$v_{t,(k+U_{t1}+\ldots+U_{t(R_t-1)})} = u_{t,R_t,k}$ $\quad k = 1, 2, \ldots, U_{tR_t}$

### 4.2.11.2 Timeslot related 2nd interleaving

In case of timeslot related 2nd interleaving, the bits input to the block interleaver are denoted by $x_{t,1}, x_{t,2}, x_{t,3}, \ldots, x_{t,U_t}$, where $t$ is the timeslot sequence number, and $U_t$ is the number of bits transmitted in this timeslot during the respective radio frame.

Let $T$ be the number of time slots in a CCTrCH during the respective radio frame (where for 1.28Mcps TDD, the respective radio frame includes subframes 1 and 2), and $t = 1, \ldots, T$. The physical layer shall assign the time slot sequence number $t$ in ascending order of the allocated time slots in the CCTrCH in the respective radio frame. In timeslot $t$, $R_t$ refers to the number of physical channels within the respective timeslot and $r = 1, \ldots, R_t$. The relation between $r$ and $t$ and the physical channel sequence number $p$ as detailed in 4.2.1213.1 is given by:

$$p = r \qquad t = 1$$

$$p = R_1 + R_2, \ldots, R_{t-1} + r \qquad 1 < t \le T$$

Defining the relation $u_{t,r,k} = u_{p,k}$ and denoting $U_{tr}$ as the number of bits for physical channel *r* in time slot *t*, the relation between $x_{t,k}$ and $u_{t,r,k}$ is given below:

$x_{t,k} = u_{t,1,k}$ $\quad k = 1, 2, \ldots, U_{t1}$

$x_{t,(k+U_{t1})} = u_{t,2,k}$ $\quad k = 1, 2, \ldots, U_{t2}$

…

$x_{t,(k+U_{t1}+\ldots+U_{t(R_t-1)})} = u_{t,R_t,k}$ $\quad k = 1, 2, \ldots, U_{tR_t}$

The following steps have to be performed for each timeslot *t*, on which the respective CCTrCH is mapped:

(1) Assign C2 = 30 to be the number of columns of the matrix. The columns of the matrix are numbered 0, 1, 2, …, C2 - 1 from left to right.

(2) Determine the number of rows of the matrix, R2, by finding minimum integer R2 such that:

$U_t \leq \mathrm{R2} \times \mathrm{C2}$.

The rows of rectangular matrix are numbered 0, 1, 2, …, R2 - 1 from top to bottom.

(3) Write the input bit sequence $x_{t,1}, x_{t,2}, x_{t,3}, \ldots, x_{t,U_t}$ into the R2 × C2 matrix row by row starting with bit $y_{t,1}$ in column 0 of row 0:

$$\begin{bmatrix} y_{t,1} & y_{t,2} & y_{t,3} & \cdots & y_{t,\mathrm{C2}} \\ y_{t,(\mathrm{C2}+1)} & y_{t,(\mathrm{C2}+2)} & y_{t,(\mathrm{C2}+3)} & \cdots & y_{t,(2\times\mathrm{C2})} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ y_{t,((\mathrm{R2}-1)\times\mathrm{C2}+1)} & y_{t,((\mathrm{R2}-1)\times\mathrm{C2}+2)} & y_{t,((\mathrm{R2}-1)\times\mathrm{C2}+3)} & \cdots & y_{t,(\mathrm{R2}\times\mathrm{C2})} \end{bmatrix}$$

where $y_{t,k} = x_{t,k}$ for *k* = 1, 2, …, $U_t$ and if R2 × C2 > $U_t$, the dummy bits are padded such that $y_{t,k}$ = 0 or 1 for $k = U_t + 1, U_t + 2, \ldots, \mathrm{R2} \times \mathrm{C2}$. These dummy bits are pruned away from the output of the matrix after the inter-column permutation.

(4) Perform the inter-column permutation for the matrix based on the pattern $\langle \mathrm{P2}(j) \rangle_{j\in\{0,1,\ldots,\mathrm{C2}-1\}}$ that is shown in table 7~~8~~, where P2(*j*) is the original column position of the *j*-th permuted column. After permutation of the columns, the bits are denoted by $y'_{t,k}$.

$$\begin{bmatrix} y'_{t,1} & y'_{t,(\mathrm{R2}+1)} & y'_{t,(2\times\mathrm{R2}+1)} & \cdots & y'_{t,((\mathrm{C2}-1)\times\mathrm{R2}+1)} \\ y'_{t,2} & y'_{t,(\mathrm{R2}+2)} & y'_{t,(2\times\mathrm{R2}+2)} & \cdots & y'_{t,((\mathrm{C2}-1)\times\mathrm{R2}+2)} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ y'_{t,\mathrm{R2}} & y'_{t,(2\times\mathrm{R2})} & y'_{t,(3\times\mathrm{R2})} & \cdots & y'_{t,(\mathrm{C2}\times\mathrm{R2})} \end{bmatrix}$$

(5) The output of the block interleaver is the bit sequence read out column by column from the inter-column permuted R2 × C2 matrix. The output is pruned by deleting dummy bits that were padded to the input of the matrix before the inter-column permutation, i.e. bits $y'_{t,k}$ that corresponds to bits $y_{t,k}$ with $k > U_t$ are removed from the output. The bits after time slot 2nd interleaving are denoted by $v_{t,1}, v_{t,2}, \ldots, v_{t,U_t}$, where $v_{t,1}$ corresponds to the bit $y'_{t,k}$ with smallest index *k* after pruning, $v_{t,2}$ to the bit $y'_{t,k}$ with second smallest index *k* after pruning, and so on.

**Table 7~~8~~ Inter-column permutation pattern for 2nd interleaving**

| Number of Columns C2 | Inter-column permutation pattern < P2(0), P2(1), …, P2(C2-1) > |
|---|---|
| 30 | <0, 20, 10, 5, 15, 25, 3, 13, 23, 8, 18, 28, 1, 11, 21, 6, 16, 26, 4, 14, 24, 19, 9, 29, 12, 2, 7, 22, 27, 17> |

## 4.2.11A~~12~~ Sub-frame segmentation for the 1.28 Mcps option

In the 1.28Mcps TDD, it is needed to add a sub-frame segmentation unit between 2nd interleaving unit and physical channel mapping unit. The operation of rate-matching guarantees that the bit streams is a even number and can be subdivided into 2 sub-frames. The transport channel multiplexing structure for uplink and downlink is shown in figure 1A~~2~~.

The input bit sequence is denoted by $x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$ where i is the TrCH number and $X_i$ is the number bits. The two output bit sequences per radio frame are denoted by $y_{i,n_i1}, y_{i,n_i2}, y_{i,n_i3}, \ldots, y_{i,n_iY_i}$ where ni is the sub-frame number in current radio frame and $Y_i$ is the number of bits per radio frame for TrCH i. The output sequences are defined as follows:

$y_{i,n_ik} = x_{i,((n_i-1)Y_i)+k}$, $n_i$ = 1 or 2, k = 1…$Y_i$

where

$Y_i = (X_i / 2)$ is the number of bits per sub-frame,

$x_{ik}$ is the $k^{th}$ bit of the input bit sequence and

$y_{i,n_ik}$ is the $k^{th}$ bit of the output bit sequence corresponding to the $n^{th}$ sub-frame

The input bit sequence to the sub-frame segmentation is denoted by $v_{t,1}, v_{t,2}, v_{t,3}, \ldots, v_{t,U_t}$, $x_{ik} = v_{t,k}$ and $X_i = U_t$.

The output bit sequence corresponding to subframe $n_i$ is denoted by $g_{p1}, g_{p2}, \ldots, g_{pU_p}$, where p is the PhCH number and $U_p$ is the number of bits in one subframe for the respective PhCH. Hence, $g_{pk} = y_{i,n_ik}$ and $U_p = Y_i$.

## 4.2.12~~13~~ Physical channel mapping

### 4.2.12~~13~~.1 Physical channel mapping for the 3.84 Mcps option

The PhCH for both uplink and downlink is defined in [6]. The bits after physical channel mapping are denoted by $w_{p,1}, w_{p,2}, \ldots, w_{p,U_p}$, where *p* is the PhCH number corresponding to the sequence number $1 \leq p \leq P$ of this physical channel as detailed below, $U_p$ is the number of bits in one radio frame for the respective PhCH, and $P \leq P_{max}$. The bits $w_{p,k}$ are mapped to the PhCHs so that the bits for each PhCH are transmitted over the air in ascending order with respect to *k*.

The physical layer shall assign the physical channel sequence number *p* to the physical channels of the CCTrCH in the respective radio frame, treating each allocated timeslot in ascending order. If within a timeslot there are multiple physical channels they shall first be ordered in ascending order of the spreading factor (*Q*) and subsequently by channelisation code index (*k*), as shown in [9].

The mapping of the bits $v_{t,1}, v_{t,2}, \ldots, v_{t,U_t}$ is performed like block interleaving, writing the bits into columns, but a PhCH with an odd number is filled in forward order, whereas a PhCH with an even number is filled in reverse order.

The mapping scheme, as described in the following subclause, shall be applied individually for each timeslot *t* used in the current frame. Therefore, the bits $v_{t,1}, v_{t,2}, \ldots, v_{t,U_t}$ are assigned to the bits of the physical channels $w_{t,1,1\ldots U_{t1}}, w_{t,2,1\ldots U_{t2}}, \ldots, w_{t,P_t,1\ldots U_{tP_t}}$ in each timeslot.

In uplink there are at most two codes allocated (P≤2). If there is only one code, the same mapping as for downlink is applied. Denote SF1 and SF2 the spreading factors used for code 1 and 2, respectively. For the number of consecutive bits to assign per code $bs_k$ the following rule is applied:

if

SF1 >= SF2 then $bs_1$ = 1 ; $bs_2$ = SF1/SF2 ;

else

SF2 > SF1 then $bs_1$ = SF2/SF1; $bs_2$ = 1 ;

end if

In the downlink case $bs_p$ is 1 for all physical channels.

#### 4.2.12~~13~~.1.1 Mapping scheme

Notation used in this subclause:

$P_t$: number of physical channels for timeslot t , $P_t$ = 1..2 for uplink ; $P_t$ = 1...16 for downlink

$U_{t,p}$: capacity in bits for the physical channel p in timeslot t

$U_{t.}$: total number of bits to be assigned for timeslot t

$bs_p$: number of consecutive bits to assign per code

for downlink all $bs_p$ = 1

for uplink if SF1 >= SF2 then $bs_1$ = 1 ; $bs_2$ = SF1/SF2 ;

if SF2 > SF1 then $bs_1$ = SF2/SF1; $bs_2$ = 1 ;

$fb_p$: number of already written bits for each code

pos: intermediate calculation variable

```
for  p=1  to P_t                         -- reset number of already written bits for every physical channel
   fb_p = 0
end for
p = 1                                    -- start with PhCH #1
for k=1  to U_t.
   do while (fb_p == U_t,p)              -- physical channel filled up already ?
      p = (p mod P_t) + 1;
   end do
   if (p mod 2) == 0
      pos = U_t,p - fb_p                 -- reverse order
   else
      pos = fb_p + 1                     -- forward order
```

endif

$w_{t,p,pos} = v_{t,k}$ -- assignment

$fb_p = fb_p + 1$ -- Increment number of already written bits

if ($fb_p$ mod $bs_p$) == 0 -- Conditional change to the next physical channel

p = (p mod $P_t$) + 1;

end if

end for

#### 4.2.12~~13~~.2 Physical channel mapping for the 1.28 Mcps option

The bit streams from the sub-frame segmentation unit are mapped onto code channels of time slots in sub-frames.

The bits after physical channel mapping are denoted by $w_{p1}, w_{p2}, \ldots, w_{pU_p}$, where p is the PhCH number and Up is the number of bits in one sub-frame for the respective PhCH. The bits wpk are mapped to the PhCHs so that the bits for each PhCH are transmitted over the air in ascending order with respect to k.

The mapping of the bits $g_{p1}, g_{p2}, \ldots, g_{pU_p}$ is performed like block interleaving, writing the bits into columns, but a PhCH with an odd number is filled in forward order, were as a PhCH with an even number is filled in reverse order.

The mapping scheme, as described in the following subclause, shall be applied individually for each timeslot t used in the current subframe. Therefore, the bits $g_{p1}, g_{p2}, \ldots, g_{pU_p}$ are assigned to the bits of the physical channels $w_{t1,1\ldots U_{t1}}, w_{t2,1\ldots U_{t2}}, \ldots, w_{tP_t,1\ldots U_{tP_t}}$ in each timeslot.

In uplink there are at most two codes allocated (P≤2). If there is only one code, the same mapping as for downlink is applied. Denote SF1 and SF2 the spreading factors used for code 1 and 2, respectively. For the number of consecutive bits to assign per code bsk the following rule is applied:

if

SF1 >= SF2 then $bs_1 = 1$ ; $bs_2 =$ SF1/SF2 ;

else

SF2 > SF1 then $bs_1 =$ SF2/SF1; $bs_2 = 1$ ;

end if

In the downlink case $bs_p$ is 1 for all physical channels.

##### 4.2.12~~13~~.2.1 Mapping scheme

Notation used in this subclause:

$P_t$: number of physical channels for timeslot t , $P_t$ = 1..2 for uplink ; $P_t$ = 1...16 for downlink

$U_{tp}$: capacity in bits for the physical channel p in timeslot t

$U_t$.: total number of bits to be assigned for timeslot t

$bs_p$: number of consecutive bits to assign per code

for downlink all $bs_p = 1$

for uplink if SF1 >= SF2 then $bs_1 = 1$ ; $bs_2 =$ SF1/SF2 ;

if SF2 > SF1 then $bs_1 =$ SF2/SF1; $bs_2 = 1$ ;

$fb_p$: number of already written bits for each code

pos: intermediate calculation variable

```
for  p=1 to P t                  -- reset number of already written bits for every physical channel
fb_p = 0
end for
p = 1                            -- start with PhCH #1
for k=1  to U_t.
do while (fb_p == U_t,p)         -- physical channel filled up already ?
p = (p mod P t)  + 1 ;
end do
if (p mod 2) == 0
pos = U_t,p - fb_p               -- reverse order
else
pos = fb_p + 1                   -- forward order
end if
w_tp,pos = g_t,k                 -- assignment
fb_p = fb_p + 1                  -- Increment number of already written bits
If (fb_p mod bs_p) == 0          -- Conditional change to the next physical channel
p = (p mod P t)  + 1 ;
end if
end for
```

### 4.2.1314 Multiplexing of different transport channels onto one CCTrCH, and mapping of one CCTrCH onto physical channels

Different transport channels can be encoded and multiplexed together into one Coded Composite Transport Channel (CCTrCH). The following rules shall apply to the different transport channels which are part of the same CCTrCH:

1) Transport channels multiplexed into one CCTrCh shall have co-ordinated timings. When the TFCS of a CCTrCH is changed because one or more transport channels are added to the CCTrCH or reconfigured within the CCTrCH, or removed from the CCTrCH, the change may only be made at the start of a radio frame with CFN fulfilling the relation

   CFN mod $F_{max}$ = 0,

   where $F_{max}$ denotes the maximum number of radio frames within the transmission time intervals of all transport channels which are multiplexed into the same CCTrCH, including any transport channels *i* which are added reconfigured or have been removed, and CFN denotes the connection frame number of the first radio frame of the changed CCTrCH.

   After addition or reconfiguration of a transport channel *i* within a CCTrCH, the TTI of transport channel *i* may only start in radio frames with CFN fulfilling the relation

   $CFN_i$ mod $F_i$ = 0.

2) Different CCTrCHs cannot be mapped onto the same physical channel.

3) One CCTrCH shall be mapped onto one or several physical channels.

4) Dedicated Transport channels and common transport channels cannot be multiplexed into the same CCTrCH.

5) For the common transport channels, only the FACH and PCH may belong to the same CCTrCH.

6) Each CCTrCH carrying a BCH shall carry only one BCH and shall not carry any other Transport Channel.

7) Each CCTrCH carrying a RACH shall carry only one RACH and shall not carry any other Transport Channel.

Hence, there are two types of CCTrCH.

CCTrCH of dedicated type, corresponding to the result of coding and multiplexing of one or several DCH.

CCTrCH of common type, corresponding to the result of the coding and multiplexing of a common channel, i.e. RACH and USCH in the uplink and DSCH, BCH, FACH or PCH in the downlink, respectively.

Transmission of TFCI is possible for CCTrCH containing Transport Channels of:

- dedicated type;
- USCH type;
- DSCH type;
- FACH and/or PCH type.

#### 4.2.13~~14~~.1 Allowed CCTrCH combinations for one UE

##### 4.2.13~~14~~.1.1 Allowed CCTrCH combinations on the uplink

The following CCTrCH combinations for one UE are allowed, also simultaneously:

1) several CCTrCH of dedicated type;

2) several CCTrCH of common type.

##### 4.2.13~~14~~.1.2 Allowed CCTrCH combinations on the downlink

The following CCTrCH combinations for one UE are allowed, also simultaneously:

3) several CCTrCH of dedicated type;

4) several CCTrCH of common type.

### 4.2.14~~15~~ Transport format detection

Transport format detection can be performed both with and without Transport Format Combination Indicator (TFCI). If a TFCI is transmitted, the receiver detects the transport format combination from the TFCI. When no TFCI is transmitted, so called blind transport format detection may be used, i.e. the receiver side uses the possible transport format combinations as a priori information.

#### 4.2.14~~15~~.1 Blind transport format detection

Blind Transport Format Detection is optional both in the UE and the UTRAN. Therefore, for all CCTrCH a TFCI shall be transmitted, including the possibility of a TFCI code word length zero, if only one TFC is defined.

#### 4.2.14~~15~~.2 Explicit transport format detection based on TFCI

##### 4.2.14~~15~~.2.1 Transport Format Combination Indicator (TFCI)

The Transport Format Combination Indicator (TFCI) informs the receiver of the transport format combination of the CCTrCHs. As soon as the TFCI is detected, the transport format combination, and hence the individual transport channels' transport formats are known, and decoding of the transport channels can be performed.

## 4.3 Coding for layer 1 control for the 3.84 Mcps option

### 4.3.1 Coding of transport format combination indicator (TFCI)

Encoding of the TFCI depends on its length. If there are 6-10 bits of TFCI the channel encoding is done as described in subclause 4.3.1.1. Also specific coding of less than 6 bits is possible as explained in subclause 4.3.1.2.

#### 4.3.1.1 Coding of long TFCI lengths

The TFCI is encoded using a (32, 10) sub-code of the second order Reed-Muller code. The coding procedure is as shown in figure 6~~7~~.

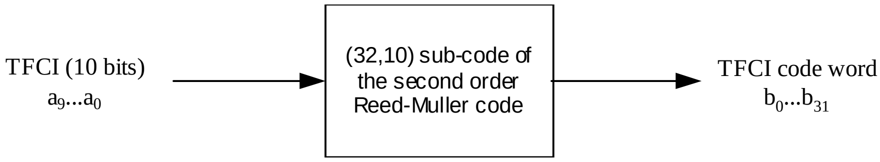


**Figure 6~~7~~: Channel coding of the TFCI bits**

If the TFCI consists of less than 10 bits, it is padded with zeros to 10 bits, by setting the most significant bits to zero. TFCI is encoded by the (32,10) sub-code of second order Reed-Muller code. The code words of the (32,10) sub-code of second order Reed-Muller code are linear combination of some among 10 basis sequences. The basis sequences are as follows in table 8~~9~~.

**Table 89: Basis sequences for (32,10) TFCI code**

| I | $M_{i,0}$ | $M_{i,1}$ | $M_{i,2}$ | $M_{i,3}$ | $M_{I,4}$ | $M_{i,5}$ | $M_{i,6}$ | $M_{i,7}$ | $M_{i,8}$ | $M_{i,9}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 2 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 3 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 4 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 5 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 6 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 7 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 8 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |
| 9 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| 10 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 11 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 12 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 13 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 14 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 15 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| 16 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| 17 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 |
| 18 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| 19 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| 20 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 21 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| 22 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 |
| 23 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| 24 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 25 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| 26 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 |
| 27 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 28 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 29 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 30 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 31 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |

The TFCI bits $a_0$ , $a_1$ , $a_2$ , $a_3$ , $a_4$ , $a_5$ , $a_6$ , $a_7$ , $a_8$ , $a_9$ (where $a_0$ is LSB and $a_9$ is MSB) shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the CCTrCH in the associated DPCH radio frame.

The output TFCI code word bits $b_i$ are given by:

$$b_i = \sum_{n=0}^{9} (a_n \times M_{i,n}) \bmod 2$$

where $i = 0,\ldots,31$. $N_{TFCI\ code\ word} = 32$.

### 4.3.1.2 Coding of short TFCI lengths

#### 4.3.1.2.1 Coding very short TFCIs by repetition

If the number of TFCI bits is 1 or 2, then repetition will be used for coding. In this case each bit is repeated to a total of 4 times giving 4-bit transmission ($N_{TFCI\ code\ word}$ =4) for a single TFCI bit and 8-bit transmission ($N_{TFCI\ code\ word}$ =8) for 2 TFCI bits. The TFCI bit(s) $b_0$ (or $b_0$ and $b_1$ where $b_0$ is the LSB) shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the CCTrCH in the associated DPCH radio frame. In the case of two TFCI bits denoted $b_0$ and $b_1$ the TFCI code word shall be { $b_0, b_1, b_0, b_1, b_0, b_1, b_0, b_1$ }.

#### 4.3.1.2.2 Coding short TFCIs using bi-orthogonal codes

If the number of TFCI bits is in the range 3 to 5 the TFCI is encoded using a (16, 5) bi-orthogonal (or first order Reed-Muller) code. The coding procedure is as shown in figure 78.

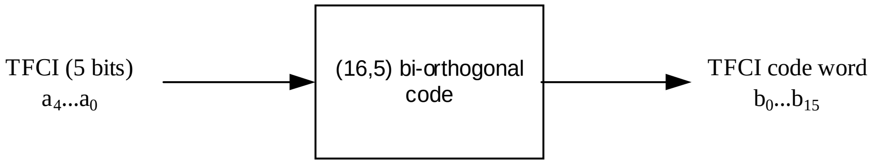


**Figure 7~~8~~: Channel coding of short length TFCI bits**

If the TFCI consists of less than 5 bits, it is padded with zeros to 5 bits, by setting the most significant bits to zero. The code words of the (16,5) bi-orthogonal code are linear combinations of 5 basis sequences as defined in table 9~~10~~.

**Table 9~~10~~: Basis sequences for (16,5) TFCI code**

| i | $M_{i,0}$ | $M_{i,1}$ | $M_{i,2}$ | $M_{i,3}$ | $M_{i,4}$ |
|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 | 0 | 1 |
| 2 | 1 | 1 | 0 | 0 | 1 |
| 3 | 0 | 0 | 1 | 0 | 1 |
| 4 | 1 | 0 | 1 | 0 | 1 |
| 5 | 0 | 1 | 1 | 0 | 1 |
| 6 | 1 | 1 | 1 | 0 | 1 |
| 7 | 0 | 0 | 0 | 1 | 1 |
| 8 | 1 | 0 | 0 | 1 | 1 |
| 9 | 0 | 1 | 0 | 1 | 1 |
| 10 | 1 | 1 | 0 | 1 | 1 |
| 11 | 0 | 0 | 1 | 1 | 1 |
| 12 | 1 | 0 | 1 | 1 | 1 |
| 13 | 0 | 1 | 1 | 1 | 1 |
| 14 | 1 | 1 | 1 | 1 | 1 |
| 15 | 0 | 0 | 0 | 0 | 1 |

The TFCI bits $a_0$ , $a_1$ , $a_2$ , $a_3$ , $a_4$ (where $a_0$ is LSB and $a_4$ is MSB) shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the CCTrCH in the associated DPCH radio frame.

The output code word bits $b_j$ are given by:

$$b_i = \sum_{n=0}^{4} (a_n \times M_{i,n}) \bmod 2$$

where $i$ = 0,…,15. $N_{TFCI\ code\ word}$ = 16.

### 4.3.1.3 Mapping of TFCI code word

The mapping of the TFCI code word to the TFCI bit positions in a timeslot shall be as follows.

Denote the number of bits in the TFCI code word by $N_{TFCI\ code\ word}$, denote the TFCI code word bits by $b_k$ where k=0… $N_{TFCI\ code\ word}$ -1.

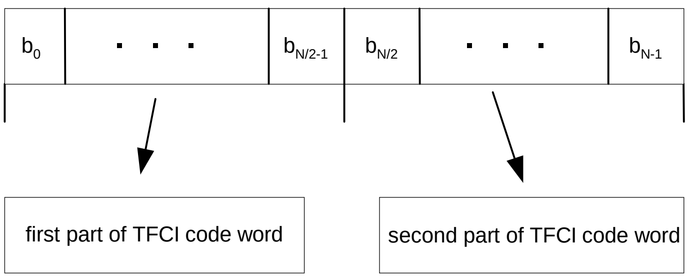


**Figure 8~~9~~: Mapping of TFCI code word bits to timeslot**

The locations of the first and second parts of the TFCI code word in the timeslot is defined in [7].

If the shortest transmission time interval of any constituent TrCH is at least 20 ms the successive TFCI code words in the frames in the TTI shall be identical. If TFCI is transmitted on multiple timeslots in a frame each timeslot shall have the same TFCI code word.

## 4.3.2 Coding and Bit Scrambling of the Paging Indicator

The paging indicator $P_q$, $q = 0, ..., N_{PI}-1$, $P_q \in \{0, 1\}$ is an identifier to instruct the UE whether there is a paging message for the groups of mobiles that are associated to the PI, calculated by higher layers, and the associated paging indicator $P_q$. The length $L_{PI}$ of the paging indicator is $L_{PI}=2$, $L_{PI}=4$ or $L_{PI}=8$ symbols. $N_{PIB} = 2*N_{PI}*L_{PI}$ bits are used for the paging indicator transmission in one radio frame. The mapping of the paging indicators to the bits $e_i$, $i = 1, ..., N_{PIB}$ is shown in table 10~~11~~.

**Table 10~~11~~: Mapping of the paging indicator**

| $P_q$ | Bits $\{e_{2Lpi*q+1}, e_{2Lpi*q+2}, \dots ,e_{2Lpi*(q+1)}\}$ | Meaning |
|---|---|---|
| 0 | {0, 0, ..., 0} | There is no necessity to receive the PCH |
| 1 | {1, 1, ..., 1} | There is the necessity to receive the PCH |

If the number $S$ of bits in one radio frame available for the PICH is bigger than the number $N_{PIB}$ of bits used for the transmission of paging indicators, the sequence $e = \{e_1, e_2, ..., e_{NPIB}\}$ is extended by $S$-$N_{PIB}$ bits that are set to zero, resulting in a sequence $h = \{h_1, h_2, ..., h_S\}$:

$$h_k = e_k, \quad k = 1, ..., N_{PIB}$$
$$h_k = 0, \quad k = N_{PIB} + 1, ..., S$$

The bits $h_k$ , $k = 1, ..., S$ on the PICH then undergo bit scrambling as defined in section 4.2.9.

The bits $s_k$, $k = 1, ..., S$ output from the bit scrambler are then transmitted over the air as shown in [7].

# 4.4 Coding for layer 1 control for the 1.28 Mcps option

## 4.4.1 Coding of transport format combination indicator (TFCI) for QPSK

The coding of TFCI for 1.28Mcps TDD is same as that of 3.84Mcps TDD.cf.[4.3.1 'Coding of transport format combination indicator'].

### 4.4.1.1 Mapping of TFCI code word

Denote the number of bits in the TFCI code word by $N_{TFCI\ code\ word}$, and denote the TFCI code word bits by $b_k$, where $k = 0, \dots, N_{TFCI\ code\ word} -1$

When the number of bits in the TFCI code word is 8, 16, 32, the mapping of the TFCI code word to the TFCI bit positions shall be as follows:

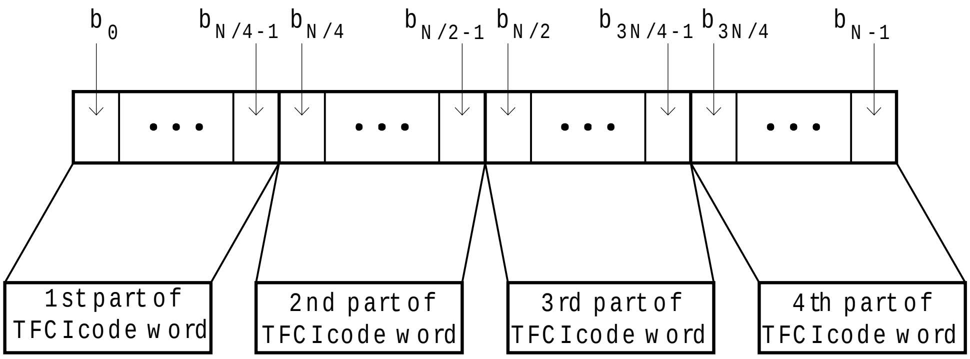


**Figure 9~~10~~: Mapping of TFCI code word bits to TFCI position in 1.28 Mcps TDD option, where N = $N_{TFCI\ code\ word}$.**

When the number of bits of the TFCI code word is 4 , then the TFCI code word is equally divided into two parts for the consecutive two subframe and mapped onto the end of the first data field in each of the consecutive subframes.The mapping for $N_{TFCI\ code\ word}$ =4 is shown in figure 10~~11~~:

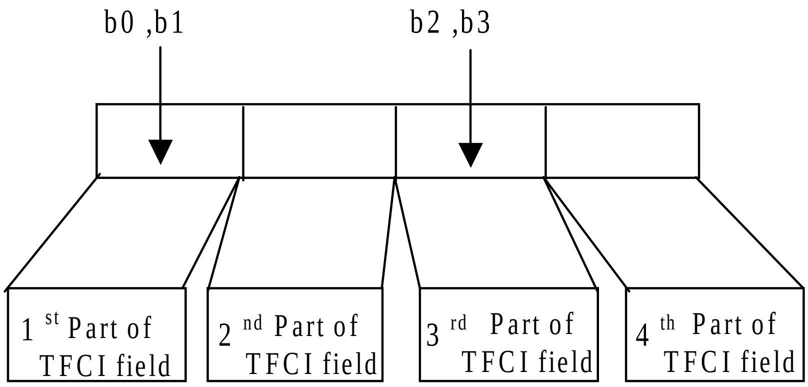


**Figure 10~~11~~: Mapping of TFCI code word bits to TFCI position in 1.28 Mcps TDD option, when $N_{TFCI\ code\ word}$ =4**

The location of the 1st to 4th parts of the TFCI code word in the timeslot is defined in [7].

If the shortest transmission time interval of any constituent TrCH is at least 20 ms, then successive TFCI code words in the frames within the TTI shall be identical. If a TFCI is transmitted on multiple timeslots in a frame each timeslot shall have the same TFCI code word.

### 4.4.2 Coding of transport format combination indicator (TFCI) for 8PSK

Encoding of TFCI bits depends on the number of them and the modulation in use. When 2 Mcps service is transmitted, 8PSK modulation is applied in 1.28 Mcps TDD option. The encoding scheme for TFCI when the number of bits are 6 – 10, and less than 6 bits is described in section 4.4.2.1 and 4.4.2.2, respectively.

#### 4.4.2.1 Coding of long TFCI lengths

When the number of TFCI bits is 6 – 10, the TFCI bits are encoded by using a (64,10) sub-code of the second order Reed-Muller code, then 16 bits out of 64 bits are punctured (Puncturing positions are 0, 4, 8, 13, 16, 20, 27, 31, 34, 38, 41, 44, 50, 54, 57, 61st bits). The coding procedure is shown in Figure 11~~12~~.

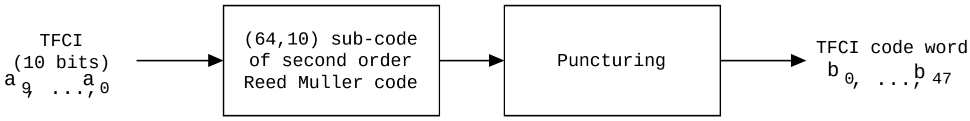


**Figure 1112: Channel coding of long TFCI bits for 8PSK**

If the TFCI consists of less than 10 bits, it is padded with zeros to 10 bits, by setting the most significant bits to zero. The code words of the punctured (48,10) sub-code of the second order Reed-Muller codes are linear combination of 10 basis sequences. The basis sequences are shown in Table 1112.

**Table 1112: Basis sequences for (48,10) TFCI code**

| I | $M_{i,0}$ | $M_{i,1}$ | $M_{i,2}$ | $M_{i,3}$ | $M_{I,4}$ | $M_{i,5}$ | $M_{i,6}$ | $M_{I,7}$ | $M_{I,8}$ | $M_{i,9}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| 2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 3 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| 4 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| 5 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| 6 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| 7 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 8 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| 9 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 10 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 11 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| 12 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| 13 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 |
| 14 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 |
| 15 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| 16 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 |
| 17 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 |
| 18 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| 19 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| 20 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| 21 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| 22 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 23 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| 24 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| 25 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| 26 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 27 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 28 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| 29 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 30 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 31 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 32 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 33 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 34 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |
| 35 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| 36 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| 37 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 |
| 38 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 39 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| 40 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| 41 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 42 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 43 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 44 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 45 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| 46 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| 47 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |

Let's define the TFCI bits as $a_0$ , $a_1$ , $a_2$ , $a_3$ , $a_4$ , $a_5$ , $a_6$ , $a_7$ , $a_8$ , $a_9$, where $a_0$ is the LSB and $a_9$ is the MSB. The TFCI bits shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the CCTrCH in the associated DPCH radio frame.

The output TFCI code word bits $b_i$ are given by:

$$b_i = \sum_{n=0}^{9} (a_n \times M_{i,n}) \bmod 2$$

where i=0…47. $N_{TFCI\ code\ word}$ =48.

### 4.4.2.2 Coding of short TFCI lengths

#### 4.4.2.2.1 Coding very short TFCIs by repetition

When the number of TFCI bits is 1 or 2, then repetition will be used for the coding. In this case, each bit is repeated to a total of 6 times giving 6-bit transmission ($N_{TFCI\ code\ word}$ = 6) for a single TFCI bit and 12-bit transmission ($N_{TFCI\ code\ word}$ = 12) for 2 TFCI bits. For a single TFCI bit $b_0$, the TFCI code word shall be {$b_0$, $b_0$, $b_0$, $b_0$, $b_0$, $b_0$}. For two TFCI bits $b_0$ and $b_1$, the TFCI code word shall be {$b_0$, $b_1$, $b_0$, $b_1$, $b_0$, $b_1$, $b_0$, $b_1$, $b_0$, $b_1$, $b_0$, $b_1$}.

#### 4.4.2.2.2 Coding short TFCIs using bi-orthogonal codes

If the number of TFCI bits is in the range of 3 to 5, the TFCI bits are encoded using a (32,5) first order Reed-Muller code, then 8 bits out of 32 bits are punctured (Puncturing positions are 0, 1, 2, 3, 4, 5, 6, 7th bits). The coding procedure is shown in Figure 12~~13~~.

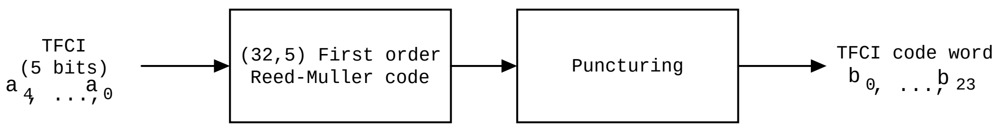


**Figure 12~~13~~: Channel coding of short TFCI bits for 8PSK**

If the TFCI consists of less than 5 bits, it is padded with zeros to 5 bits, by setting the most significant bits to zero. The code words of the punctured (32,5) first order Reed-Muller codes are linear combination of 5 basis sequences shown in Table 12~~13~~.

**Table 12~~13~~: Basis sequences for (24,5) TFCI code**

| I | $M_{i,0}$ | $M_{i,1}$ | $M_{i,2}$ | $M_{i,3}$ | $M_{i,4}$ |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 | 1 | 0 |
| 2 | 0 | 1 | 0 | 1 | 0 |
| 3 | 1 | 1 | 0 | 1 | 0 |
| 4 | 0 | 0 | 1 | 1 | 0 |
| 5 | 1 | 0 | 1 | 1 | 0 |
| 6 | 0 | 1 | 1 | 1 | 0 |
| 7 | 1 | 1 | 1 | 1 | 0 |
| 8 | 0 | 0 | 0 | 0 | 1 |
| 9 | 1 | 0 | 0 | 0 | 1 |
| 10 | 0 | 1 | 0 | 0 | 1 |
| 11 | 1 | 1 | 0 | 0 | 1 |
| 12 | 0 | 0 | 1 | 0 | 1 |
| 13 | 1 | 0 | 1 | 0 | 1 |
| 14 | 0 | 1 | 1 | 0 | 1 |
| 15 | 1 | 1 | 1 | 0 | 1 |
| 16 | 0 | 0 | 0 | 1 | 1 |
| 17 | 1 | 0 | 0 | 1 | 1 |
| 18 | 0 | 1 | 0 | 1 | 1 |
| 19 | 1 | 1 | 0 | 1 | 1 |
| 20 | 0 | 0 | 1 | 1 | 1 |
| 21 | 1 | 0 | 1 | 1 | 1 |
| 22 | 0 | 1 | 1 | 1 | 1 |
| 23 | 1 | 1 | 1 | 1 | 1 |

Let's define the TFCI bits as $a_0$ , $a_1$ , $a_2$ , $a_3$ , $a_4$, where $a_0$ is the LSB and $a_4$ is the MSB. The TFCI bits shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the CCTrCH in the associated DPCH radio frame.

The output code word bits $b_i$ are given by:

$$b_i = \sum_{n=0}^{4} (a_n \times M_{i,n}) \bmod 2$$

where i=0…23. $N_{TFCI\ code\ word}$ =24.

### 4.4.2.3 Mapping of TFCI code word

Denote the number of bits in the TFCI code word by $N_{TFCI\ code\ word}$, and denote the TFCI code word bits by $b_k$, where k = 0, …, $N_{TFCI\ code\ word}$ -1.

When the number of bits in the TFCI code word is 12, 24 or 48, the mapping of the TFCI code word to the TFCI bit positions in a time slot shall be as follows.

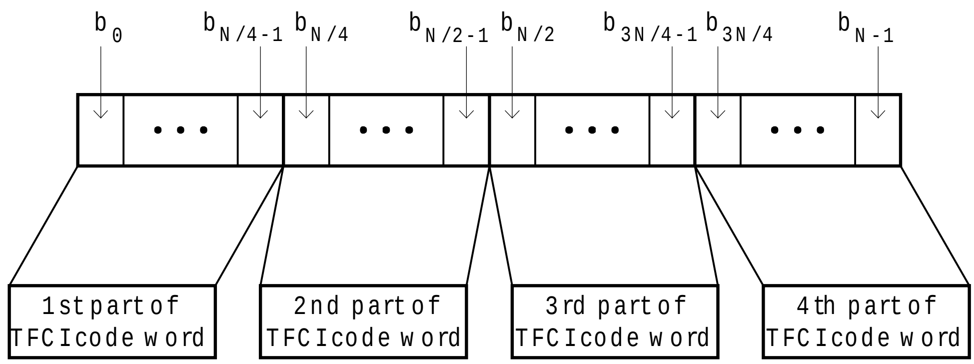


**Figure 13~~14~~: Mapping of TFCI code word bits to timeslot in 1.28 Mcps TDD option, where N = $N_{TFCI\ code\ word}$.**

When the number of bits in the TFCI code word is 6, the TFCI code word is equally divided into two parts for the consecutive two sub-frames and mapped onto the first data field in each of the consecutive sub-frames. The mapping of the TFCI code word to the TFCI bit positions in a time slot shall be as shown in figure 14~~15~~.

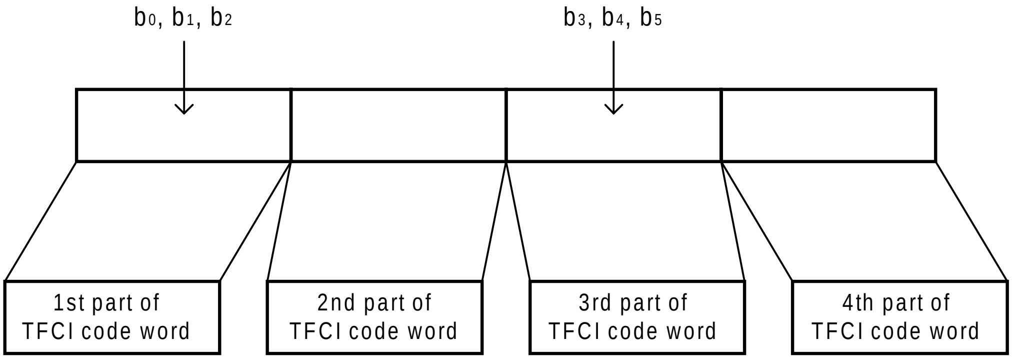


**Figure 14~~15~~: Mapping of TFCI code word bits to timeslot in 1.28 Mcps TDD option when $N_{TFCI\ code\ word}$ = 6**

The location of the 1st to 4th parts of the TFCI code word in the timeslot is defined in [7].

## 4.4.3 Coding and Bit Scrambling of the Paging Indicator

The paging indicator $P_q$, $q$ = 0, ..., $N_{PI}$-1, $P_q \in \{0, 1\}$ is an identifier to instruct the UE whether there is a paging message for the groups of mobiles that are associated to the PI, calculated by higher layers, and the associated paging indicator $P_q$. The length $L_{PI}$ of the paging indicator is $L_{PI}$=2, $L_{PI}$=4 or $L_{PI}$=8 symbols. $N_{PIB} = 2*N_{PI}*L_{PI}$ bits are used for the paging indicator transmission in one radio frame. The mapping of the paging indicators to the bits $e_i$, $i$ = 1, ..., $N_{PIB}$ is shown in table 13~~14~~.

**Table 13~~14~~: Mapping of the paging indicator**

| $P_q$ | Bits $\{e_{2L_{PI}*q+1}, e_{2L_{PI}*q+2}, \ldots, e_{2L_{PI}*(q+1)}\}$ | Meaning |
|---|---|---|
| 0 | {0, 0, ..., 0} | There is no necessity to receive the PCH |
| 1 | {1, 1, ..., 1} | There is the necessity to receive the PCH |

If the number $S$ of bits in one radio frame available for the PICH is bigger than the number $N_{PIB}$ of bits used for the transmission of paging indicators, the sequence $e = \{e_1, e_2, \ldots, e_{NPIB}\}$ is extended by $S$-$N_{PIB}$ bits that are set to zero, resulting in a sequence $h = \{h_1, h_2, \ldots, h_S\}$:

$$_k = e_k, \quad k = 1, \ldots, N_{PIB}$$
$$_k = 0, \quad k = N_{PIB} + 1, \ldots, S$$

The bits $h_k$ , $k$ = 1, ..., $S$ on the PICH then undergo bit scrambling as defined in section 4.2.9.

The bits $s_k$, $k$ = 1, ..., S output from the bit scrambler are then transmitted over the air as shown in [7].

## 4.4.4 Coding of the Fast Physical Access Channel (FPACH) information bits

The FPACH burst is composed by 32 information bits which are block coded and convolutional coded, and then delivered in one sub-frame as follows:

1. The 32 information bits are protected by 8 parity bits for error detection as described in sub-clause 4.2.1.1.
2. Convolutional code with constraint length 9 and coding rate ½ is applied as described in sub-clause 4.2.3.1. The size of data block c(k) after convolutional encoder is 96 bits.
3. To adjust the size of the data block c(k) to the size of the FPACH burst, 8 bits are punctured as described in sub-clause 4.2.7 with the following clarifications:

- $N_{i;j}$ =96 is the number of bits in a radio sub-frame before rate matching
- $\Delta N_{i,,j}$ = -8 is the number of bits to punctured in a radio sub-frame
- $e_{ini}$ = a x $N_{ij}$

The 88 bits after rate matching are then delivered to the intra-frame interleaving.

4. The bits in input to the interleaving unit are denoted as {x(0), …, x(87)}. The coded bits are block rectangular interleaved according to the following rule: the input is written row by row, the output is read column by column.

$$\begin{bmatrix} x(0) & x(1) & x(2) & \dots\ x(7) \\ x(8) & x(9) & x(10) & \dots x(15) \\ \vdots & \vdots & \vdots & \dots \quad \vdots \\ x(80) & x(81) & x(82) & \dots x(87) \end{bmatrix}$$

Hence, the interleaved sequence is denoted by y (i) and are given by:

y(0), y(1), …, y(87)=x(0), x(8), …,x(80),x(1), …, x(87).

# Annex A (informative): Change history

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 14/01/00 | RAN_05 | RAN_05 | - | | Approved at TSG RAN #5 and placed under Change Control | - | 3.0.0 |
| 14/01/00 | RAN_06 | RP-99694 | 001 | 3 | Correction of rate matching parameters for repetition after 1st Interleaving in 25.222 | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99694 | 002 | 1 | Clarification of bit separation and collection | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99694 | 003 | - | Changing the initial offset value for convolutional code rate matching | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99693 | 004 | 1 | Editorial corrections to TS 25.222 | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99694 | 007 | - | Update of rate matching rule for TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99694 | 009 | 1 | Modified physical channel mapping scheme | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99694 | 013 | - | Introduction of TFCI for S-CCPCH in TDD mode | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99694 | 015 | - | TFCI coding and mapping in TDD | 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-000068 | 017 | - | Corrections to TS 25.222 | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 018 | - | Refinements of Physical Channel Mapping | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 019 | 1 | TFCI coding specification in TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 021 | - | Modification of Turbo code internal interleaver | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 023 | - | Update of TS 25.222 - clarification of BTFD for TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 025 | - | Change of TFCI basis for TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 026 | - | Padding Function for Turbo coding of small blocks | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 027 | - | Editorial modification of shifting parameter calculation for turbo code puncturing | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 029 | 1 | Editorial changes of channel coding section | 3.1.1 | 3.2.0 |
| 26/06/00 | RAN_08 | RP-000272 | 030 | - | Parity bit attachment to 0 size transport block | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000272 | 031 | - | Correction of the mapping formula | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000272 | 034 | - | Alignment of Multiplexing for TDD | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000272 | 036 | 2 | Bit separation of the Turbo encoded data | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000272 | 038 | 2 | Revision of code block segmentation description | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000272 | 039 | - | Editorial corrections in channel coding section | 3.2.0 | 3.3.0 |
| 23/09/00 | RAN_09 | RP-000345 | 040 | 1 | Update of TS 25.222 | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000345 | 041 | 1 | Editorial corrections in Turbo code internal interleaver section | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000345 | 042 | - | Paging Indicator Terminology | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000345 | 043 | 1 | Bit separation and collection for rate matching | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000345 | 048 | - | Puncturing Limit definition in WG1 specification | 3.3.0 | 3.4.0 |
| 15/12/00 | RAN_10 | RP-000543 | 049 | - | Clarification on the Ci formula | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000543 | 050 | - | Correction on TFCI & TPC Transmission | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000543 | 053 | 1 | Editorial corrections in TS 25.222 | 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-010063 | 051 | 1 | Bit Scrambling for TDD | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010063 | 054 | 1 | Corrections & Clarifications for TS25.222 | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010071 | 055 | 1 | Inclusion of 1.28Mcps TDD in TS 25.222 | 3.5.0 | 4.0.0 |
| 21/09/01 | RAN_13 | RP-010523 | 057 | - | TFCI Terminology | 4.0.0 | 4.1.0 |
| 21/09/01 | RAN_13 | RP-010529 | 058 | - | 5ms TTI for PRACH for 1.28 Mcps TDD | 4.0.0 | 4.1.0 |
| 21/09/01 | RAN_13 | RP-010529 | 060 | - | A correction on the meaning of FPACH in TS 25.222 | 4.0.0 | 4.1.0 |
| 14/12/01 | RAN_14 | RP-010747 | 059 | - | Bit Scrambling for TDD | 4.1.0 | 4.2.0 |
| 14/12/01 | RAN_14 | RP-010747 | 061 | - | Corrections in clause 4.1 and 4.2 of TS 25.222 | 4.1.0 | 4.2.0 |
| 08/03/02 | RAN_15 | RP-020050 | 063 | 1 | Correction to addition of padding zeros to PICH in TDD | 4.2.0 | 4.3.0 |
| 08/03/02 | RAN_15 | RP-020050 | 065 | 3 | Clarification of the requirement for the determination of the rate matching parameters and editorial corrections to 25.222 | 4.2.0 | 4.3.0 |
| 07/06/02 | RAN_16 | RP-020311 | 071 | 1 | Second Stage Interleaving and Physical Channel Mapping | 4.3.0 | 4.4.0 |
| 07/06/02 | RAN_16 | RP-020311 | 075 | 1 | Zero padding for TFCI (3.84Mcps TDD) | 4.3.0 | 4.4.0 |
| 07/06/02 | RAN_16 | RP-020314 | 072 | - | Correction to addition of padding zeros to PICH in 1.28 Mcps TDD | 4.3.0 | 4.4.0 |
| 07/06/02 | RAN_16 | RP-020314 | 085 | - | Zero padding for TFCI (1.28Mcps TDD) | 4.3.0 | 4.4.0 |
| 19/09/02 | RAN_17 | RP-020570 | 096 | 1 | Clarification of the definition of layer 1 transport channel numbers | 4.4.0 | 4.5.0 |
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**3GPP TSG-RAN1 Meeting #29**
**Shanghai, China, 5 – 8 November 2002**

***R1-02-1390***

*CR-Form-v7*

# CHANGE REQUEST

| | | | | | |
|---|---|---|---|---|---|
| ⌘ **25.222** | **CR** **107** | ⌘ **rev** | **-** | ⌘ Current version: | **5.2.1** ⌘ |

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

***Proposed change affects:*** UICC apps⌘ [ ] ME [X] Radio Access Network [X] Core Network [ ]

| | | | |
|---|---|---|---|
| ***Title:*** ⌘ | Editorial modification to the section numberings | | |
| ***Source:*** ⌘ | TSG RAN WG1 | | |
| ***Work item code:*** ⌘ | TEI5 | ***Date:*** ⌘ | 29/10/2002 |
| ***Category:*** ⌘ | **D** | ***Release:*** ⌘ | Rel-5 |
| | *Use one of the following categories:*<br>***F*** *(correction)*<br>***A*** *(corresponds to a correction in an earlier release)*<br>***B*** *(addition of feature),*<br>***C*** *(functional modification of feature)*<br>***D*** *(editorial modification)*<br>Detailed explanations of the above categories can be found in 3GPP TR 21.900. | | *Use one of the following releases:*<br>*2 (GSM Phase 2)*<br>*R96 (Release 1996)*<br>*R97 (Release 1997)*<br>*R98 (Release 1998)*<br>*R99 (Release 1999)*<br>*Rel-4 (Release 4)*<br>*Rel-5 (Release 5)*<br>*Rel-6 (Release 6)* |

| | |
|---|---|
| ***Reason for change:*** ⌘ | The numbering used is not consistent with TS21.801. |
| ***Summary of change:*** ⌘ | The sections, figures, and tables numberings are adjusted to follow the guidlines given in TS21.801. |
| ***Consequences if not approved:*** ⌘ | Confusion and misunderstanding, not consistent with specification guidelines and the rest of the document. |

| | | | | |
|---|---|---|---|---|
| ***Clauses affected:*** ⌘ | All the document | | | |
| | **Y** | **N** | | |
| ***Other specs affected:*** ⌘ | | **X** | Other core specifications ⌘ | |
| | | **X** | Test specifications | |
| | | **X** | O&M Specifications | |
| ***Other comments:*** ⌘ | | | | |

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1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

# Contents

# Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

# 1 Scope

The present document describes multiplexing, channel coding and interleaving for UTRA Physical Layer TDD mode.

# 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 25.202: "UE capabilities".

[2] 3GPP TS 25.211: "Transport channels and physical channels (FDD)".

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

[4] 3GPP TS 25.213: "Spreading and modulation (FDD)".

[5] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[6] 3GPP TS 25.215: "Physical layer – Measurements (FDD)".

[7] 3GPP TS 25.221: "Transport channels and physical channels (TDD)".

[9] 3GPP TS 25.223: "Spreading and modulation (TDD)".

[10] 3GPP TS 25.224: "Physical layer procedures (TDD)".

[11] 3GPP TS 25.225: "Measurements".

[12] 3GPP TS 25.331: "RRC Protocol Specification".

[13] 3GPP TS 25.308: "High Speed Downlink Packet Access (HSDPA): Overall description (stage 2)".

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

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

**TrCH number:** The transport channel number identifies a TrCH in the context of L1. The L3 transport channel identity (TrCH ID) maps onto the L1 transport channel number. The mapping between the transport channel number and the TrCH ID is as follows: TrCH 1 corresponds to the TrCH with the lowest TrCH ID, TrCH 2 corresponds to the TrCH with the next lowest TrCH ID and so on.

## 3.2 Symbols

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

| | |
|---|---|
| $\lceil x \rceil$ | round towards ∞, i.e. integer such that $x \le \lceil x \rceil < x+1$ |
| $\lfloor x \rfloor$ | round towards -∞, i.e. integer such that $x-1 < \lfloor x \rfloor \le x$ |
| $\lvert x \rvert$ | absolute value of $x$ |

Unless otherwise is explicitly stated when the symbol is used, the meaning of the following symbols are:

| | |
|---|---|
| $i$ | TrCH number |
| $j$ | TFC number |
| $k$ | Bit number |
| $l$ | TF number |
| $m$ | Transport block number |
| $n$ | Radio frame number |
| $p$ | PhCH number |
| r | Code block number |
| $I$ | Number of TrCHs in a CCTrCH. |
| $C_i$ | Number of code blocks in one TTI of TrCH $i$. |
| $F_i$ | Number of radio frames in one TTI of TrCH $i$. |
| $M_i$ | Number of transport blocks in one TTI of TrCH $i$. |
| $N_{TCFI\ code\ word}$ | Number of TFCI code word bits after TFCI encoding |
| $P$ | Number of PhCHs used for one CCTrCH. |
| $PL$ | Puncturing Limit. Signalled from higher layers |
| $RM_i$ | Rate Matching attribute for TrCH $i$. Signalled from higher layers. |

Temporary variables, i.e. variables used in several (sub)clauses with different meaning.

x, X
y, Y
z, Z

## 3.3 Abbreviations

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

| | |
|---|---|
| <ACRONYM> | <Explanation> |
| ARQ | Automatic Repeat on Request |
| BCH | Broadcast Channel |
| BER | Bit Error Rate |
| BS | Base Station |
| BSS | Base Station Subsystem |
| CBR | Constant Bit Rate |
| CCCH | Common Control Channel |
| CCTrCH | Coded Composite Transport Channel |
| CDMA | Code Division Multiple Access |
| CFN | Connection Frame Number |
| CQI | Channel Quality Indicator |
| CRC | Cyclic Redundancy Check |
| DCA | Dynamic Channel Allocation |
| DCCH | Dedicated Control Channel |
| DCH | Dedicated Channel |
| DL | Downlink |
| DRX | Discontinuous Reception |
| DSCH | Downlink Shared Channel |
| DTX | Discontinuous Transmission |
| FACH | Forward Access Channel |
| FDD | Frequency Division Duplex |
| FDMA | Frequency Division Multiple Access |
| FEC | Forward Error Control |

| | |
|---|---|
| FER | Frame Error Rate |
| GF | Galois Field |
| HARQ | Hybrid Automatic Repeat reQuest |
| HS-DSCH | High Speed Downlink Shared Channel |
| HS-PDSCH | High Speed Physical Downlink Shared Channel |
| HS-SCCH | Shared Control Channel for HS-DSCH |
| HS-SICH | Shared Information Channel for HS-DSCH |
| JD | Joint Detection |
| L1 | Layer 1 |
| L2 | Layer 2 |
| LLC | Logical Link Control |
| MA | Multiple Access |
| MAC | Medium Access Control |
| MS | Mobile Station |
| MT | Mobile Terminated |
| NRT | Non-Real Time |
| OVSF | Orthogonal Variable Spreading Factor |
| PC | Power Control |
| PCCC | Parallel Concatenated Convolutional Code |
| PCH | Paging Channel |
| PhCH | Physical Channel |
| PI | Paging Indicator (value calculated by higher layers) |
| $P_q$ | Paging Indicator (indicator set by physical layer) |
| QoS | Quality of Service |
| QPSK | Quaternary Phase Shift Keying |
| RACH | Random Access Channel |
| RF | Radio Frequency |
| RLC | Radio Link Control |
| RMF | Recommended Modulation Format |
| RRC | Radio Resource Control |
| RRM | Radio Resource Management |
| RSC | Recursive Systematic Convolutional Coder |
| RT | Real Time |
| RTBS | Recommended Transport Block Size |
| RU | Resource Unit |
| RV | Redundancy Version |
| SCCC | Serial Concatenated Convolutional Code |
| SCH | Synchronization Channel |
| SNR | Signal to Noise Ratio |
| TCH | Traffic channel |
| TDD | Time Division Duplex |
| TDMA | Time Division Multiple Access |
| TFC | Transport Format Combination |
| TFCI | Transport Format Combination Indicator |
| TFRC | Transport Format Resouce Combination |
| TFRI | Transport Format Resouce Indicator |
| TPC | Transmit Power Control |
| TrBk | Transport Block |
| TrCH | Transport Channel |
| TTI | Transmission Time Interval |
| UE | User Equipment |
| UL | Uplink |
| UMTS | Universal Mobile Telecommunications System |
| USCH | Uplink Shared Channel |
| UTRA | UMTS Terrestrial Radio Access |
| VBR | Variable Bit Rate |

# 4 Multiplexing, channel coding and interleaving

## 4.1 General

Data stream from/to MAC and higher layers (Transport block / Transport block set) is encoded/decoded to offer transport services over the radio transmission link. Channel coding scheme is a combination of error detection, error correcting (including rate matching), and interleaving and transport channels mapping onto/splitting from physical channels.

In the UTRA-TDD mode, the total number of basic physical channels (a certain time slot one spreading code on a certain carrier frequency) per frame is given by the maximum number of time slots and the maximum number of CDMA codes per time slot.

## 4.2 General coding/multiplexing of TrCHs

This section only applies to the transport channels: DCH, RACH, DSCH, USCH, BCH, FACH and PCH. Other transport channels which do not use the general method are described separately below.

Figure 1 illustrates the overall concept of transport-channel coding and multiplexing. Data arrives to the coding/multiplexing unit in form of transport block sets, once every transmission time interval. The transmission time interval is transport-channel specific from the set {5 ms$^{(*1)}$, 10 ms, 20 ms, 40 ms, 80 ms}.

Note: $^{(*1)}$ may be applied for PRACH for 1.28 Mcps TDD

The following coding/multiplexing steps can be identified:

- add CRC to each transport block (see subclause 4.2.1);
- TrBk concatenation / Code block segmentation (see subclause 4.2.2);
- channel coding (see subclause 4.2.3) ;
- radio frame size equalization (see subclause 4.2.4);
- interleaving (two steps, see subclauses 4.2.5 and 4.2.10);
- radio frame segmentation (see subclause 4.2.6);
- rate matching (see subclause 4.2.7);
- multiplexing of transport channels (see subclause 4.2.8);
- bit scrambling (see subclause 4.2.9);
- physical channel segmentation (see subclause 4.2.10);
- sub-frame segmentation(see subclause 4.2.11A~~12~~ only for 1.28Mcps TDD)
- mapping to physical channels (see subclause 4.2.12~~13~~).

The coding/multiplexing steps for uplink and downlink are shown in figures 1 and 1A~~2~~.

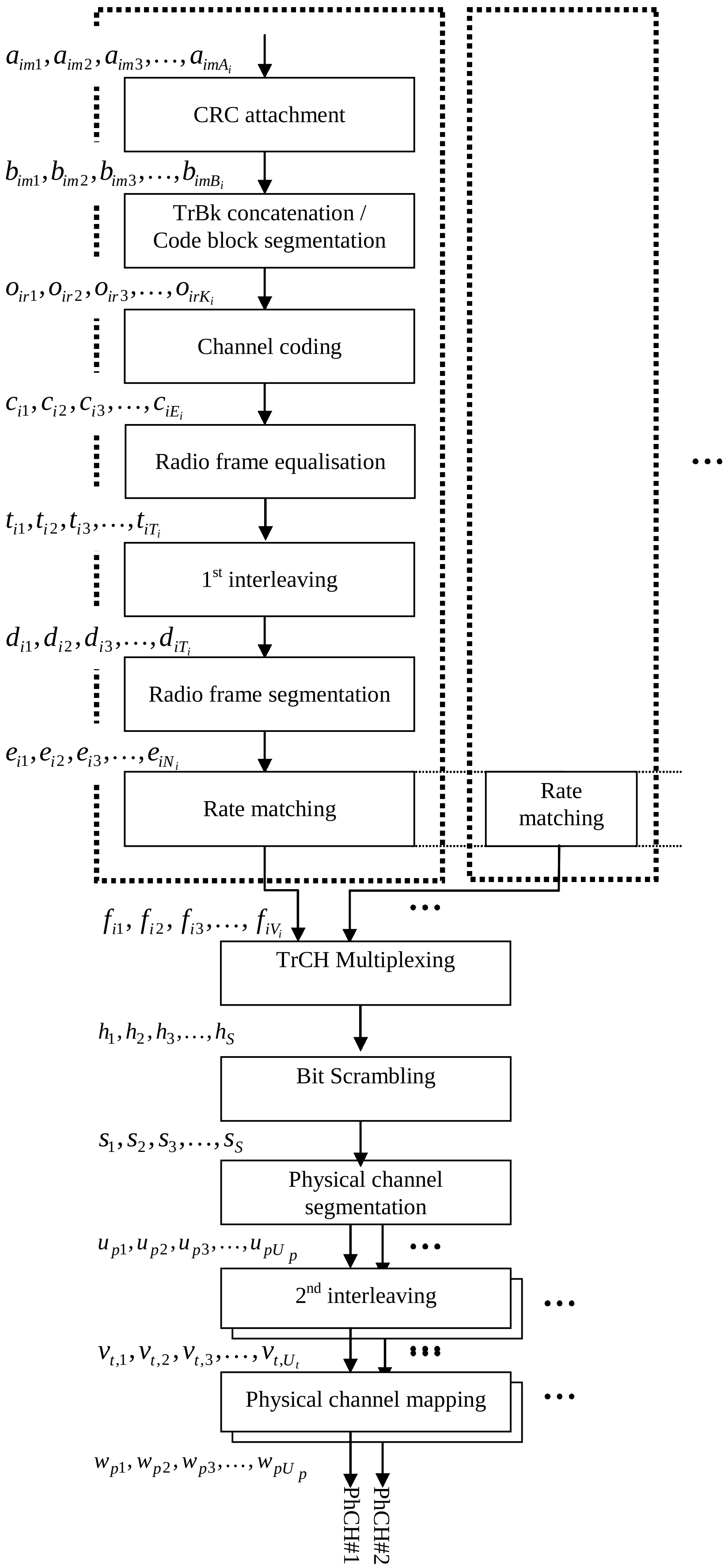


**Figure 1: Transport channel multiplexing structure for uplink and downlink for 3.84Mcps TDD**

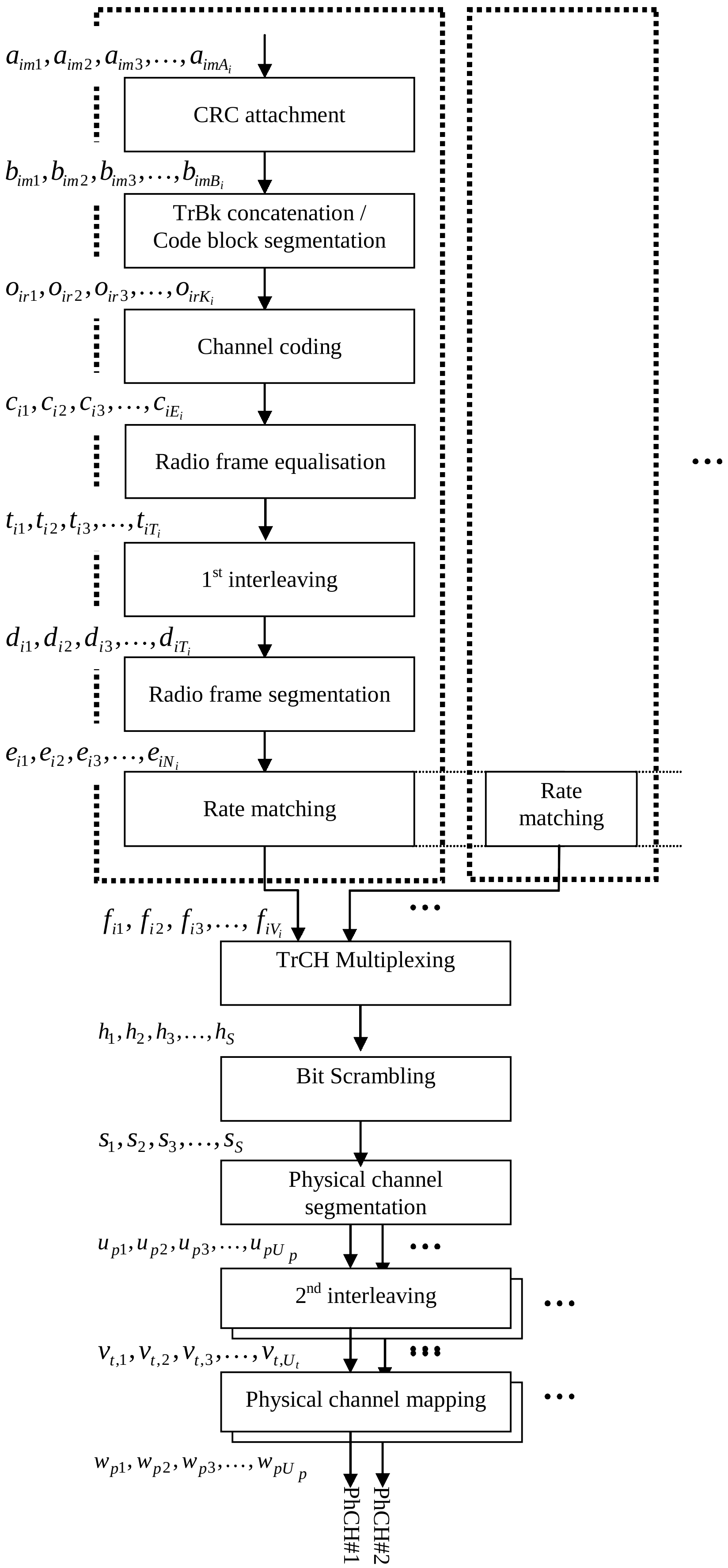


**Figure 1A2: Transport channel multiplexing structure for uplink and downlink of 1.28Mcps TDD**

Primarily, transport channels are multiplexed as described above, i.e. into one data stream mapped on one or several physical channels. However, an alternative way of multiplexing services is to use multiple CCTrCHs (Coded Composite Transport Channels), which corresponds to having several parallel multiplexing chains as in figures 1 and 1A2, resulting in several data streams, each mapped to one or several physical channels.

## 4.2.1 CRC attachment

Error detection is provided on transport blocks through a Cyclic Redundancy Check (CRC). The size of the CRC is 24, 16, 12, 8 or 0 bits and it is signalled from higher layers what CRC size that should be used for each transport channel.

### 4.2.1.1 CRC calculation

The entire transport block is used to calculate the CRC parity bits for each transport block. The parity bits are generated by one of the following cyclic generator polynomials:

$$g_{CRC24}(D) = D^{24} + D^{23} + D^{6} + D^{5} + D + 1$$

$$g_{CRC16}(D) = D^{16} + D^{12} + D^{5} + 1$$

$$g_{CRC12}(D) = D^{12} + D^{11} + D^{3} + D^{2} + D + 1$$

$$g_{CRC8}(D) = D^{8} + D^{7} + D^{4} + D^{3} + D + 1$$

Denote the bits in a transport block delivered to layer 1 by $a_{im1}, a_{im2}, a_{im3}, \ldots, a_{imA_i}$, and the parity bits by $p_{im1}, p_{im2}, p_{im3}, \ldots, p_{imL_i}$. $A_i$ is the size of a transport block of TrCH $i$, $m$ is the transport block number, and $L_i$ is the number of parity bits. $L_i$ can take the values 24, 16, 12, 8, or 0 depending on what is signalled from higher layers.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_{im1}D^{A_i+23} + a_{im2}D^{A_i+22} + \ldots + a_{imA_i}D^{24} + p_{im1}D^{23} + p_{im2}D^{22} + \ldots + p_{im23}D^{1} + p_{im24}$$

yields a remainder equal to 0 when divided by $g_{CRC24}(D)$, polynomial:

$$a_{im1}D^{A_i+15} + a_{im2}D^{A_i+14} + \ldots + a_{imA_i}D^{16} + p_{im1}D^{15} + p_{im2}D^{14} + \ldots + p_{im15}D^{1} + p_{im16}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, polynomial:

$$a_{im1}D^{A_i+11} + a_{im2}D^{A_i+10} + \ldots + a_{imA_i}D^{12} + p_{im1}D^{11} + p_{im2}D^{10} + \ldots + p_{im11}D^{1} + p_{im12}$$

yields a remainder equal to 0 when divided by $g_{CRC12}(D)$ and the polynomial:

$$a_{im1}D^{A_i+7} + a_{im2}D^{A_i+6} + \ldots + a_{imA_i}D^{8} + p_{im1}D^{7} + p_{im2}D^{6} + \ldots + p_{im7}D^{1} + p_{im8}$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

If no transport blocks are input to the CRC calculation ($M_i = 0$), no CRC attachment shall be done. If transport blocks are input to the CRC calculation ($M_i \neq 0$) and the size of a transport block is zero ($A_i = 0$), CRC shall be attached, i.e. all parity bits equal to zero.

### 4.2.1.2 Relation between input and output of the CRC attachment block

The bits after CRC attachment are denoted by $b_{im1}, b_{im2}, b_{im3}, \ldots, b_{imB_i}$, where $B_i = A_i + L_i$. The relation between $a_{imk}$ and $b_{imk}$ is:

$$b_{imk} = a_{imk} \qquad k = 1, 2, 3, \ldots, A_i$$

$$b_{imk} = p_{im(L_i+1-(k-A_i))} \qquad k = A_i + 1, A_i + 2, A_i + 3, \ldots, A_i + L_i$$

## 4.2.2 Transport block concatenation and code block segmentation

All transport blocks in a TTI are serially concatenated. If the number of bits in a TTI is larger than the maximum size of a code block, then code block segmentation is performed after the concatenation of the transport blocks. The maximum size of the code blocks depends on whether convolutional, turbo coding or no coding is used for the TrCH.

### 4.2.2.1 Concatenation of transport blocks

The bits input to the transport block concatenation are denoted by $b_{im1}, b_{im2}, b_{im3}, \ldots, b_{imB_i}$ where $i$ is the TrCH number, $m$ is the transport block number, and $B_i$ is the number of bits in each block (including CRC). The number of transport blocks on TrCH $i$ is denoted by $M_i$. The bits after concatenation are denoted by $x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$, where $i$ is the TrCH number and $X_i=M_iB_i$. They are defined by the following relations:

$x_{ik} = b_{i1k}$ $\quad k = 1, 2, \ldots, B_i$

$x_{ik} = b_{i,2,(k-B_i)}$ $\quad k = B_i + 1, B_i + 2, \ldots, 2B_i$

$x_{ik} = b_{i,3,(k-2B_i)}$ $\quad k = 2B_i + 1, 2B_i + 2, \ldots, 3B_i$

…

$x_{ik} = b_{i,M_i,(k-(M_i-1)B_i)}$ $\quad k = (M_i - 1)B_i + 1, (M_i - 1)B_i + 2, \ldots, M_iB_i$

### 4.2.2.2 Code block segmentation

Segmentation of the bit sequence from transport block concatenation is performed if $X_i>Z$. The code blocks after segmentation are of the same size. The number of code blocks on TrCH $i$ is denoted by $C_i$. If the number of bits input to the segmentation, $X_i$, is not a multiple of $C_i$, filler bits are added to the beginning of the first block. If turbo coding is selected and $X_i < 40$, filler bits are added to the beginning of the code block. The filler bits are transmitted and they are always set to 0. The maximum code block sizes are:

- convolutional coding: $Z = 504$;
- turbo coding: $Z = 5114$;
- no channel coding: $Z =$ *unlimited*.

The bits output from code block segmentation, for $C_i \neq 0$, are denoted by $o_{ir1}, o_{ir2}, o_{ir3}, \ldots, o_{irK_i}$, where $i$ is the TrCH number, $r$ is the code block number, and $K_i$ is the number of bits per code block.

Number of code blocks:

$$C_i = \begin{cases} \lceil X_i / Z \rceil & \text{when } Z \neq \textit{unlimited} \\ 0 & \text{when } Z = \textit{unlimited} \text{ and } X_i = 0 \\ 1 & \text{when } Z = \textit{unlimited} \text{ and } X_i \neq 0 \end{cases}$$

Number of bits in each code block (applicable for $C_i \neq 0$ only):

if $X_i < 40$ and Turbo coding is used, then

$K_i = 40$

else

$K_i = \lceil X_i / C_i \rceil$

end if

Number of filler bits: $Y_i = C_i K_i - X_i$

for $k = 1$ to $Y_i$ -- Insertion of filler bits

$$o_{i1k} = 0$$

end for

for $k = Y_i+1$ to $K_i$

$$o_{i1k} = x_{i,(k-Y_i)}$$

end for

$r = 2$ -- Segmentation

while $r \le C_i$

for $k = 1$ to $K_i$

$$o_{irk} = x_{i,(k+(r-1)\cdot K_i - Y_i)}$$

end for

r = r+1

end while

## 4.2.3 Channel coding

Code blocks are delivered to the channel coding block. They are denoted by $o_{ir1}, o_{ir2}, o_{ir3}, \ldots, o_{irK_i}$, where $i$ is the TrCH number, $r$ is the code block number, and $K_i$ is the number of bits in each code block. The number of code blocks on TrCH $i$ is denoted by $C_i$. After encoding the bits are denoted by $y_{ir1}, y_{ir2}, y_{ir3}, \ldots, y_{irY_i}$, where $Y_i$ is the number of encoded bits. The relation between $o_{irk}$ and $y_{irk}$ and between $K_i$ and $Y_i$ is dependent on the channel coding scheme.

The following channel coding schemes can be applied to transport channels:

- convolutional coding;
- turbo coding;
- no coding.

Usage of coding scheme and coding rate for the different types of TrCH is shown in tables 1 and 1A~~2~~. The values of $Y_i$ in connection with each coding scheme:

- convolutional coding with rate 1/2: $Y_i = 2*K_i + 16$; rate 1/3: $Y_i = 3*K_i + 24$;
- turbo coding with rate 1/3: $Y_i = 3*K_i + 12$;
- no coding: $Y_i = K_i$.

**Table 1: Usage of channel coding scheme and coding rate for 3.84Mcps TDD**

| Type of TrCH | Coding scheme | Coding rate |
|---|---|---|
| BCH | Convolutional coding | 1/2 |
| PCH | | |
| RACH | | |
| DCH, DSCH, FACH, USCH | | 1/3, 1/2 |
| | Turbo coding | 1/3 |
| | No coding | |

**Table 1A2: Usage of channel coding scheme and coding rate for 1.28Mcps TDD**

| Type of TrCH | Coding scheme | Coding rate |
|---|---|---|
| BCH | Convolutional coding | 1/3 |
| PCH | | 1/3, 1/2 |
| RACH | | 1/2 |
| DCH, DSCH, FACH, USCH | | 1/3, 1/2 |
| | Turbo coding | 1/3 |
| | No coding | |

### 4.2.3.1 Convolutional coding

Convolutional codes with constraint length 9 and coding rates 1/3 and 1/2 are defined.

The configuration of the convolutional coder is presented in figure 23.

Output from the rate 1/3 convolutional coder shall be done in the order output 0, output 1, output 2, output 0, output 1, output 2, output 0,…,output 2. Output from the rate 1/2 convolutional coder shall be done in the order output 0, output 1, output 0, output 1, output 0, …, output 1.

8 tail bits with binary value 0 shall be added to the end of the code block before encoding.

The initial value of the shift register of the coder shall be "all 0" when starting to encode the input bits.

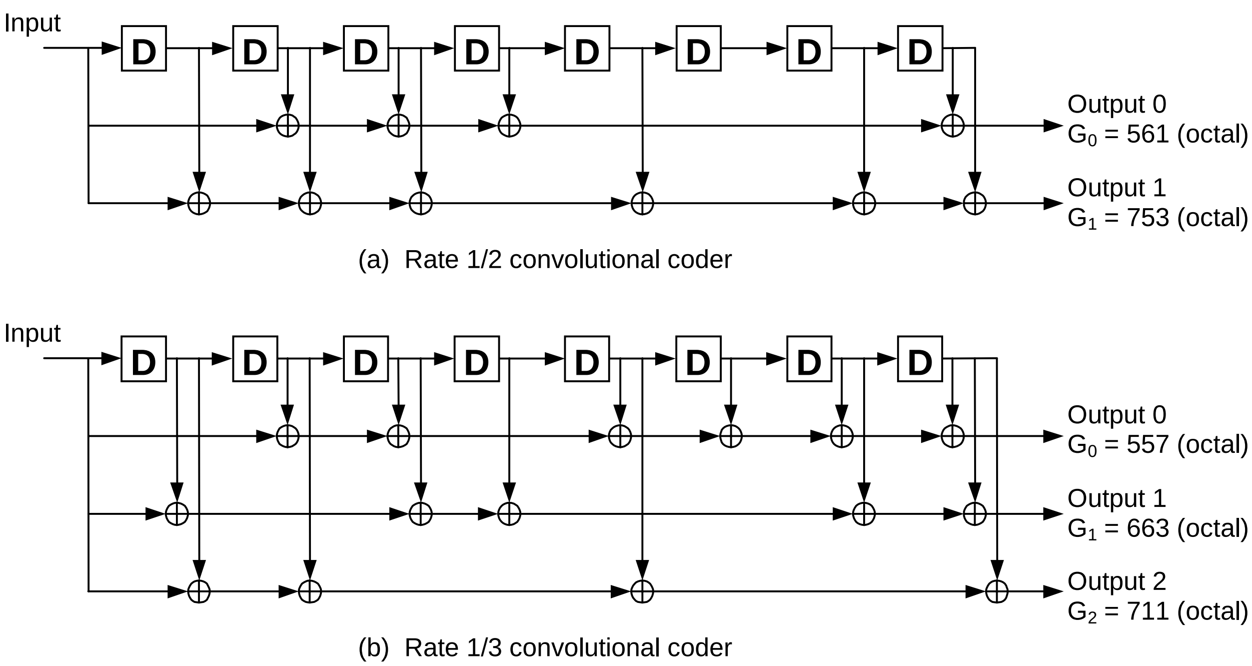


**Figure 23: Rate 1/2 and rate 1/3 convolutional coders**

### 4.2.3.2 Turbo coding

#### 4.2.3.2.1 Turbo coder

The scheme of Turbo coder is a Parallel Concatenated Convolutional Code (PCCC) with two 8-state constituent encoders and one Turbo code internal interleaver. The coding rate of Turbo coder is 1/3. The structure of Turbo coder is illustrated in figure 34.

The transfer function of the 8-state constituent code for PCCC is:

$$G(D) = \left[1, \frac{g_1(D)}{g_0(D)}\right],$$

where

$$g_0(D) = 1 + D^2 + D^3,$$

$$g_1(D) = 1 + D + D^3.$$

The initial value of the shift registers of the 8-state constituent encoders shall be all zeros when starting to encode the input bits.

Output from the Turbo coder is , Y'(0), X(1), Y(1), Y'(1), etc:

$$x_1, z_1, z'_1, x_2, z_2, z'_2, \ldots, x_K, z_K, z'_K,$$

where $x_1, x_2, \ldots, x_K$ are the bits input to the Turbo coder i.e. both first 8-state constituent encoder and Turbo code internal interleaver, and $K$ is the number of bits, and $z_1, z_2, \ldots, z_K$ and $z'_1, z'_2, \ldots, z'_K$ are the bits output from first and second 8-state constituent encoders, respectively.

The bits output from Turbo code internal interleaver are denoted by $x'_1, x'_2, \ldots, x'_K$, and these bits are to be input to the second 8-state constituent encoder.

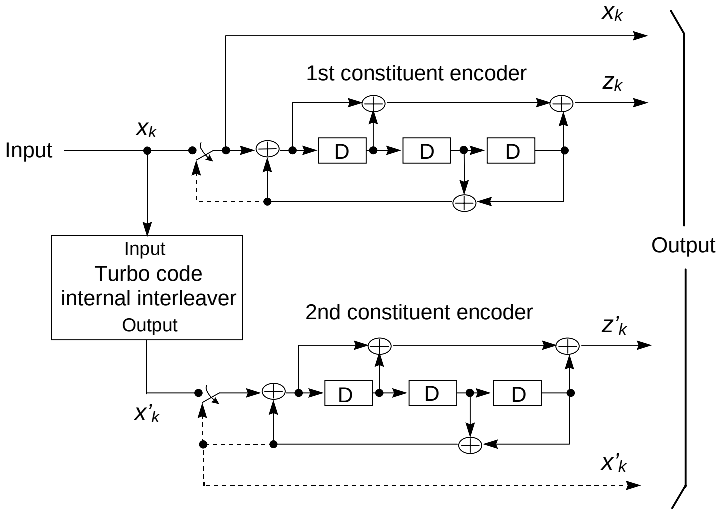


**Figure 34: Structure of rate 1/3 Turbo coder (dotted lines apply for trellis termination only)**

### 4.2.3.2.2 Trellis termination for Turbo coder

Trellis termination is performed by taking the tail bits from the shift register feedback after all information bits are encoded. Tail bits are padded after the encoding of information bits.

The first three tail bits shall be used to terminate the first constituent encoder (upper switch of figure 34 in lower position) while the second constituent encoder is disabled. The last three tail bits shall be used to terminate the second constituent encoder (lower switch of figure 34 in lower position) while the first constituent encoder is disabled.

The transmitted bits for trellis termination shall then be:

$$x_{K+1}, z_{K+1}, x_{K+2}, z_{K+2}, x_{K+3}, z_{K+3}, x'_{K+1}, z'_{K+1}, x'_{K+2}, z'_{K+2}, x'_{K+3}, z'_{K+3}.$$

#### 4.2.3.2.3 Turbo code internal interleaver

The Turbo code internal interleaver consists of bits-input to a rectangular matrix with padding, intra-row and inter-row permutations of the rectangular matrix, and bits-output from the rectangular matrix with pruning. The bits input to the Turbo code internal interleaver are denoted by $x_1, x_2, x_3, \ldots, x_K$, where $K$ is the integer number of the bits and takes one value of 40 $\leq K \leq$ 5114. The relation between the bits input to the Turbo code internal interleaver and the bits input to the channel coding is defined by $x_k = o_{irk}$ and $K = K_i$.

**The following subclause specific symbols are used in subclauses 4.2.3.2.3.1 to 4.2.3.4.3.3:**

| | |
|---|---|
| $K$ | Number of bits input to Turbo code internal interleaver |
| $R$ | Number of rows of rectangular matrix |
| $C$ | Number of columns of rectangular matrix |
| $p$ | Prime number |
| $v$ | Primitive root |
| $\langle s(j) \rangle_{j \in \{0,1,\cdots,p-2\}}$ | Base sequence for intra-row permutation |
| $q_i$ | Minimum prime integers |
| $r_i$ | Permuted prime integers |
| $\langle T(i) \rangle_{i \in \{0,1,\cdots,R-1\}}$ | Inter-row permutation pattern |
| $\langle U_i(j) \rangle_{j \in \{0,1,\cdots,C-1\}}$ | Intra-row permutation pattern of $i$-th row |
| $i$ | Index of row number of rectangular matrix |
| $j$ | Index of column number of rectangular matrix |
| $k$ | Index of bit sequence |

##### 4.2.3.2.3.1 Bits-input to rectangular matrix with padding

The bit sequence $x_1, x_2, x_3, \ldots, x_K$ input to the Turbo code internal interleaver is written into the rectangular matrix as follows.

(1) Determine the number of rows of the rectangular matrix, $R$, such that:

$$R = \begin{cases} 5, \text{if } (40 \leq K \leq 159) \\ 10, \text{if } ((160 \leq K \leq 200) \text{ or } (481 \leq K \leq 530)) \\ 20, \text{if } (K = \text{any other value}) \end{cases}.$$

The rows of rectangular matrix are numbered 0, 1, …, $R$ - 1 from top to bottom.

(2) Determine the prime number to be used in the intra-permutation, $p$, and the number of columns of rectangular matrix, $C$, such that:

if (481 $\leq K \leq$ 530) then

$p$ = 53 and $C = p$.

else

Find minimum prime number $p$ from table 23 such that

$$K \leq R \times (p+1),$$

and determine $C$ such that

$$C = \begin{cases} p-1 & if \quad K \le R \times (p-1) \\ p & if \quad R \times (p-1) < K \le R \times p \\ p+1 & if \quad R \times p < K \end{cases}.$$

end if

The columns of rectangular matrix are numbered 0, 1, …, $C$ - 1 from left to right.

**Table 23: List of prime number *p* and associated primitive root *v***

| p | v | p | v | p | v | p | v | p | v |
|---|---|---|---|---|---|---|---|---|---|
| 7 | 3 | 47 | 5 | 101 | 2 | 157 | 5 | 223 | 3 |
| 11 | 2 | 53 | 2 | 103 | 5 | 163 | 2 | 227 | 2 |
| 13 | 2 | 59 | 2 | 107 | 2 | 167 | 5 | 229 | 6 |
| 17 | 3 | 61 | 2 | 109 | 6 | 173 | 2 | 233 | 3 |
| 19 | 2 | 67 | 2 | 113 | 3 | 179 | 2 | 239 | 7 |
| 23 | 5 | 71 | 7 | 127 | 3 | 181 | 2 | 241 | 7 |
| 29 | 2 | 73 | 5 | 131 | 2 | 191 | 19 | 251 | 6 |
| 31 | 3 | 79 | 3 | 137 | 3 | 193 | 5 | 257 | 3 |
| 37 | 2 | 83 | 2 | 139 | 2 | 197 | 2 | | |
| 41 | 6 | 89 | 3 | 149 | 2 | 199 | 3 | | |
| 43 | 3 | 97 | 5 | 151 | 6 | 211 | 2 | | |

(3) Write the input bit sequence $x_1, x_2, x_3, \ldots, x_K$ into the $R \times C$ rectangular matrix row by row starting with bit $y_1$ in column 0 of row 0:

$$\begin{bmatrix} y_1 & y_2 & y_3 & \cdots & y_C \\ y_{(C+1)} & y_{(C+2)} & y_{(C+3)} & \cdots & y_{2C} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ y_{((R-1)C+1)} & y_{((R-1)C+2)} & y_{((R-1)C+3)} & \cdots & y_{R \times C} \end{bmatrix}.$$

where $y_k = x_k$ for $k$ = 1, 2, …, $K$ and if $R \times C > K$, the dummy bits are padded such that $y_k = 0 or 1$ for $k = K + 1$, $K$ + 2, …, $R \times C$. These dummy bits are pruned away from the output of the rectangular matrix after intra-row and inter-row permutations.

#### 4.2.3.2.3.2 Intra-row and inter-row permutations

After the bits-input to the $R \times C$ rectangular matrix, the intra-row and inter-row permutations for the $R \times C$ rectangular matrix are performed stepwise by using the following algorithm with steps (1) – (6).

(1) Select a primitive root $v$ from table 23 in section 4.2.3.2.3.1, which is indicated on the right side of the prime number $p$.

(2) Construct the base sequence $\langle s(j) \rangle_{j \in \{0,1,\cdots,p-2\}}$ for intra-row permutation as:

$s(j) = (v \times s(j-1)) \bmod p$, $j$ = 1, 2,… ($p$ - 2), and $s(0) = 1$.

(3) Assign $q_0 = 1$ to be the first prime integer in the sequence $\langle q_i \rangle_{i \in \{0,1,\cdots,R-1\}}$, and determine the prime integer $q_i$ in the sequence $\langle q_i \rangle_{i \in \{0,1,\cdots,R-1\}}$ to be a least prime integer such that g.c.d($q_i$, $p$ - 1) = 1, $q_i > 6$, and $q_i > q_{(i-1)}$ for each $i$ = 1, 2, …, $R$ – 1. Here g.c.d. is greatest common divisor.

(4) Permute the sequence $\langle q_i \rangle_{i \in \{0,1,\cdots,R-1\}}$ to make the sequence $\langle r_i \rangle_{i \in \{0,1,\cdots,R-1\}}$ such that

$r_{T(i)} = q_i$, $i$ = 0, 1, …. , $R$ - 1, where $\langle T(i) \rangle_{i \in \{0,1,\cdots,R-1\}}$ is the inter-row permutation pattern defined as the one of the four kind of patterns, which are shown in table 34, depending on the number of input bits *K*.

**Table 34: Inter-row permutation patterns for Turbo code internal interleaver**

| Number of input bits *K* | Number of rows *R* | Inter-row permutation patterns <*T*(0), *T*(1), …, *T*(*R* - 1)> |
|---|---|---|
| $(40 \le K \le 159)$ | 5 | <4, 3, 2, 1, 0> |
| $(160 \le K \le 200)$ or $(481 \le K \le 530)$ | 10 | <9, 8, 7, 6, 5, 4, 3, 2, 1, 0> |
| $(2281 \le K \le 2480)$ or $(3161 \le K \le 3210)$ | 20 | <19, 9, 14, 4, 0, 2, 5, 7, 12, 18, 16, 13, 17, 15, 3, 1, 6, 11, 8, 10> |
| *K* = any other value | 20 | <19, 9, 14, 4, 0, 2, 5, 7, 12, 18, 10, 8, 13, 17, 3, 1, 16, 6, 15, 11> |

(5) Perform the *i*-th (*i* = 0,1, …, *R* - 1) intra-row permutation as:

if (*C* = *p*) then

$U_i(j) = s((j \times r_i) \bmod (p-1))$, $j$ = 0, 1, …, ($p$ - 2), and $U_i(p - 1) = 0$,

where $U_i(j)$ is the original bit position of *j*-th permuted bit of *i*-th row.

end if

if (C = *p* + 1) then

$U_i(j) = s((j \times r_i) \bmod (p-1))$, $j$ = 0, 1, …, ($p$ - 2). $U_i(p - 1) = 0$, and $U_i(p) = p$,

where $U_i(j)$ is the original bit position of *j*-th permuted bit of *i*-th row, and

if ($K = R \times C$) then

Exhange $U_{R-1}(p)$ with $U_{R-1}(0)$.

end if

end if

if (*C* = *p* - 1) then

$U_i(j) = s((j \times r_i) \bmod (p-1)) - 1$, $j$ =0, 1, …, ($p$ - 2),

where $U_i(j)$ is the original bit position of *j*-th permuted bit of *i*-th row.

end if

(6) Perform the inter-row permutation for the rectangular matrix based on the pattern $\langle T(i) \rangle_{i \in \{0,1,\cdots,R-1\}}$,

where $T(i)$ is the original row position of the *i*-th permuted row.

#### 4.2.3.2.3.3 Bits-output from rectangular matrix with pruning

After intra-row and inter-row permutations, the bits of the permuted rectangular matrix are denoted by $y'_k$:

$$\begin{bmatrix} y'_1 & y'_{(R+1)} & y'_{(2R+1)} & \cdots y'_{((C-1)R+1)} \\ y'_2 & y'_{(R+2)} & y'_{(2R+2)} & \cdots y'_{((C-1)R+2)} \\ \vdots & \vdots & \vdots & \cdots \quad \vdots \\ y'_R & y'_{2R} & y'_{3R} & \cdots \quad y'_{C\times R} \end{bmatrix}$$

The output of the Turbo code internal interleaver is the bit sequence read out column by column from the intra-row and inter-row permuted $R \times C$ rectangular matrix starting with bit $y'_1$ in row 0 of column 0 and ending with bit $y'_{CR}$ in row $R$ - 1 of column $C$ - 1. The output is pruned by deleting dummy bits that were padded to the input of the rectangular matrix before intra-row and inter row permutations, i.e. bits $y'_k$ that corresponds to bits $y_k$ with $k > K$ are removed from the output. The bits output from Turbo code internal interleaver are denoted by $x'_1, x'_2, \ldots, x'_K$, where $x'_1$ corresponds to the bit $y'_k$ with smallest index $k$ after pruning, $x'_2$ to the bit $y'_k$ with second smallest index $k$ after pruning, and so on. The number of bits output from Turbo code internal interleaver is $K$ and the total number of pruned bits is:

$R \times C - K$.

#### 4.2.3.3 Concatenation of encoded blocks

After the channel coding for each code block, if $C_i$ is greater than 1, the encoded blocks are serially concatenated so that the block with lowest index $r$ is output first from the channel coding block, otherwise the encoded block is output from channel coding block as it is. The bits output are denoted by $c_{i1}, c_{i2}, c_{i3}, \ldots, c_{iE_i}$, where $i$ is the TrCH number and $E_i = C_i Y_i$. The output bits are defined by the following relations:

$$c_{ik} = y_{i1k} \quad k = 1, 2, \ldots, Y_i$$

$$c_{ik} = y_{i,2,(k-Y_i)} \quad k = Y_i + 1, Y_i + 2, \ldots, 2Y_i$$

$$c_{ik} = y_{i,3,(k-2Y_i)} \quad k = 2Y_i + 1, 2Y_i + 2, \ldots, 3Y_i$$

$$\ldots$$

$$c_{ik} = y_{i,C_i,(k-(C_i-1)Y_i)} \quad k = (C_i - 1)Y_i + 1, (C_i - 1)Y_i + 2, \ldots, C_i Y_i$$

If no code blocks are input to the channel coding ($C_i = 0$), no bits shall be output from the channel coding, i.e. $E_i = 0$.

### 4.2.4 Radio frame size equalisation

Radio frame size equalisation is padding the input bit sequence in order to ensure that the output can be segmented in $F_i$ data segments of same size as described in the subclause 4.2.6.

The input bit sequence to the radio frame size equalisation is denoted by $c_{i1}, c_{i2}, c_{i3}, \ldots, c_{iE_i}$, where $i$ is TrCH number and $E_i$ the number of bits. The output bit sequence is denoted by $t_{i1}, t_{i2}, t_{i3}, \ldots, t_{iT_i}$, where $T_i$ is the number of bits. The output bit sequence is derived as follows:

$t_{ik} = c_{ik}$, for k = 1… $E_i$ and

$t_{ik} = \{0, 1\}$ for k= $E_i$ +1… $T_i$, if $E_i < T_i$

where

$T_i = F_i * N_i$ and

$N_i = \lceil E_i / F_i \rceil$ is the number of bits per segment after size equalisation.

### 4.2.5 1st interleaving

The 1st interleaving is a block interleaver with inter-column permutations. The input bit sequence to the block interleaver is denoted by $x_{i,1}, x_{i,2}, x_{i,3}, \ldots, x_{i,X_i}$, where $i$ is TrCH number and $X_i$ the number of bits. Here $X_i$ is guaranteed to be an integer multiple of the number of radio frames in the TTI. The output bit sequence from the block interleaver is derived as follows:

1) select the number of columns C1 from table 4~~5~~ depending on the TTI. The columns are numbered 0, 1, …, C1 - 1 from left to right.

2) determine the number of rows of the matrix, R1 defined as

   R1 = $X_i$ / C1.

The rows of the matrix are numbered 0, 1, …, R1 - 1 from top to bottom.

3) write the input bit sequence into the R1 × C1 matrix row by row starting with bit $x_{i,1}$ in column 0 of row 0 and ending with bit $x_{i,(\mathrm{R1}\times\mathrm{C1})}$ in column C1 - 1 of row R1 – 1:

$$\begin{bmatrix} x_{i,1} & x_{i,2} & x_{i,3} & \ldots & x_{i,\mathrm{C1}} \\ x_{i,(\mathrm{C1}+1)} & x_{i,(\mathrm{C1}+2)} & x_{i,(\mathrm{C1}+3)} & \ldots & x_{i,(2\times\mathrm{C1})} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ x_{i,((\mathrm{R1}-1)\times\mathrm{C1}+1)} & x_{i,((\mathrm{R1}-1)\times\mathrm{C1}+2)} & x_{i,((\mathrm{R1}-1)\times\mathrm{C1}+3)} & \ldots & x_{i,(\mathrm{R1}\times\mathrm{C1})} \end{bmatrix}$$

4) Perform the inter-column permutation for the matrix based on the pattern $\left\langle \mathrm{P1}_{\mathrm{C1}}(j) \right\rangle_{j\in\{0,1,\ldots,\mathrm{C1}-1\}}$ shown in table 45, where $\mathrm{P1}_{\mathrm{C1}}(j)$ is the original column position of the $j$-th permuted column. After permutation of the columns, the bits are denoted by $y_{i,k}$:

$$\begin{bmatrix} y_{i,1} & y_{i,(\mathrm{R1}+1)} & y_{i,(2\times\mathrm{R1}+1)} & \ldots & y_{i,((\mathrm{C1}-1)\times\mathrm{R1}+1)} \\ y_{i,2} & y_{i,(\mathrm{R1}+2)} & y_{i,(2\times\mathrm{R1}+2)} & \ldots & y_{i,((\mathrm{C1}-1)\times\mathrm{R1}+2)} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ y_{i,\mathrm{R1}} & y_{i,(2\times\mathrm{R1})} & y_{i,(3\times\mathrm{R1})} & \ldots & y_{i,(\mathrm{C1}\times\mathrm{R1})} \end{bmatrix}$$

5) Read the output bit sequence $y_{i,1}, y_{i,2}, y_{i,3}, \ldots, y_{i,(\mathrm{C1}\times\mathrm{R1})}$ of the block interleaver column by column from the inter-column permuted R1 × C1 matrix. Bit $y_{i,1}$ corresponds to row 0 of column 0 and bit $y_{i,(\mathrm{R1}\times\mathrm{C1})}$ corresponds to row R1 - 1 of column C1 - 1.

**Table 45 Inter-column permutation patterns for 1st interleaving**

| TTI | Number of columns C1 | Inter-column permutation patterns <$\mathrm{P1}_{\mathrm{C1}}(0)$, $\mathrm{P1}_{\mathrm{C1}}(1)$, …, $\mathrm{P1}_{\mathrm{C1}}(\mathrm{C1}-1)$> |
|---|---|---|
| 5ms(*1), 10 ms | 1 | <0> |
| 20 ms | 2 | <0,1> |
| 40 ms | 4 | <0,2,1,3> |
| 80 ms | 8 | <0,4,2,6,1,5,3,7> |

(*1) can be used for PRACH for 1.28 Mcps TDD

### 4.2.5.1 Relation between input and output of 1st interleaving

The bits input to the 1st interleaving are denoted by $t_{i,1}, t_{i,2}, t_{i,3}, \ldots, t_{i,T_i}$, where $i$ is the TrCH number and $T_i$ the number of bits. Hence, $x_{i,k} = t_{i,k}$ and $X_i = T_i$.

The bits output from the 1st interleaving are denoted by $d_{i,1}, d_{i,2}, d_{i,3}, \ldots, d_{i,T_i}$, and $d_{i,k} = y_{i,k}$.

## 4.2.6 Radio frame segmentation

When the transmission time interval is longer than 10 ms, the input bit sequence is segmented and mapped onto consecutive $F_i$ radio frames. Following radio frame size equalisation the input bit sequence length is guaranteed to be an integer multiple of $F_i$.

The input bit sequence is denoted by $x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$ where $i$ is the TrCH number and $X_i$ is the number bits. The $F_i$ output bit sequences per TTI are denoted by $y_{i,n_i1}, y_{i,n_i2}, y_{i,n_i3}, \ldots, y_{i,n_iY_i}$ where $n_i$ is the radio frame number in current TTI and $Y_i$ is the number of bits per radio frame for TrCH $i$. The output sequences are defined as follows:

$y_{i,n_ik} = x_{i,((n_i-1)Y_i)+k}$, $n_i = 1\ldots F_i$, $k = 1\ldots Y_i$

where

$Y_i = (X_i / F_i)$ is the number of bits per segment.

The $n_i$ –th segment is mapped to the $n_i$ –th radio frame of the transmission time interval.

The input bit sequence to the radio frame segmentation is denoted by $d_{i1}, d_{i2}, d_{i3}, \dots, d_{iT_i}$, where $i$ is the TrCH number and $T_i$ the number of bits. Hence, $x_{ik} = d_{ik}$ and $X_i = T_i$.

The output bit sequence corresponding to radio frame $n_i$ is denoted by $e_{i1}, e_{i2}, e_{i3}, \dots, e_{iN_i}$, where $i$ is the TrCH number and $N_i$ is the number of bits. Hence, $e_{i,k} = y_{i,n_i k}$ and $N_i = Y_i$.

## 4.2.7 Rate matching

Rate matching means that bits on a TrCH are repeated or punctured. Higher layers assign a rate-matching attribute for each TrCH. This attribute is semi-static and can only be changed through higher layer signalling. The rate-matching attribute is used when the number of bits to be repeated or punctured is calculated.

The number of bits on a TrCH can vary between different transmission time intervals. When the number of bits between different transmission time intervals is changed, bits are repeated to ensure that the total bit rate after TrCH multiplexing is identical to the total channel bit rate of the allocated physical channels.

If no bits are input to the rate matching for all TrCHs within a CCTrCH, the rate matching shall output no bits for all TrCHs within the CCTrCH.

**Notation used in subclause 4.2.7 and subclauses:**

$N_{ij}$ : Number of bits in a radio frame before rate matching on TrCH *i* with transport format combination *j*.

$\Delta N_{i,j}$ : If positive – number of bits to be repeated in each radio frame on TrCH *i* with transport format

If negative – number of bits to be punctured in each radio frame on TrCH *i* with transport format combination *j*.

$RM_i$ : Semi-static rate matching attribute for TrCH *i*. Signalled from higher layers.

$PL$ : Puncturing limit. This value limits the amount of puncturing that can be applied in order to minimise the number of physical channels. Signalled from higher layers. The allowed puncturing in % is actually equal to (1-PL)*100.

$N_{data,j}$ : Total number of bits that are available for a CCTrCH in a radio frame with transport format combination j.

$P$ : number of physical channels used in the current frame.

$P_{max}$ : maximum number of physical channels allocated for a CCTrCH.

$U_p$ : Number of data bits in the physical channel p with p = 1...P.

$I$ : Number of TrCHs in a CCTrCH.

$Z_{ij}$ : Intermediate calculation variable.

$F_i$ : Number of radio frames in the transmission time interval of TrCH *i*.

$n_i$ : Radio frame number in the transmission time interval of TrCH *i* ($0 \le n_i < F_i$).

$q$ : Average puncturing or repetition distance(normalised to only show the remaining rate matching on top of an integer number of repetitions).

$P1_F(n_i)$ : The column permutation function of the 1st interleaver, $P1_F(x)$ is the original position of column with number x after permutation. P1 is defined on table 4~~5~~ of section 4.2.5 (note that $P1_F$ self-inverse).

S[n] : The shift of the puncturing or repetition pattern for radio frame $n_i$ when $n = P1_{F_i}(n_i)$.

$TF_i(j)$ : Transport format of TrCH i for the transport format combination j.

$TFS(i)$ : The set of transport format indexes $l$ for TrCH i.

$e_{ini}$ : Initial value of variable e in the rate matching pattern determination algorithm of subclause 4.2.7.3.

$e_{plus}$ : Increment of variable $e$ in the rate matching pattern determination algorithm of subclause 4.2.7.3.

$e_{minus}$ : Decrement of variable $e$ in the rate matching pattern determination algorithm of subclause 4.2.7.3.

$b$ : Indicates systematic and parity bits.

$b$=1: Systematic bit. $X(t)$ in subclause 4.2.3.2.1.

$b$=2: $1^{st}$ parity bit (from the upper Turbo constituent encoder). $Y(t)$ in subclause 4.2.3.2.1.

$b$=3: $2^{nd}$ parity bit (from the lower Turbo constituent encoder). $Y'(t)$ in subclause 4.2.3.2.1.

### 4.2.7.1 Determination of rate matching parameters

The following relations, defined for all TFC $j$, are used when calculating the rate matching pattern:

$$Z_{0,j} = 0$$

$$Z_{i,j} = \left\lfloor \frac{\left(\left(\sum_{m=1}^{i} RM_m \times N_{m,j}\right) \times N_{data,j}\right)}{\sum_{m=1}^{I} RM_m \times N_{m,j}} \right\rfloor \quad \text{for all i = 1 ... } I \text{ (1)}$$

$$\Delta N_{i,j} = Z_{i,j} - Z_{i-1,j} - N_{i,j} \quad \text{for all i = 1 ... } I$$

Puncturing can be used to minimise the required transmission capacity. The maximum amount of puncturing that can be applied is 1-PL, PL is signalled from higher layers. The possible values for $N_{data}$ depend on the number of physical channels $P_{max}$, allocated to the respective CCTrCH, and on their characteristics (spreading factor, length of midamble and TFCI code word, usage of TPC and multiframe structure), which is given in [7].

For each physical channel an individual minimum spreading factor $Sp_{min}$ is transmitted by means of the higher layers. Denote the number of data bits in each physical channel by $U_{p,Sp}$, where $p$ indicates the sequence number $1 \le p \le P_{max}$ and $Sp$ indicates the spreading factor with the possible values {$16, 8, 4, 2, 1$} of this physical channel. The index $p$ is described in section 4.2.12~~13~~ with the following modifications: spreading factor ($Q$) is replaced by the minimum spreading factor $Sp_{min}$ and $k$ is replaced by the channelization code index at $Q = Sp_{min}$. Then, for $N_{data}$ one of the following values in ascending order can be chosen:

$$\left\{U_{1,S1_{min}}, U_{1,S1_{min}} + U_{2,S2_{min}}, U_{1,S1_{min}} + U_{2,S2_{min}} + \ldots + U_{P_{max},(SP_{max})_{min}}\right\}$$

Optionally, if indicated by higher layers for the UL the UE shall vary the spreading factor autonomously, so that $N_{data}$ is one of the following values in ascending order:

$$\left\{U_{1,16}, \ldots, U_{1,S1_{min}}, U_{1,S1_{min}} + U_{2,16}, \ldots, U_{1,S1_{min}} + U_{2,S2_{min}}, \ldots, U_{1,S1_{min}} + U_{2,S2_{min}} + \ldots + U_{P_{max},16}, \ldots, U_{1,S1_{min}} + U_{2,S2_{min}} + \ldots + U_{P_{max},(SP_{max})_{min}}\right\}$$

$N_{data,j}$ for the transport format combination j is determined by executing the following algorithm:

$$\text{SET1} = \{ N_{data} \text{ such that } \left(\min_{1 \le y \le I}\{RM_y\}\right) \times N_{data} - PL \times \sum_{x=1}^{I} RM_x \times N_{x,j} \text{ is non negative } \}$$

$N_{data,j}$ = min SET1

The number of bits to be repeated or punctured, $\Delta N_{i,j}$, within one radio frame for each TrCH i is calculated with the relations given at the beginning of this subclause for all possible transport format combinations j and selected every radio frame. The number of physical channels corresponding to $N_{data,\,j}$, shall be denoted by P.

If $\Delta N_{i,j} = 0$ then the output data of the rate matching is the same as the input data and the rate matching algorithm of subclause 4.2.7.3 does not need to be executed.

Otherwise, the rate matching pattern is calculated with the algorithm described in subclause 4.2.7.3. For this algorithm the parameters $e_{ini}$, $e_{plus}$, $e_{minus}$, and $X_i$ are needed, which are calculated according to the equations in subclauses 4.2.7.1.1 and 4.2.7.1.2.

### 4.2.7.1.1 Uncoded and convolutionally encoded TrCHs

a = 2

$\Delta N_i = \Delta N_{i,j}$

$X_i = N_{i,j}$

$R = \Delta N_{i,j} \bmod N_{i,j}$ -- note: in this context $\Delta N_{i,j} \bmod N_{i,j}$ is in the range of 0 to $N_{i,j}-1$ i.e. -1 mod 10 = 9.

if $R \neq 0$ and $2 \times R \leq N_{i,j}$

then $q = \lceil N_{i,j} / R \rceil$

else

$q = \lceil N_{i,j} / (R - N_{i,j}) \rceil$

endif

NOTE 1: q is a signed quantity.

If q is even

then $q' = q + \gcd(|q|, F_i) / F_i$ -- where gcd ($|q|$, $F_i$) means greatest common divisor of $|q|$ and $F_i$

NOTE 2: q' is not an integer, but a multiple of 1/8.

else

$q' = q$

endif

for x = 0 to $F_i$-1

$S[|\lfloor x \times q' \rfloor| \bmod F_i] = (|\lfloor x * q' \rfloor| \text{ div } F_i)$

end for

$e_{ini} = (a \times S[P1_{F_i}(n_i)] \times |\Delta N_i| + 1) \bmod (a \times N_{i,j})$

$e_{plus} = a \times X_i$

$e_{minus} = a \times |\Delta N_i|$

puncturing for $\Delta N_i < 0$, repetition otherwise.

### 4.2.7.1.2 Turbo encoded TrCHs

If repetition is to be performed on turbo encoded TrCHs, i.e. $\Delta N_{i,j} > 0$, the parameters in subclause 4.2.7.1.1 are used.

If puncturing is to be performed, the parameters below shall be used. Index *b* is used to indicate systematic (*b*=1), 1st parity (*b*=2), and 2nd parity bit (*b*=3).

a = 2 when $b$=2

a = 1 when $b$=3

$$\Delta N_i = \begin{cases} \lfloor \Delta N_{i,j}/2 \rfloor, & b = 2 \\ \lceil \Delta N_{i,j}/2 \rceil, & b = 3 \end{cases}$$

If $\Delta N_i$ is calculated as 0 for $b$=2 or $b$=3, then the following procedure and the rate matching algorithm of subclause 4.2.7.3 don't need to be performed for the corresponding parity bit stream.

$X_i = \lfloor N_{i,j}/3 \rfloor$ ,

$q = \lfloor X_i /|\Delta N_i| \rfloor$

if(q $\leq$ 2)

for $r$=0 to $F_i$-1

S[(3×$r$+b-1) mod $F_i$] = $r$ mod 2;

end for

else

if q is even

then q′ = q – $gcd$(q, $F_i$)/ $F_i$ -- where $gcd$ (q, $F_i$) means greatest common divisor of q and $F_i$

NOTE: q′ is not an integer, but a multiple of 1/8.

else q′ = q

endif

for $x$=0 to $F_i$ –1

r = $\lceil x \times q' \rceil$ mod $F_i$;

S[(3×r+b-1) mod $F_i$] = $\lceil x \times q' \rceil$ div $F_i$;

endfor

endif

For each radio frame, the rate-matching pattern is calculated with the algorithm in subclause 4.2.7.3, where:

$X_i$ is as above,

$e_{ini}$ = (a×S[P1 $F_i$ ($n_i$)]×·|$\Delta N_i$| + $X_i$) mod (a×$X_i$), if $e_{ini}$ = 0 then $e_{ini}$ = a×$X_i$

$e_{plus}$ = a×$X_i$

$e_{minus}$ = a×|$\Delta N_i$|

### 4.2.7.2 Bit separation and collection for rate matching

The systematic bits of turbo encoded TrCHs shall not be punctured, the other bits may be punctured. The systematic bits, first parity bits, and second parity bits in the bit sequence input to the rate matching block are therefore separated into three sequences.

The first sequence contains:

- All of the systematic bits that are from turbo encoded TrCHs.

- From 0 to 2 first and/or second parity bits that are from turbo encoded TrCHs. These bits come into the first sequence when the total number of bits in a block after radio frame segmentation is not a multiple of three.

- Some of the systematic, first parity and second parity bits that are for trellis termination.

The second sequence contains:

- All of the first parity bits that are from turbo encoded TrCHs, except those that go into the first sequence when the total number of bits is not a multiple of three.

- Some of the systematic, first parity and second parity bits that are for trellis termination.

The third sequence contains:

- All of the second parity bits that are from turbo encoded TrCHs, except those that go into the first sequence when the total number of bits is not a multiple of three.

- Some of the systematic, first parity and second parity bits that are for trellis termination.

The second and third sequences shall be of equal length, whereas the first sequence can contain from 0 to 2 more bits. Puncturing is applied only to the second and third sequences.

The bit separation function is transparent for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition. The bit separation and bit collection are illustrated in figures 45 and 56.

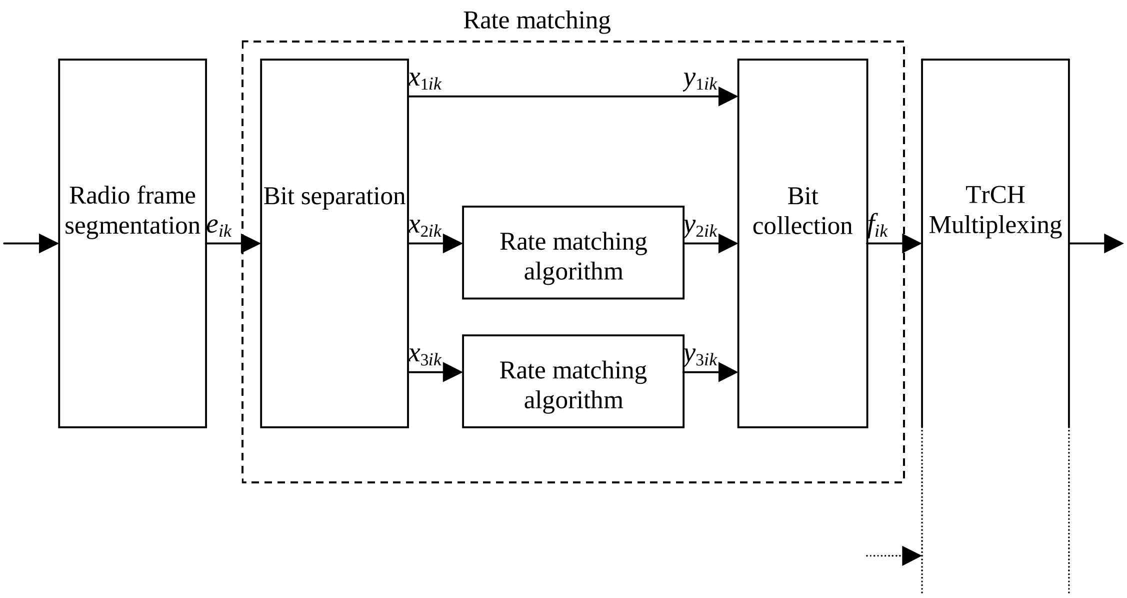


**Figure 45: Puncturing of turbo encoded TrCHs**

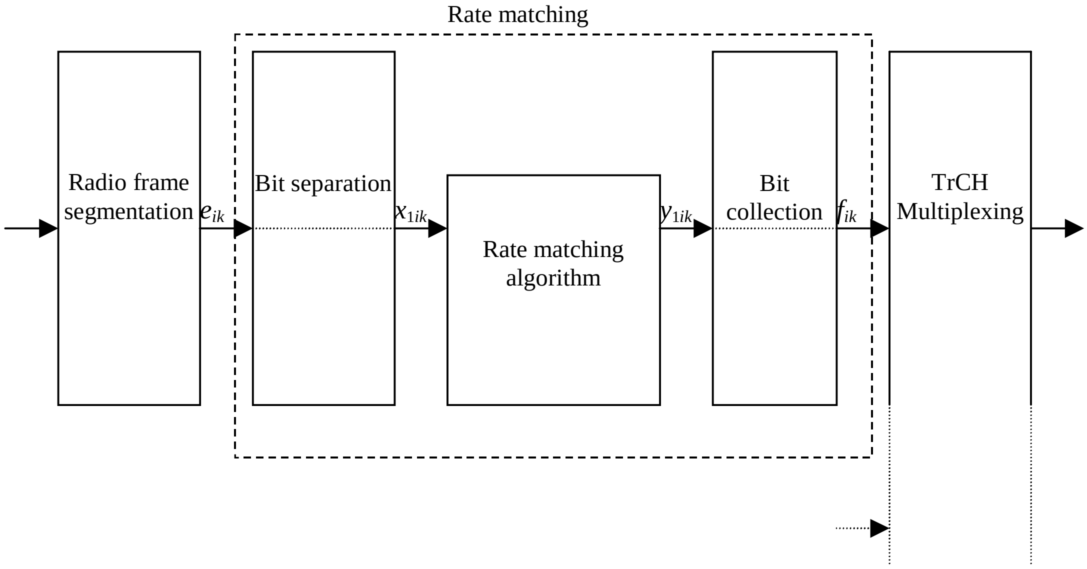


**Figure 56: Rate matching for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition**

The bit separation is dependent on the 1st interleaving and offsets are used to define the separation for different TTIs. $b$ indicates the three sequences defined in this section, with $b$=1 indicating the first sequence, $b$ = 2 the second one, and $b$ = 3 the third one.

The offsets $\alpha_b$ for these sequences are listed in table 56.

**Table 56: TTI dependent offset needed for bit separation**

| TTI (ms) | $\alpha_1$ | $\alpha_2$ | $\alpha_3$ |
|---|---|---|---|
| 10, 40 | 0 | 1 | 2 |
| 20, 80 | 0 | 2 | 1 |

The bit separation is different for different radio frames in the TTI. A second offset is therefore needed. The radio frame number for TrCH $i$ is denoted by $n_i$. and the offset by $\beta_{n_i}$.

**Table 67: Radio frame dependent offset needed for bit separation**

| TTI (ms) | $\beta_0$ | $\beta_1$ | $\beta_2$ | $\beta_3$ | $\beta_4$ | $\beta_5$ | $\beta_6$ | $\beta_7$ |
|---|---|---|---|---|---|---|---|---|
| 10 | 0 | NA | NA | NA | NA | NA | NA | NA |
| 20 | 0 | 1 | NA | NA | NA | NA | NA | NA |
| 40 | 0 | 1 | 2 | 0 | NA | NA | NA | NA |
| 80 | 0 | 1 | 2 | 0 | 1 | 2 | 0 | 1 |

### 4.2.7.2.1 Bit separation

The bits input to the rate matching are denoted by $e_{i,1}, e_{i,2}, e_{i,3}, \ldots, e_{i,N_i}$, where $i$ is the TrCH number and $N_i$ is the number of bits input to the rate matching block. Note that the transport format combination number $j$ for simplicity has been left out in the bit numbering, i.e. $N_i$=$N_{ij}$. The bits after separation are denoted by $x_{b,i,1}, x_{b,i,2}, x_{b,i,3}, \ldots, x_{b,i,X_i}$. For turbo encoded TrCHs with puncturing, $b$ indicates the three sequences defined in section 4.2.7.2, with $b$=1 indicating the first sequence, and so forth. For all other cases $b$ is defined to be 1. $X_i$ is the number of bits in each separated bit sequence. The relation between $e_{i,k}$ and $x_{b,i,k}$ is given below.

For turbo encoded TrCHs with puncturing:

$$x_{1,i,k} = e_{i,3(k-1)+1+(\alpha_1+\beta_{n_i}) \bmod 3} \qquad k = 1, 2, 3, \ldots, X_i \qquad X_i = \lfloor N_i / 3 \rfloor$$

$x_{1,i,\lfloor N_i/3 \rfloor+k} = e_{i,3\lfloor N_i/3 \rfloor+k}$ $k = 1, \ldots, N_i \bmod 3$ Note: When ($N_i$ mod 3) = 0 this row is not needed.

$x_{2,i,k} = e_{i,3(k-1)+1+(\alpha_2+\beta_{n_i}) \bmod 3}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = \lfloor N_i/3 \rfloor$

$x_{3,i,k} = e_{i,3(k-1)+1+(\alpha_3+\beta_{n_i}) \bmod 3}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = \lfloor N_i/3 \rfloor$

For uncoded TrCHs, convolutionally encoded TrCHs, and turbo encoded TrCHs with repetition:

$x_{1,i,k} = e_{i,k}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = N_i$

#### 4.2.7.2.2 Bit collection

The bits $x_{b,i,k}$ are input to the rate matching algorithm described in subclause 4.2.7.3. The bits output from the rate matching algorithm are denoted $y_{b,i,1}, y_{b,i,2}, y_{b,i,3}, \ldots, y_{b,i,Y_i}$.

Bit collection is the inverse function of the separation. The bits after collection are denoted by $z_{b,i,1}, z_{b,i,2}, z_{b,i,3}, \ldots, z_{b,i,Y_i}$. After bit collection, the bits indicated as punctured are removed and the bits are then denoted by $f_{i,1}, f_{i,2}, f_{i,3}, \ldots, f_{i,V_i}$, where $i$ is the TrCH number and $V_i = N_{i,j} + \Delta N_{i,j}$. The relations between $y_{b,i,k}$, $z_{b,i,k}$, and $f_{i,k}$ are given below.

For turbo encoded TrCHs with puncturing ($Y_i = X_i$):

$z_{i,3(k-1)+1+(\alpha_1+\beta_{n_i}) \bmod 3} = y_{1,i,k}$ $k = 1, 2, 3, \ldots, Y_I$

$z_{i,3\lfloor N_i/3 \rfloor+k} = y_{1,i,\lfloor N_i/3 \rfloor+k}$ $k = 1, \ldots, N_i \bmod 3$ Note: When ($N_i$ mod 3) = 0 this row is not needed.

$z_{i,3(k-1)+1+(\alpha_2+\beta_{n_i}) \bmod 3} = y_{2,i,k}$ $k = 1, 2, 3, \ldots, Y_i$

$z_{i,3(k-1)+1+(\alpha_3+\beta_{n_i}) \bmod 3} = y_{3,i,k}$ $k = 1, 2, 3, \ldots, Y_i$

After the bit collection, bits $z_{i,k}$ with value $\delta$, where $\delta \notin \{0, 1\}$, are removed from the bit sequence. Bit $f_{i,1}$ corresponds to the bit $z_{i,k}$ with smallest index $k$ after puncturing, bit $f_{i,2}$ corresponds to the bit $z_{i,k}$ with second smallest index $k$ after puncturing, and so on.

For uncoded TrCHs, convolutionally encoded TrCHs, and turbo encoded TrCHs with repetition:

$z_{i,k} = y_{1,i,k}$ $k = 1, 2, 3, \ldots, Y_i$

When repetition is used, $f_{i,k} = z_{i,k}$ and $Y_i = V_i$.

When puncturing is used, $Y_i = X_i$ and bits $z_{i,k}$ with value $\delta$, where $\delta \notin \{0, 1\}$, are removed from the bit sequence. Bit $f_{i,1}$ corresponds to the bit $z_{i,k}$ with smallest index $k$ after puncturing, bit $f_{i,2}$ corresponds to the bit $z_{i,k}$ with second smallest index $k$ after puncturing, and so on.

### 4.2.7.3 Rate matching pattern determination

The bits input to the rate matching are denoted by $x_{i,1}, x_{i,2}, x_{i,3}, \ldots, x_{i,X_i}$, where $i$ is the TrCH and $X_i$ is the parameter given in subclauses 4.2.7.1.1 and 4.2.7.1.2.

NOTE: The transport format combination number j for simplicity has been left out in the bit numbering.

The rate matching rule is as follows:

if puncturing is to be performed

$e = e_{ini}$ -- initial error between current and desired puncturing ratio

m = 1 -- index of current bit

do while m <= $X_i$

$e = e - e_{minus}$ -- update error

if e <= 0 then -- check if bit number m should be punctured

set bit $x_{i,m}$ to $\delta$ where $\delta \notin \{0, 1\}$

$e = e + e_{plus}$ -- update error

end if

m = m + 1 -- next bit

end do

else

e = $e_{ini}$ -- initial error between current and desired puncturing ratio

m = 1 -- index of current bit

do while m <= $X_i$

$e = e - e_{minus}$ -- update error

do while e <= 0 -- check if bit number m should be repeated

repeat bit $x_{i,m}$

$e = e + e_{plus}$ -- update error

end do

m = m + 1 -- next bit

end do

end if

A repeated bit is placed directly after the original one.

### 4.2.8 TrCH multiplexing

Every 10 ms, one radio frame from each TrCH is delivered to the TrCH multiplexing. These radio frames are serially multiplexed into a coded composite transport channel (CCTrCH). If the TTI is smaller than 10ms, then no TrCH multiplexing is performed.

The bits input to the TrCH multiplexing are denoted by $f_{i,1}, f_{i,2}, f_{i,3}, \ldots, f_{i,V_i}$, where $i$ is the TrCH id number and $V_i$ is the number of bits in the radio frame of TrCH $i$. The number of TrCHs is denoted by $I$. The bits output from TrCH multiplexing are denoted by $h_1, h_2, h_3, \ldots, h_S$, where $S$ is the number of bits, i.e. $S = \sum_i V_i$. The TrCH multiplexing is defined by the following relations:

$h_k = f_{1,k}$ $k = 1, 2, \ldots, V_1$

$h_k = f_{2,(k-V_1)}$ $k = V_1+1, V_1+2, \ldots, V_1+V_2$

$h_k = f_{3,(k-(V_1+V_2))}$ $k = (V_1+V_2)+1, (V_1+V_2)+2, \ldots, (V_1+V_2)+V_3$

…

$$h_k = f_{I,(k-(V_1+V_2+\ldots+V_{I-1}))} \qquad k = (V_1+V_2+\ldots+V_{I-1})+1,\ (V_1+V_2+\ldots+V_{I-1})+2,\ \ldots,\ (V_1+V_2+\ldots+V_{I-1})+V_I$$

## 4.2.9 Bit Scrambling

The bits output from the TrCH multiplexer are scrambled in the bit scrambler. The bits input to the bit scrambler are denoted by $h_1, h_2, h_3, \ldots, h_S$ , where $S$ is the number of bits input to the bit scrambling block equal to the total number of bits on the CCTrCH. The bits after bit scrambling are denoted $s_1, s_2, s_3, \ldots, s_S$ .

Bit scrambling is defined by the following relation:

$$s_k = h_k \oplus p_k \quad k = 1,2\ldots,S$$

and $p_k$ results from the following operation:

$$p_k = \left(\sum_{i=1}^{16} g_i \cdot p_{k-i}\right) \bmod 2\,;\ p_k = 0; k < 1\ ;\ p_1 = 1\,;\ \ g = \{0,0,0,0,0,0,0,0,0,0,1,0,1,1,0,1\}$$

## 4.2.10 Physical channel segmentation

When more than one PhCH is used, physical channel segmentation divides the bits among the different PhCHs. The bits input to the physical channel segmentation are denoted by $s_1, s_2, s_3, \ldots, s_S$ , where S is the number of bits input to the physical channel segmentation block. The number of PhCHs after rate matching is denoted by *P*, as defined in subclause 4.2.7.1.

The bits after physical channel segmentation are denoted $u_{p,1}, u_{p,2}, u_{p,3}, \ldots, u_{p,U_p}$ , where $p$ is PhCH number and $U_p$ is the in general variable number of bits in the respective radio frame for each PhCH. The relation between $s_k$ and $u_{p,k}$ is given below.

Bits on first PhCH after physical channel segmentation:

$$u_{1,k} = s_k \qquad k = 1, 2, \ldots, U_1$$

Bits on second PhCH after physical channel segmentation:

$$u_{2,k} = s_{(k+U_1)} \qquad k = 1, 2, \ldots, U_2$$

…

Bits on the $P^{th}$ PhCH after physical channel segmentation:

$$u_{P,k} = s_{(k+U_1+\ldots+U_{P-1})} \qquad k = 1, 2, \ldots, U_P$$

## 4.2.11 2nd interleaving

The 2$^{nd}$ interleaving is a block interleaver and consists of bits input to a matrix with padding, the inter-column permutation for the matrix and bits output from the matrix with pruning. The 2nd interleaving can be applied jointly to all data bits transmitted during one frame, or separately within each timeslot, on which the CCTrCH is mapped. The selection of the 2nd interleaving scheme is controlled by higher layer.

#### 4.2.11.1 Frame related 2nd interleaving

In case of frame related 2nd interleaving, the bits input to the block interleaver are denoted by $x_1, x_2, x_3, \ldots, x_U$ , where $U$ is the total number of bits after TrCH multiplexing transmitted during the respective radio frame with $S = U = \sum_p U_p$ .

The relation between $x_k$ and the bits $u_{p,k}$ in the respective physical channels is given below:

$x_k = u_{1,k}$ $\quad k = 1, 2, \ldots, U_1$

$x_{(k+U_1)} = u_{2,k}$ $\quad k = 1, 2, \ldots, U_2$

…

$x_{(k+U_1+\ldots+U_{P-1})} = u_{P,k}$ $\quad k = 1, 2, \ldots, U_P$

The following steps have to be performed once for each CCTrCH:

(1) Assign C2 = 30 to be the number of columns of the matrix. The columns of the matrix are numbered 0, 1, 2, …, C2 - 1 from left to right.

(2) Determine the number of rows of the matrix, R2, by finding minimum integer R2 such that:

$U \leq \text{R2} \times \text{C2}$.

The rows of rectangular matrix are numbered 0, 1, 2, …, R2 - 1 from top to bottom.

(3) Write the input bit sequence $x_1, x_2, x_3, \ldots, x_U$ into the R2 × C2 matrix row by row starting with bit $y_1$ in column 0 of row 0:

$$\begin{bmatrix} y_1 & y_2 & y_3 & \ldots & y_{\text{C2}} \\ y_{(\text{C2}+1)} & y_{(\text{C2}+2)} & y_{(\text{C2}+3)} & \ldots & y_{(2\times\text{C2})} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ y_{((\text{R2}-1)\times\text{C2}+1)} & y_{((\text{R2}-1)\times\text{C2}+2)} & y_{((\text{R2}-1)\times\text{C2}+3)} & \ldots & y_{(\text{R2}\times\text{C2})} \end{bmatrix}$$

where $y_k = x_k$ for $k$ = 1, 2, …, $U$ and if R2 × C2 > $U$, the dummy bits are padded such that $y_k$ = 0 or 1 for $k$ = $U$ + 1, $U$ + 2, …, R2 × C2. These dummy bits are pruned away from the output of the matrix after the inter-column permutation.

(4) Perform the inter-column permutation for the matrix based on the pattern $\langle \text{P}2(j) \rangle_{j\in\{0,1,\ldots,\text{C2}-1\}}$ that is shown in table 78, where $\text{P}_2(j)$ is the original column position of the $j$-th permuted column. After permutation of the columns, the bits are denoted by $y'_k$ .

$$\begin{bmatrix} y'_1 & y'_{(\text{R2}+1)} & y'_{(2\times\text{R2}+1)} & \ldots & y'_{((\text{C2-1})\times\text{R2}+1)} \\ y'_2 & y'_{(\text{R2}+2)} & y'_{(2\times\text{R2}+2)} & \ldots & y'_{((\text{C2-1})\times\text{R2}+2)} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ y'_{\text{R2}} & y'_{(2\times\text{R2})} & y'_{(3\times\text{R2})} & \ldots & y'_{(\text{C2}\times\text{R2})} \end{bmatrix}$$

(5) The output of the block interleaver is the bit sequence read out column by column from the inter-column permuted R2 × C2 matrix. The output is pruned by deleting dummy bits that were padded to the input of the matrix before the inter-column permutation, i.e. bits $y'_k$ that corresponds to bits $y_k$ with $k > U$ are removed from the output. The bits at the output of the block interleaver are denoted by $z_1, z_2, \ldots, z_U$ , where $z_1$

corresponds to the bit $y'_k$ with smallest index $k$ after pruning, $z_2$ to the bit $y'_k$ with second smallest index $k$ after pruning, and so on.

The bits $z_1, z_2, \ldots, z_U$ shall be segmented as follows:

$u_{1,k} = z_k$ $\quad k = 1, 2, \ldots, U_1$

$u_{2,k} = z_{(k+U_1)}$ $\quad k = 1, 2, \ldots, U_2$

…

$u_{P,k} = z_{(k+U_1+\ldots+U_{P-1})}$ $\quad k = 1, 2, \ldots, U_P$

The bits after frame related 2nd interleaving are denoted by $v_{t,1}, v_{t,2}, \ldots, v_{t,U_t}$, where $t$ refers to the timeslot sequence number and $U_t$ is the number of bits transmitted in this timeslot during the respective radio frame.

Let $T$ be the number of time slots in a CCTrCH during the respective radio frame (where for 1.28Mcps TDD, the respective radio frame includes subframes 1 and 2), and $t = 1, \ldots, T$. The physical layer shall assign the time slot sequence number $t$ in ascending order of the allocated time slots in the CCTrCH in the respective radio frame. In time slot $t$, $R_t$ refers to the number of physical channels within the respective time slot and $r = 1, \ldots, R_t$. The relation between $r$ and $t$ and the physical channel sequence number $p$ as detailed in 4.2.12~~13~~.1 is given by:

$$p = r \qquad t = 1$$

$$p = R_1 + R_2, \ldots, R_{t-1} + r \qquad 1 < t \leq T$$

Defining the relation $u_{t,r,k} = u_{p,k}$ and denoting $U_{tr}$ as the number of bits for physical channel $r$ in time slot $t$, the relation between $v_{t,k}$ and $u_{t,r,k}$ is given below:

$v_{t,k} = u_{t,1,k}$ $\quad k = 1, 2, \ldots, U_{t1}$

$v_{t,(k+U_{t1})} = u_{t,2,k}$ $\quad k = 1, 2, \ldots, U_{t2}$

…

$v_{t,(k+U_{t1}+\ldots+U_{t(R_t-1)})} = u_{t,R_t,k}$ $\quad k = 1, 2, \ldots, U_{tR_t}$

#### 4.2.11.2 Timeslot related 2nd interleaving

In case of timeslot related 2nd interleaving, the bits input to the block interleaver are denoted by $x_{t,1}, x_{t,2}, x_{t,3}, \ldots, x_{t,U_t}$, where $t$ is the timeslot sequence number, and $U_t$ is the number of bits transmitted in this timeslot during the respective radio frame.

Let $T$ be the number of time slots in a CCTrCH during the respective radio frame (where for 1.28Mcps TDD, the respective radio frame includes subframes 1 and 2), and $t = 1, \ldots, T$. The physical layer shall assign the time slot sequence number $t$ in ascending order of the allocated time slots in the CCTrCH in the respective radio frame. In timeslot $t$, $R_t$ refers to the number of physical channels within the respective timeslot and $r = 1, \ldots, R_t$. The relation between $r$ and $t$ and the physical channel sequence number $p$ as detailed in 4.2.12~~13~~.1 is given by:

$$p = r \qquad t = 1$$

$$p = R_1 + R_2, \ldots, R_{t-1} + r \qquad 1 < t \leq T$$

Defining the relation $u_{t,r,k} = u_{p,k}$ and denoting $U_{tr}$ as the number of bits for physical channel *r* in time slot *t*, the relation between $x_{t,k}$ and $u_{t,r,k}$ is given below:

$x_{t,k} = u_{t,1,k}$ $\qquad k = 1, 2, \ldots, U_{t1}$

$x_{t,(k+U_{t1})} = u_{t,2,k}$ $\qquad k = 1, 2, \ldots, U_{t2}$

…

$x_{t,(k+U_{t1}+\ldots+U_{t(R_t-1)})} = u_{t,R_t,k}$ $\qquad k = 1, 2, \ldots, U_{tR_t}$

The following steps have to be performed for each timeslot *t*, on which the respective CCTrCH is mapped:

(1) Assign C2 = 30 to be the number of columns of the matrix. The columns of the matrix are numbered 0, 1, 2, …, C2 - 1 from left to right.

(2) Determine the number of rows of the matrix, R2, by finding minimum integer R2 such that:

$U_t \leq \text{R2} \times \text{C2}$.

The rows of rectangular matrix are numbered 0, 1, 2, …, R2 - 1 from top to bottom.

(3) Write the input bit sequence $x_{t,1}, x_{t,2}, x_{t,3}, \ldots, x_{t,U_t}$ into the R2 × C2 matrix row by row starting with bit $y_{t,1}$ in column 0 of row 0:

$$\begin{bmatrix} y_{t,1} & y_{t,2} & y_{t,3} & \cdots & y_{t,\text{C2}} \\ y_{t,(\text{C2}+1)} & y_{t,(\text{C2}+2)} & y_{t,(\text{C2}+3)} & \cdots & y_{t,(2\times\text{C2})} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ y_{t,((\text{R2}-1)\times\text{C2}+1)} & y_{t,((\text{R2}-1)\times\text{C2}+2)} & y_{t,((\text{R2}-1)\times\text{C2}+3)} & \cdots & y_{t,(\text{R2}\times\text{C2})} \end{bmatrix}$$

where $y_{t,k} = x_{t,k}$ for $k = 1, 2, \ldots, U_t$ and if $\text{R2} \times \text{C2} > U_t$, the dummy bits are padded such that $y_{t,k}$ = 0 or 1 for $k = U_t + 1, U_t + 2, \ldots, \text{R2} \times \text{C2}$. These dummy bits are pruned away from the output of the matrix after the inter-column permutation.

(4) Perform the inter-column permutation for the matrix based on the pattern $\langle \text{P2}(j) \rangle_{j\in\{0,1,\ldots,\text{C2}-1\}}$ that is shown in table 7~~8~~, where P2(*j*) is the original column position of the *j*-th permuted column. After permutation of the columns, the bits are denoted by $y'_{t,k}$.

$$\begin{bmatrix} y'_{t,1} & y'_{t,(\text{R2}+1)} & y'_{t,(2\times\text{R2}+1)} & \cdots & y'_{t,((\text{C2}-1)\times\text{R2}+1)} \\ y'_{t,2} & y'_{t,(\text{R2}+2)} & y'_{t,(2\times\text{R2}+2)} & \cdots & y'_{t,((\text{C2}-1)\times\text{R2}+2)} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ y'_{t,\text{R2}} & y'_{t,(2\times\text{R2})} & y'_{t,(3\times\text{R2})} & \cdots & y'_{t,(\text{C2}\times\text{R2})} \end{bmatrix}$$

(5) The output of the block interleaver is the bit sequence read out column by column from the inter-column permuted R2 × C2 matrix. The output is pruned by deleting dummy bits that were padded to the input of the matrix before the inter-column permutation, i.e. bits $y'_{t,k}$ that corresponds to bits $y_{t,k}$ with $k > U_t$ are removed from the output. The bits after time slot 2nd interleaving are denoted by $v_{t,1}, v_{t,2}, \ldots, v_{t,U_t}$, where $v_{t,1}$ corresponds to the bit $y'_{t,k}$ with smallest index *k* after pruning, $v_{t,2}$ to the bit $y'_{t,k}$ with second smallest index *k* after pruning, and so on.

**Table 7~~8~~ Inter-column permutation pattern for 2nd interleaving**

| Number of Columns C2 | Inter-column permutation pattern < P2(0), P2(1), …, P2(C2-1) > |
|---|---|
| 30 | <0, 20, 10, 5, 15, 25, 3, 13, 23, 8, 18, 28, 1, 11, 21, 6, 16, 26, 4, 14, 24, 19, 9, 29, 12, 2, 7, 22, 27, 17> |

## 4.2.11A~~12~~ Sub-frame segmentation for the 1.28 Mcps option

In the 1.28Mcps TDD, it is needed to add a sub-frame segmentation unit between 2nd interleaving unit and physical channel mapping unit. The operation of rate-matching guarantees that the bit streams is a even number and can be subdivided into 2 sub-frames. The transport channel multiplexing structure for uplink and downlink is shown in figure 1A~~2~~.

The input bit sequence is denoted by $x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$ where i is the TrCH number and $X_i$ is the number bits. The two output bit sequences per radio frame are denoted by $y_{i,n_i1}, y_{i,n_i2}, y_{i,n_i3}, \ldots, y_{i,n_iY_i}$ where ni is the sub-frame number in current radio frame and $Y_i$ is the number of bits per radio frame for TrCH i. The output sequences are defined as follows:

$y_{i,n_ik} = x_{i,((n_i-1)Y_i)+k}$ , $n_i$ = 1 or 2, k = 1…$Y_i$

where

$Y_i = (X_i / 2)$ is the number of bits per sub-frame,

$x_{ik}$ is the k^th bit of the input bit sequence and

$y_{i,n_ik}$ is the k^th bit of the output bit sequence corresponding to the n^th sub-frame

The input bit sequence to the sub-frame segmentation is denoted by $v_{t,1}, v_{t,2}, v_{t,3}, \ldots, v_{t,U_t}$ , $x_{ik} = v_{t,k}$ and $X_i = U_t$.

The output bit sequence corresponding to subframe $n_i$ is denoted by $g_{p1}, g_{p2}, \ldots, g_{pU_p}$ , where p is the PhCH number and $U_p$ is the number of bits in one subframe for the respective PhCH. Hence, $g_{pk} = y_{i,n_ik}$ and $U_p = Y_i$.

## 4.2.12~~13~~ Physical channel mapping

### 4.2.12~~13~~.1 Physical channel mapping for the 3.84 Mcps option

The PhCH for both uplink and downlink is defined in [6]. The bits after physical channel mapping are denoted by $w_{p,1}, w_{p,2}, \ldots, w_{p,U_p}$ , where *p* is the PhCH number corresponding to the sequence number $1 \le p \le P$ of this physical channel as detailed below, $U_p$ is the number of bits in one radio frame for the respective PhCH, and $P \le P_{max}$. The bits $w_{p,k}$ are mapped to the PhCHs so that the bits for each PhCH are transmitted over the air in ascending order with respect to *k*.

The physical layer shall assign the physical channel sequence number *p* to the physical channels of the CCTrCH in the respective radio frame, treating each allocated timeslot in ascending order. If within a timeslot there are multiple physical channels they shall first be ordered in ascending order of the spreading factor (*Q*) and subsequently by channelisation code index (*k*), as shown in [9].

The mapping of the bits $v_{t,1}, v_{t,2}, \ldots, v_{t,U_t}$ is performed like block interleaving, writing the bits into columns, but a PhCH with an odd number is filled in forward order, whereas a PhCH with an even number is filled in reverse order.

The mapping scheme, as described in the following subclause, shall be applied individually for each timeslot *t* used in the current frame. Therefore, the bits $v_{t,1}, v_{t,2}, \ldots, v_{t,U_t}$ are assigned to the bits of the physical channels $w_{t,1,1\ldots U_{t1}}, w_{t,2,1\ldots U_{t2}}, \ldots, w_{t,P_t,1\ldots U_{tP_t}}$ in each timeslot.

In uplink there are at most two codes allocated (P≤2). If there is only one code, the same mapping as for downlink is applied. Denote SF1 and SF2 the spreading factors used for code 1 and 2, respectively. For the number of consecutive bits to assign per code $bs_k$ the following rule is applied:

if

SF1 >= SF2 then $bs_1$ = 1 ; $bs_2$ = SF1/SF2 ;

else

SF2 > SF1 then $bs_1$ = SF2/SF1; $bs_2$ = 1 ;

end if

In the downlink case $bs_p$ is 1 for all physical channels.

#### 4.2.12~~13~~.1.1 Mapping scheme

Notation used in this subclause:

$P_t$: number of physical channels for timeslot t , $P_t$ = 1..2 for uplink ; $P_t$ = 1...16 for downlink

$U_{t,p}$: capacity in bits for the physical channel p in timeslot t

$U_t$: total number of bits to be assigned for timeslot t

$bs_p$: number of consecutive bits to assign per code

for downlink all $bs_p$ = 1

for uplink if SF1 >= SF2 then $bs_1$ = 1 ; $bs_2$ = SF1/SF2 ;

if SF2 > SF1 then $bs_1$ = SF2/SF1; $bs_2$ = 1 ;

$fb_p$: number of already written bits for each code

pos: intermediate calculation variable

```
for  p=1  to P_t                          -- reset number of already written bits for every physical channel
   fb_p = 0
end for
p = 1                                     -- start with PhCH #1
for k=1  to U_t
   do while (fb_p == U_t,p)               -- physical channel filled up already ?
      p = (p mod P_t) + 1;
   end do
   if (p mod 2) == 0
      pos = U_t,p - fb_p                  -- reverse order
   else
      pos = fb_p + 1                      -- forward order
```

endif

$w_{t,p,pos} = v_{t,k}$ -- assignment

$fb_p = fb_p + 1$ -- Increment number of already written bits

if ($fb_p$ mod $bs_p$) == 0 -- Conditional change to the next physical channel

p = (p mod $P_t$) + 1;

end if

end for

### 4.2.12~~13~~.2 Physical channel mapping for the 1.28 Mcps option

The bit streams from the sub-frame segmentation unit are mapped onto code channels of time slots in sub-frames.

The bits after physical channel mapping are denoted by $w_{p1}, w_{p2}, \dots, w_{pU_p}$, where p is the PhCH number and Up is the number of bits in one sub-frame for the respective PhCH. The bits wpk are mapped to the PhCHs so that the bits for each PhCH are transmitted over the air in ascending order with respect to k.

The mapping of the bits $g_{p1}, g_{p2}, \dots, g_{pU_p}$ is performed like block interleaving, writing the bits into columns, but a PhCH with an odd number is filled in forward order, were as a PhCH with an even number is filled in reverse order.

The mapping scheme, as described in the following subclause, shall be applied individually for each timeslot t used in the current subframe. Therefore, the bits $g_{p1}, g_{p2}, \dots, g_{pU_p}$ are assigned to the bits of the physical channels $w_{t1,1\dots U_{t1}}, w_{t2,1\dots U_{t2}}, \dots, w_{tP_t,1\dots U_{tP_t}}$ in each timeslot.

In uplink there are at most two codes allocated (P≤2). If there is only one code, the same mapping as for downlink is applied. Denote SF1 and SF2 the spreading factors used for code 1 and 2, respectively. For the number of consecutive bits to assign per code bsk the following rule is applied:

if

SF1 >= SF2 then $bs_1 = 1$ ; $bs_2$ = SF1/SF2 ;

else

SF2 > SF1 then $bs_1$ = SF2/SF1; $bs_2 = 1$ ;

end if

In the downlink case $bs_p$ is 1 for all physical channels.

#### 4.2.12~~13~~.2.1 Mapping scheme

Notation used in this subclause:

$P_t$: number of physical channels for timeslot t , $P_t$ = 1..2 for uplink ; $P_t$ = 1...16 for downlink

$U_{tp}$: capacity in bits for the physical channel p in timeslot t

$U_t$.: total number of bits to be assigned for timeslot t

$bs_p$: number of consecutive bits to assign per code

for downlink all $bs_p = 1$

for uplink if SF1 >= SF2 then $bs_1 = 1$ ; $bs_2$ = SF1/SF2 ;

if SF2 > SF1 then $bs_1$ = SF2/SF1; $bs_2 = 1$ ;

$fb_p$: number of already written bits for each code

pos: intermediate calculation variable

```
for p=1 to P t          -- reset number of already written bits for every physical channel
fbp = 0
end for
p = 1                   -- start with PhCH #1
for k=1 to Ut.
do while (fbp == Ut,p)  -- physical channel filled up already ?
p = (p mod P t) + 1 ;
end do
if (p mod 2) == 0
pos = Ut,p - fbp        -- reverse order
else
pos = fbp + 1           -- forward order
end if
wtp,pos = gt,k          -- assignment
fbp = fbp + 1           -- Increment number of already written bits
If (fbp mod bsp) == 0   -- Conditional change to the next physical channel
p = (p mod P t) + 1 ;
end if
end for
```

### 4.2.1314 Multiplexing of different transport channels onto one CCTrCH, and mapping of one CCTrCH onto physical channels

Different transport channels can be encoded and multiplexed together into one Coded Composite Transport Channel (CCTrCH). The following rules shall apply to the different transport channels which are part of the same CCTrCH:

1) Transport channels multiplexed into one CCTrCh shall have co-ordinated timings. When the TFCS of a CCTrCH is changed because one or more transport channels are added to the CCTrCH or reconfigured within the CCTrCH, or removed from the CCTrCH, the change may only be made at the start of a radio frame with CFN fulfilling the relation

   CFN mod $F_{max}$ = 0,

   where $F_{max}$ denotes the maximum number of radio frames within the transmission time intervals of all transport channels which are multiplexed into the same CCTrCH, including any transport channels *i* which are added reconfigured or have been removed, and CFN denotes the connection frame number of the first radio frame of the changed CCTrCH.

   After addition or reconfiguration of a transport channel *i* within a CCTrCH, the TTI of transport channel *i* may only start in radio frames with CFN fulfilling the relation

   $CFN_i$ mod $F_i$ = 0.

2) Different CCTrCHs cannot be mapped onto the same physical channel.

3) One CCTrCH shall be mapped onto one or several physical channels.

4) Dedicated Transport channels and common transport channels cannot be multiplexed into the same CCTrCH.

5) For the common transport channels, only the FACH and PCH may belong to the same CCTrCH.

6) Each CCTrCH carrying a BCH shall carry only one BCH and shall not carry any other Transport Channel.

7) Each CCTrCH carrying a RACH shall carry only one RACH and shall not carry any other Transport Channel.

Hence, there are two types of CCTrCH.

CCTrCH of dedicated type, corresponding to the result of coding and multiplexing of one or several DCH.

CCTrCH of common type, corresponding to the result of the coding and multiplexing of a common channel, i.e. RACH and USCH in the uplink and DSCH, BCH, FACH or PCH in the downlink, respectively.

Transmission of TFCI is possible for CCTrCH containing Transport Channels of:

- dedicated type;
- USCH type;
- DSCH type;
- FACH and/or PCH type.

#### 4.2.13~~14~~.1 Allowed CCTrCH combinations for one UE

##### 4.2.13~~14~~.1.1 Allowed CCTrCH combinations on the uplink

The following CCTrCH combinations for one UE are allowed, also simultaneously:

1) several CCTrCH of dedicated type;

2) several CCTrCH of common type.

##### 4.2.13~~14~~.1.2 Allowed CCTrCH combinations on the downlink

The following CCTrCH combinations for one UE are allowed, also simultaneously:

3) several CCTrCH of dedicated type;

4) several CCTrCH of common type.

### 4.2.14~~15~~ Transport format detection

Transport format detection can be performed both with and without Transport Format Combination Indicator (TFCI). If a TFCI is transmitted, the receiver detects the transport format combination from the TFCI. When no TFCI is transmitted, so called blind transport format detection may be used, i.e. the receiver side uses the possible transport format combinations as a priori information.

#### 4.2.14~~15~~.1 Blind transport format detection

Blind Transport Format Detection is optional both in the UE and the UTRAN. Therefore, for all CCTrCH a TFCI shall be transmitted, including the possibility of a TFCI code word length zero, if only one TFC is defined.

#### 4.2.14~~15~~.2 Explicit transport format detection based on TFCI

##### 4.2.14~~15~~.2.1 Transport Format Combination Indicator (TFCI)

The Transport Format Combination Indicator (TFCI) informs the receiver of the transport format combination of the CCTrCHs. As soon as the TFCI is detected, the transport format combination, and hence the individual transport channels' transport formats are known, and decoding of the transport channels can be performed.

## 4.3 Coding for layer 1 control for the 3.84 Mcps option

### 4.3.1 Coding of transport format combination indicator (TFCI)

Encoding of the TFCI depends on its length. If there are 6-10 bits of TFCI the channel encoding is done as described in subclause 4.3.1.1. Also specific coding of less than 6 bits is possible as explained in subclause 4.3.1.2.

#### 4.3.1.1 Coding of long TFCI lengths

The TFCI is encoded using a (32, 10) sub-code of the second order Reed-Muller code. The coding procedure is as shown in figure 6~~7~~.

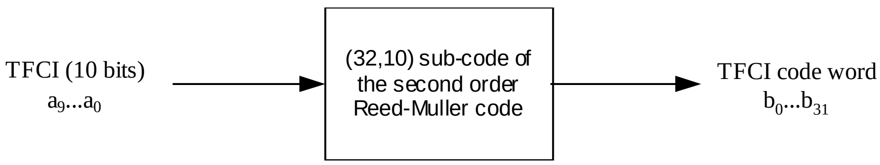


**Figure 6~~7~~: Channel coding of the TFCI bits**

If the TFCI consists of less than 10 bits, it is padded with zeros to 10 bits, by setting the most significant bits to zero. TFCI is encoded by the (32,10) sub-code of second order Reed-Muller code. The code words of the (32,10) sub-code of second order Reed-Muller code are linear combination of some among 10 basis sequences. The basis sequences are as follows in table 8~~9~~.

**Table 89: Basis sequences for (32,10) TFCI code**

| I | $M_{i,0}$ | $M_{i,1}$ | $M_{i,2}$ | $M_{i,3}$ | $M_{i,4}$ | $M_{i,5}$ | $M_{i,6}$ | $M_{i,7}$ | $M_{i,8}$ | $M_{i,9}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 2 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 3 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 4 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 5 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 6 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 7 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 8 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |
| 9 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| 10 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 11 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 12 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 13 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 14 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 15 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| 16 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| 17 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 |
| 18 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| 19 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| 20 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 21 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| 22 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 |
| 23 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| 24 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 25 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| 26 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 |
| 27 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 28 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 29 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 30 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 31 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |

The TFCI bits $a_0$ , $a_1$ , $a_2$ , $a_3$ , $a_4$ , $a_5$ , $a_6$ , $a_7$ , $a_8$ , $a_9$ (where $a_0$ is LSB and $a_9$ is MSB) shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the CCTrCH in the associated DPCH radio frame.

The output TFCI code word bits $b_i$ are given by:

$$b_i = \sum_{n=0}^{9} (a_n \times M_{i,n}) \bmod 2$$

where $i$ = 0,…,31. $N_{TFCI\ code\ word}$ = 32.

### 4.3.1.2 Coding of short TFCI lengths

#### 4.3.1.2.1 Coding very short TFCIs by repetition

If the number of TFCI bits is 1 or 2, then repetition will be used for coding. In this case each bit is repeated to a total of 4 times giving 4-bit transmission ($N_{TFCI\ code\ word}$ =4) for a single TFCI bit and 8-bit transmission ($N_{TFCI\ code\ word}$ =8) for 2 TFCI bits. The TFCI bit(s) $b_0$ (or $b_0$ and $b_1$ where $b_0$ is the LSB) shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the CCTrCH in the associated DPCH radio frame. In the case of two TFCI bits denoted $b_0$ and $b_1$ the TFCI code word shall be { $b_0$, $b_1$, $b_0$, $b_1$, $b_0$, $b_1$, $b_0$, $b_1$ }.

#### 4.3.1.2.2 Coding short TFCIs using bi-orthogonal codes

If the number of TFCI bits is in the range 3 to 5 the TFCI is encoded using a (16, 5) bi-orthogonal (or first order Reed-Muller) code. The coding procedure is as shown in figure 78.

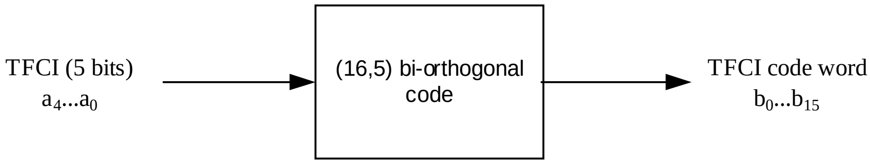


**Figure 78: Channel coding of short length TFCI bits**

If the TFCI consists of less than 5 bits, it is padded with zeros to 5 bits, by setting the most significant bits to zero. The code words of the (16,5) bi-orthogonal code are linear combinations of 5 basis sequences as defined in table 910.

**Table 910: Basis sequences for (16,5) TFCI code**

| i | $M_{i,0}$ | $M_{i,1}$ | $M_{i,2}$ | $M_{i,3}$ | $M_{i,4}$ |
|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 | 0 | 1 |
| 2 | 1 | 1 | 0 | 0 | 1 |
| 3 | 0 | 0 | 1 | 0 | 1 |
| 4 | 1 | 0 | 1 | 0 | 1 |
| 5 | 0 | 1 | 1 | 0 | 1 |
| 6 | 1 | 1 | 1 | 0 | 1 |
| 7 | 0 | 0 | 0 | 1 | 1 |
| 8 | 1 | 0 | 0 | 1 | 1 |
| 9 | 0 | 1 | 0 | 1 | 1 |
| 10 | 1 | 1 | 0 | 1 | 1 |
| 11 | 0 | 0 | 1 | 1 | 1 |
| 12 | 1 | 0 | 1 | 1 | 1 |
| 13 | 0 | 1 | 1 | 1 | 1 |
| 14 | 1 | 1 | 1 | 1 | 1 |
| 15 | 0 | 0 | 0 | 0 | 1 |

The TFCI bits $a_0$ , $a_1$ , $a_2$ , $a_3$ , $a_4$ (where $a_0$ is LSB and $a_4$ is MSB) shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the CCTrCH in the associated DPCH radio frame.

The output code word bits $b_j$ are given by:

$$b_i = \sum_{n=0}^{4} (a_n \times M_{i,n}) \bmod 2$$

where $i$ = 0,…,15. $N_{\text{TFCI code word}}$ = 16.

#### 4.3.1.3 Mapping of TFCI code word

The mapping of the TFCI code word to the TFCI bit positions in a timeslot shall be as follows.

Denote the number of bits in the TFCI code word by $N_{\text{TFCI code word}}$, denote the TFCI code word bits by $b_k$ where k=0…$N_{\text{TFCI code word}}$ -1.

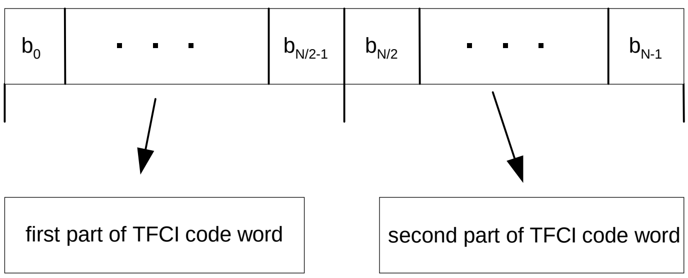


**Figure 89: Mapping of TFCI code word bits to timeslot**

The locations of the first and second parts of the TFCI code word in the timeslot is defined in [7].

If the shortest transmission time interval of any constituent TrCH is at least 20 ms the successive TFCI code words in the frames in the TTI shall be identical. If TFCI is transmitted on multiple timeslots in a frame each timeslot shall have the same TFCI code word.

### 4.3.2 Coding and Bit Scrambling of the Paging Indicator

The paging indicator $P_q$, $q = 0, ..., N_{PI}-1$, $P_q \in \{0, 1\}$ is an identifier to instruct the UE whether there is a paging message for the groups of mobiles that are associated to the PI, calculated by higher layers, and the associated paging indicator $P_q$. The length $L_{PI}$ of the paging indicator is $L_{PI}=2$, $L_{PI}=4$ or $L_{PI}=8$ symbols. $N_{PIB} = 2*N_{PI}*L_{PI}$ bits are used for the paging indicator transmission in one radio frame. The mapping of the paging indicators to the bits $e_i$, $i = 1, ..., N_{PIB}$ is shown in table 1011.

**Table 1011: Mapping of the paging indicator**

| $P_q$ | Bits $\{e_{2Lpi*q+1}, e_{2Lpi*q+2}, ... ,e_{2Lpi*(q+1)}\}$ | Meaning |
|---|---|---|
| 0 | {0, 0, ..., 0} | There is no necessity to receive the PCH |
| 1 | {1, 1, ..., 1} | There is the necessity to receive the PCH |

If the number $S$ of bits in one radio frame available for the PICH is bigger than the number $N_{PIB}$ of bits used for the transmission of paging indicators, the sequence $e = \{e_1, e_2, ..., e_{NPIB}\}$ is extended by $S-N_{PIB}$ bits that are set to zero, resulting in a sequence $h = \{h_1, h_2, ..., h_S\}$:

$$h_k = e_k, \quad k = 1, ..., N_{PIB}$$
$$h_k = 0, \quad k = N_{PIB} + 1, ..., S$$

The bits $h_k$ , $k = 1, ..., S$ on the PICH then undergo bit scrambling as defined in section 4.2.9.

The bits $s_k$, $k = 1, ..., S$ output from the bit scrambler are then transmitted over the air as shown in [7].

## 4.4 Coding for layer 1 control for the 1.28 Mcps option

### 4.4.1 Coding of transport format combination indicator (TFCI) for QPSK

The coding of TFCI for 1.28Mcps TDD is same as that of 3.84Mcps TDD.cf.[4.3.1 'Coding of transport format combination indicator'].

#### 4.4.1.1 Mapping of TFCI code word

Denote the number of bits in the TFCI code word by $N_{TFCI\ code\ word}$, and denote the TFCI code word bits by $b_k$, where $k = 0, …, N_{TFCI\ code\ word}-1$

When the number of bits in the TFCI code word is 8, 16, 32, the mapping of the TFCI code word to the TFCI bit positions shall be as follows:

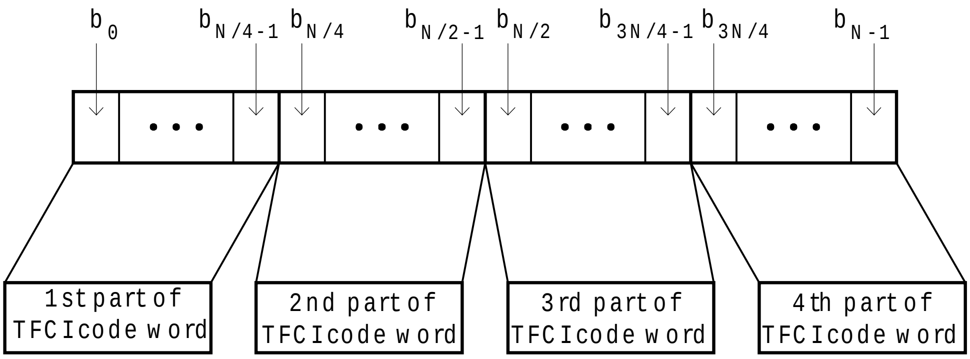


**Figure 9~~10~~: Mapping of TFCI code word bits to TFCI position in 1.28 Mcps TDD option, where N = $N_{\text{TFCI code word}}$.**

When the number of bits of the TFCI code word is 4 , then the TFCI code word is equally divided into two parts for the consecutive two subframe and mapped onto the end of the first data field in each of the consecutive subframes.The mapping for $N_{\text{TFCI code word}}$ =4 is shown in figure 10~~11~~:

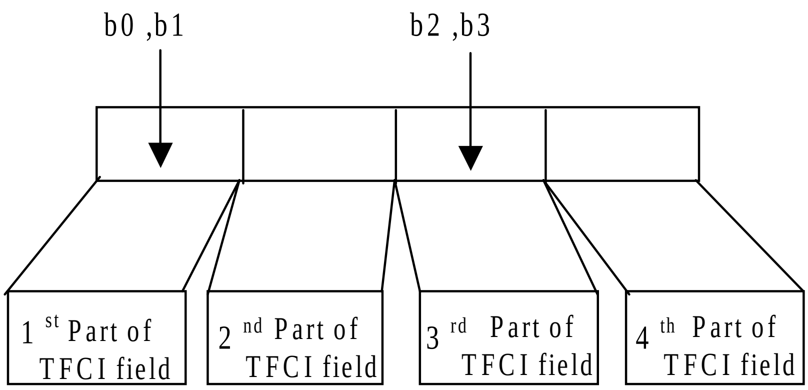


**Figure 10~~11~~: Mapping of TFCI code word bits to TFCI position in 1.28 Mcps TDD option, when $N_{\text{TFCI code word}}$ =4**

The location of the 1st to 4th parts of the TFCI code word in the timeslot is defined in [7].

If the shortest transmission time interval of any constituent TrCH is at least 20 ms, then successive TFCI code words in the frames within the TTI shall be identical. If a TFCI is transmitted on multiple timeslots in a frame each timeslot shall have the same TFCI code word.

## 4.4.2 Coding of transport format combination indicator (TFCI) for 8PSK

Encoding of TFCI bits depends on the number of them and the modulation in use. When 2 Mcps service is transmitted, 8PSK modulation is applied in 1.28 Mcps TDD option. The encoding scheme for TFCI when the number of bits are 6 – 10, and less than 6 bits is described in section 4.4.2.1 and 4.4.2.2, respectively.

### 4.4.2.1 Coding of long TFCI lengths

When the number of TFCI bits is 6 – 10, the TFCI bits are encoded by using a (64,10) sub-code of the second order Reed-Muller code, then 16 bits out of 64 bits are punctured (Puncturing positions are 0, 4, 8, 13, 16, 20, 27, 31, 34, 38, 41, 44, 50, 54, 57, 61st bits). The coding procedure is shown in Figure 11~~12~~.

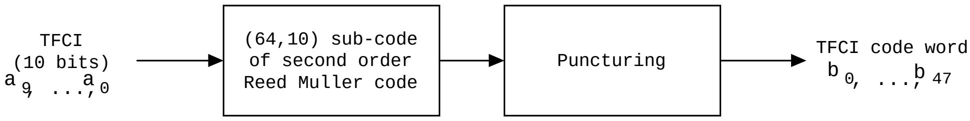


**Figure 11~~12~~: Channel coding of long TFCI bits for 8PSK**

If the TFCI consists of less than 10 bits, it is padded with zeros to 10 bits, by setting the most significant bits to zero. The code words of the punctured (48,10) sub-code of the second order Reed-Muller codes are linear combination of 10 basis sequences. The basis sequences are shown in Table 11~~12~~.

**Table 11~~12~~: Basis sequences for (48,10) TFCI code**

| I | $M_{i,0}$ | $M_{i,1}$ | $M_{i,2}$ | $M_{i,3}$ | $M_{I,4}$ | $M_{i,5}$ | $M_{i,6}$ | $M_{I,7}$ | $M_{I,8}$ | $M_{i,9}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| 2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 3 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| 4 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| 5 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| 6 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| 7 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 8 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| 9 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 10 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 11 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| 12 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| 13 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 |
| 14 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 |
| 15 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| 16 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 |
| 17 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 |
| 18 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| 19 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| 20 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| 21 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| 22 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 23 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| 24 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| 25 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| 26 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 27 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 28 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| 29 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 30 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 31 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 32 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 33 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 34 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |
| 35 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| 36 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| 37 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 |
| 38 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 39 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| 40 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| 41 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 42 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 43 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 44 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 45 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| 46 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| 47 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |

Let's define the TFCI bits as $a_0$ , $a_1$ , $a_2$ , $a_3$ , $a_4$ , $a_5$ , $a_6$ , $a_7$ , $a_8$ , $a_9$, where $a_0$ is the LSB and $a_9$ is the MSB. The TFCI bits shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the CCTrCH in the associated DPCH radio frame.

The output TFCI code word bits $b_i$ are given by:

$$b_i = \sum_{n=0}^{9} (a_n \times M_{i,n}) \bmod 2$$

where i=0…47. $N_{TFCI\ code\ word}$ =48.

### 4.4.2.2 Coding of short TFCI lengths

#### 4.4.2.2.1 Coding very short TFCIs by repetition

When the number of TFCI bits is 1 or 2, then repetition will be used for the coding. In this case, each bit is repeated to a total of 6 times giving 6-bit transmission ($N_{TFCI\ code\ word}$ = 6) for a single TFCI bit and 12-bit transmission ($N_{TFCI\ code\ word}$ = 12) for 2 TFCI bits. For a single TFCI bit $b_0$, the TFCI code word shall be {$b_0$, $b_0$, $b_0$, $b_0$, $b_0$, $b_0$}. For two TFCI bits $b_0$ and $b_1$, the TFCI code word shall be {$b_0$, $b_1$, $b_0$, $b_1$, $b_0$, $b_1$, $b_0$, $b_1$, $b_0$, $b_1$, $b_0$, $b_1$}.

#### 4.4.2.2.2 Coding short TFCIs using bi-orthogonal codes

If the number of TFCI bits is in the range of 3 to 5, the TFCI bits are encoded using a (32,5) first order Reed-Muller code, then 8 bits out of 32 bits are punctured (Puncturing positions are 0, 1, 2, 3, 4, 5, 6, $7^{th}$ bits). The coding procedure is shown in Figure 12~~13~~.

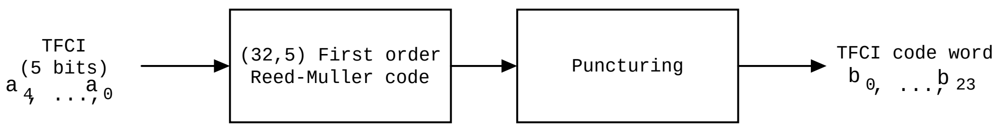


**Figure 12~~13~~: Channel coding of short TFCI bits for 8PSK**

If the TFCI consists of less than 5 bits, it is padded with zeros to 5 bits, by setting the most significant bits to zero. The code words of the punctured (32,5) first order Reed-Muller codes are linear combination of 5 basis sequences shown in Table 12~~13~~.

**Table 12~~13~~: Basis sequences for (24,5) TFCI code**

| I | $M_{i,0}$ | $M_{i,1}$ | $M_{i,2}$ | $M_{i,3}$ | $M_{i,4}$ |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 | 1 | 0 |
| 2 | 0 | 1 | 0 | 1 | 0 |
| 3 | 1 | 1 | 0 | 1 | 0 |
| 4 | 0 | 0 | 1 | 1 | 0 |
| 5 | 1 | 0 | 1 | 1 | 0 |
| 6 | 0 | 1 | 1 | 1 | 0 |
| 7 | 1 | 1 | 1 | 1 | 0 |
| 8 | 0 | 0 | 0 | 0 | 1 |
| 9 | 1 | 0 | 0 | 0 | 1 |
| 10 | 0 | 1 | 0 | 0 | 1 |
| 11 | 1 | 1 | 0 | 0 | 1 |
| 12 | 0 | 0 | 1 | 0 | 1 |
| 13 | 1 | 0 | 1 | 0 | 1 |
| 14 | 0 | 1 | 1 | 0 | 1 |
| 15 | 1 | 1 | 1 | 0 | 1 |
| 16 | 0 | 0 | 0 | 1 | 1 |
| 17 | 1 | 0 | 0 | 1 | 1 |
| 18 | 0 | 1 | 0 | 1 | 1 |
| 19 | 1 | 1 | 0 | 1 | 1 |
| 20 | 0 | 0 | 1 | 1 | 1 |
| 21 | 1 | 0 | 1 | 1 | 1 |
| 22 | 0 | 1 | 1 | 1 | 1 |
| 23 | 1 | 1 | 1 | 1 | 1 |

Let's define the TFCI bits as $a_0$ , $a_1$ , $a_2$ , $a_3$ , $a_4$, where $a_0$ is the LSB and $a_4$ is the MSB. The TFCI bits shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the CCTrCH in the associated DPCH radio frame.

The output code word bits $b_i$ are given by:

$$b_i = \sum_{n=0}^{4} (a_n \times M_{i,n}) \bmod 2$$

where i=0…23. $N_{TFCI\ code\ word}$ =24.

#### 4.4.2.3 Mapping of TFCI code word

Denote the number of bits in the TFCI code word by $N_{TFCI\ code\ word}$, and denote the TFCI code word bits by $b_k$, where k = 0, …, $N_{TFCI\ code\ word}$ -1.

When the number of bits in the TFCI code word is 12, 24 or 48, the mapping of the TFCI code word to the TFCI bit positions in a time slot shall be as follows.

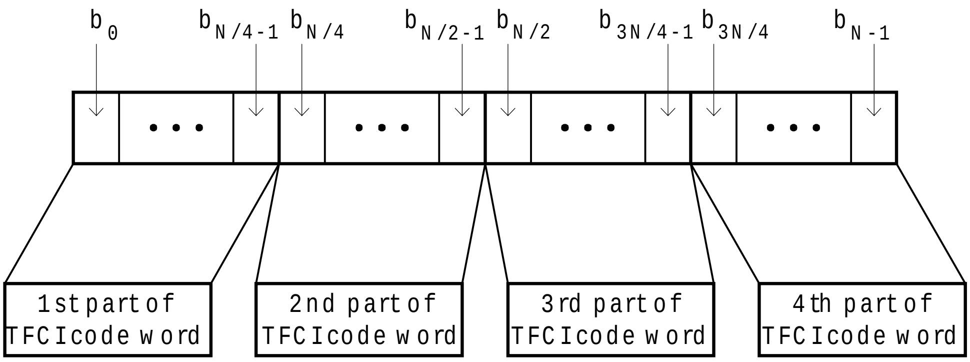


**Figure 13~~14~~: Mapping of TFCI code word bits to timeslot in 1.28 Mcps TDD option, where N = $N_{TFCI\ code\ word}$.**

When the number of bits in the TFCI code word is 6, the TFCI code word is equally divided into two parts for the consecutive two sub-frames and mapped onto the first data field in each of the consecutive sub-frames. The mapping of the TFCI code word to the TFCI bit positions in a time slot shall be as shown in figure 14~~15~~.

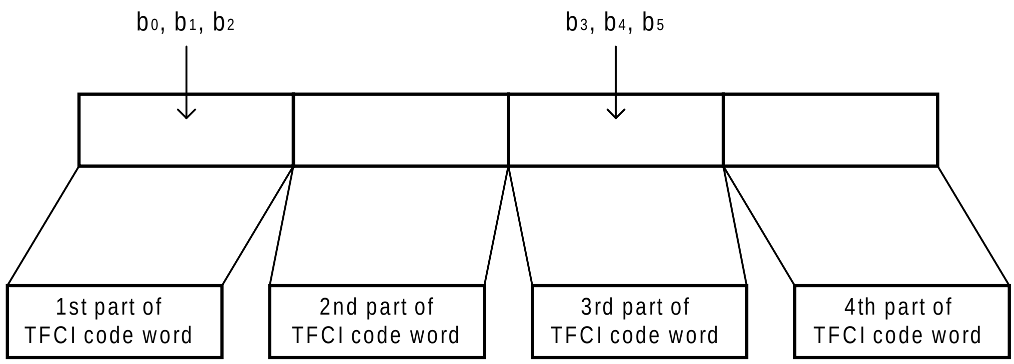


**Figure 14~~15~~: Mapping of TFCI code word bits to timeslot in 1.28 Mcps TDD option when $N_{TFCI\ code\ word}$ = 6**

The location of the 1st to 4th parts of the TFCI code word in the timeslot is defined in [7].

### 4.4.3 Coding and Bit Scrambling of the Paging Indicator

The paging indicator $P_q$, $q = 0, ..., N_{PI}-1$, $P_q \in \{0, 1\}$ is an identifier to instruct the UE whether there is a paging message for the groups of mobiles that are associated to the PI, calculated by higher layers, and the associated paging indicator $P_q$. The length $L_{PI}$ of the paging indicator is $L_{PI}=2$, $L_{PI}=4$ or $L_{PI}=8$ symbols. $N_{PIB} = 2*N_{PI}*L_{PI}$ bits are used for the paging indicator transmission in one radio frame. The mapping of the paging indicators to the bits $e_i$, $i = 1, ..., N_{PIB}$ is shown in table 13~~14~~.

**Table 13~~14~~: Mapping of the paging indicator**

| $P_q$ | Bits $\{e_{2L_{PI}*q+1}, e_{2L_{PI}*q+2}, ..., e_{2L_{PI}*(q+1)}\}$ | Meaning |
|---|---|---|
| 0 | {0, 0, ..., 0} | There is no necessity to receive the PCH |
| 1 | {1, 1, ..., 1} | There is the necessity to receive the PCH |

If the number $S$ of bits in one radio frame available for the PICH is bigger than the number $N_{PIB}$ of bits used for the transmission of paging indicators, the sequence $e = \{e_1, e_2, ..., e_{NPIB}\}$ is extended by $S-N_{PIB}$ bits that are set to zero, resulting in a sequence $h = \{h_1, h_2, ..., h_S\}$:

$$_k = e_k, \quad k = 1, ..., N_{PIB}$$
$$_k = 0, \quad k = N_{PIB}+1, ..., S$$

The bits $h_k$ , $k = 1, ..., S$ on the PICH then undergo bit scrambling as defined in section 4.2.9.

The bits $s_k$, $k = 1, ..., S$ output from the bit scrambler are then transmitted over the air as shown in [7].

### 4.4.4 Coding of the Fast Physical Access Channel (FPACH) information bits

The FPACH burst is composed by 32 information bits which are block coded and convolutional coded, and then delivered in one sub-frame as follows:

1. The 32 information bits are protected by 8 parity bits for error detection as described in sub-clause 4.2.1.1.
2. Convolutional code with constraint length 9 and coding rate ½ is applied as described in sub-clause 4.2.3.1. The size of data block c(k) after convolutional encoder is 96 bits.
3. To adjust the size of the data block c(k) to the size of the FPACH burst, 8 bits are punctured as described in sub-clause 4.2.7 with the following clarifications:

- $N_{i;j}$ =96 is the number of bits in a radio sub-frame before rate matching
- $\Delta N_{i,,j}$ = -8 is the number of bits to punctured in a radio sub-frame
- $e_{ini}$ = a x $N_{ij}$

The 88 bits after rate matching are then delivered to the intra-frame interleaving.

4. The bits in input to the interleaving unit are denoted as {x(0), …, x(87)}. The coded bits are block rectangular interleaved according to the following rule: the input is written row by row, the output is read column by column.

$$\begin{bmatrix} x(0) & x(1) & x(2) & \ldots\ x(7) \\ x(8) & x(9) & x(10) & \ldots x(15) \\ \vdots & \vdots & \vdots & \ldots\ \ \vdots \\ x(80) & x(81) & x(82) & \ldots x(87) \end{bmatrix}$$

Hence, the interleaved sequence is denoted by y (i) and are given by:

y(0), y(1), …, y(87)=x(0), x(8), …,x(80),x(1), …, x(87).

## 4.5 Coding for HS-DSCH

Figure 1516 illustrates the overall concept of transport-channel coding for HS-DSCH. Data arrives at the coding unit in the form of one transport block once every TTI. The TTI is 5 ms for 1.28 Mcps TDD and 10 ms for 3.84 Mcps TDD.

The following coding steps for HS-DSCH can be identified:

- add CRC to each transport block (see subclause 4.5.1);
- code block segmentation (see subclause 4.5.2);
- channel coding (see subclause 4.5.3);
- hybrid ARQ (see subclause 4.5.4);
- bit scrambling (see subclause 4.5.5);
- interleaving for HS-DSCH (see subclause 4.5.6);
- constellation re-arrangement for 16QAM (see subclause 4.5.7);
- mapping to physical channels (see subclause 4.5.8).

The coding steps for HS-DSCH are shown in figure 1615.

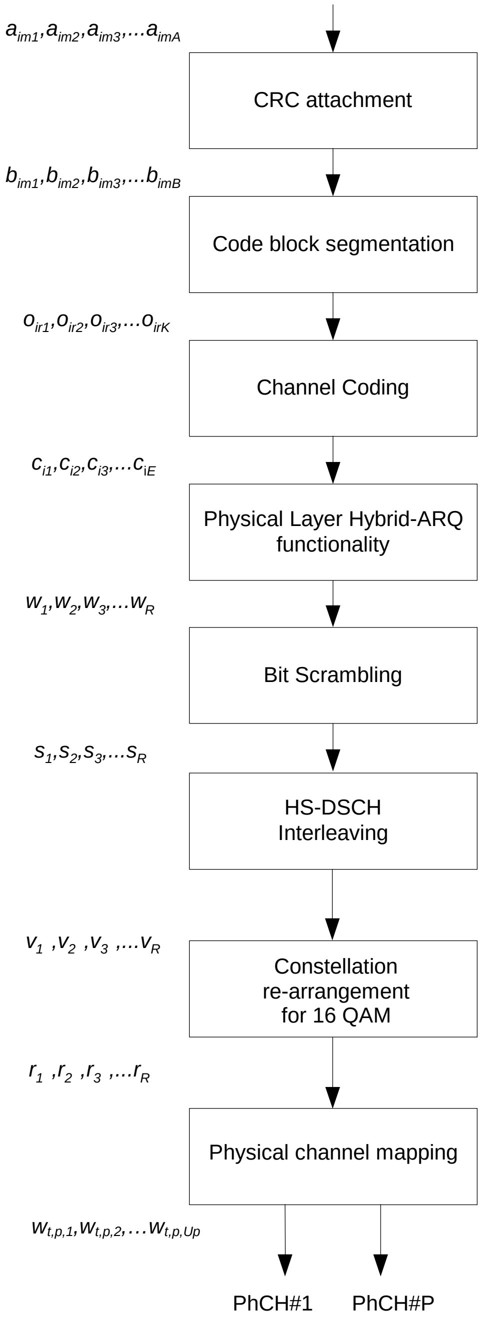


**Figure ~~16~~15. Coding chain for HS-DSCH**

In the following the number of transport blocks is always one. When referencing non HS-DSCH formulae which are used in correspondence with HS-DSCH formulae the convention is used that transport block subscripts may be omitted (e.g. $X_i$ when i is always 1 may be written X).

## 4.5.1 CRC attachment for HS-DSCH

A CRC of size 24 bits is calculated and added per HS-DSCH TTI. The CRC polynomial is defined in 4.2.1.1 with the following specific parameters: $i = 1$, $L_1 = 24$ bits.

## 4.5.2 Code block segmentation for HS-DSCH

Code block segmentation for the HS-DSCH transport channel shall be done with the general method described in 4.2.2.2 above with the following specific parameters.

There will only be one transport block, $i$ = 1. The bits $b_{im1}$, $b_{im2}$, $b_{im3}$,…$b_{imB}$ input to the block are mapped to the bits $x_{i1}$, $x_{i2}$, $x_{i3}$,…$x_{iX1}$ directly. It follows that $X_1 = B$. Note that the bits $x$ referenced here refer only to the internals of the code block segmentation function. The output bits from the code block segmentation function are $o_{ir1}$, $o_{ir2}$, $o_{ir3}$,…$o_{irK}$.

The value of Z = 5114 for turbo coding shall be used.

### 4.5.3 Channel coding for HS-DSCH

Channel coding for the HS-DSCH transport channel shall be done with the general method described in 4.2.3.2 above with the following specific parameters.

There will be a maximum of one transport block, $i$ = 1. The rate 1/3 turbo coding shall be used.

### 4.5.4 Hybrid ARQ for HS-DSCH

The hybrid ARQ functionality matches the number of bits at the output of the channel coder to the total number of bits of the HS-PDSCH set to which the HS-DSCH is mapped. The hybrid ARQ functionality is controlled by the redundancy version (RV) parameters. The exact set of bits at the output of the hybrid ARQ functionality depends on the number of input bits, the number of output bits, and the RV parameters.

The hybrid ARQ functionality consists of two rate-matching stages and a virtual buffer as shown in the figure below.

The first rate matching stage matches the number of input bits to the virtual IR buffer, information about which is provided by higher layers. Note that, if the number of input bits does not exceed the virtual IR buffering capability, the first rate-matching stage is transparent.

The second rate matching stage matches the number of bits after first rate matching stage to the number of physical channel bits available in the HS-PDSCH set in the TTI.

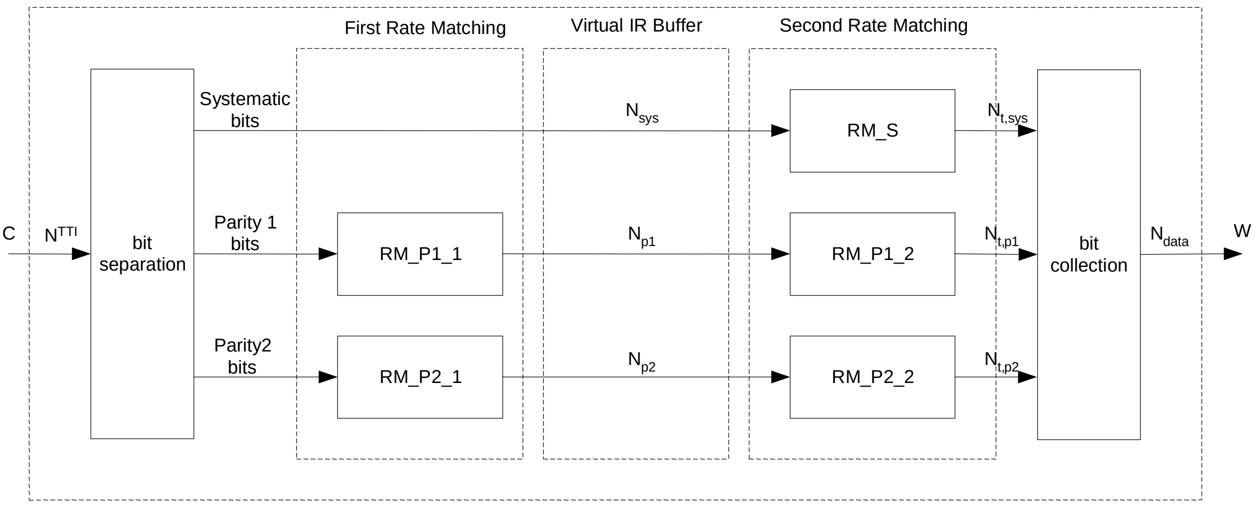


**Figure 16~~17~~: HS-DSCH hybrid ARQ functionality**

#### 4.5.4.1 HARQ bit separation

The HARQ bit separation function shall be performed in the same way as bit separation for turbo encoded TrCHs in 4.2.7.2 above.

#### 4.5.4.2 HARQ First Rate Matching Stage

HARQ first stage rate matching for the HS-DSCH transport channel shall be done with the general method described in 4.2.7.1.2 above with the following specific parameters.

The maximum number of soft bits available in the virtual IR buffer is $N_{IR}$ which is signalled from higher layers for each HARQ process. The number of coded bits in a TTI before rate matching is $N^{TTI}$ this is deduced from information signalled from higher layers and parameters signalled on the HS-SCCH for each TTI. Note that HARQ processing and physical layer storage occurs independently for each HARQ process currently active.

If $N_{IR}$ is greater than or equal to $N^{TTI}$ (i.e. all coded bits of the corresponding TTI can be stored) the first rate matching stage shall be transparent. This can, for example, be achieved by setting $e_{minus} = 0$. Note that no repetition is performed.

If $N_{IR}$ is smaller than $N^{TTI}$ the parity bit streams are punctured as in 4.2.7.1.2 above by setting the rate matching parameter $\Delta N_{il}^{TTI} = N_{IR} - N^{TTI}$ where the subscripts i and l refer to transport channel and transport format in the referenced sub-clause. Note the negative value is expected when the rate matching implements puncturing. Bits selected for puncturing which appear as δ in the algorithm in 4.2.7 above shall be discarded and not counted in the totals for the streams through the virtual IR buffer.

### 4.5.4.3 HARQ Second Rate Matching Stage

HARQ second stage rate matching for the HS-DSCH transport channel shall be done with the general method described in 4.2.7.3 above with the following specific parameters. Bits selected for puncturing which appear as $\delta$ in the algorithm in 4.2.7.3 above shall be discarded and are not counted in the streams towards the bit collection.

The parameters of the second rate matching stage depend on the value of the RV parameters s and r. The parameter s can take the value 0 or 1 to distinguish between transmissions that prioritise systematic bits (s = 1) and non systematic bits (s = 0). The parameter r (range 0 to $r_{max}$-1) changes the initial error variable $e_{ini}$ in the case of puncturing. In case of repetition both parameters *r* and *s* change the initial error variable $e_{ini}$. The parameters $X_i$, $e_{plus}$ and $e_{minus}$ are calculated as per table ~~15~~14 below.

Denote the number of bits before second rate matching as $N_{sys}$ for the systematic bits, $N_{p1}$ for the parity 1 bits, and $N_{p2}$ for the parity 2 bits, respectively. Denote the number of physical channels used for the HS-DSCH by *P*. $N_{data}$ is the number of bits available to the HS-DSCH in one TTI and defined as $N_{data}=P \times N_{Data/Slot}$, where $N_{Data/Slot}$ is defined in [7]. The rate matching parameters are determined as follows.

For $N_{data} \le N_{sys} + N_{p1} + N_{p2}$, puncturing is performed in the second rate matching stage. The number of transmitted systematic bits in a transmission is $N_{t,sys} = \min\{N_{sys}, N_{data}\}$ for a transmission that prioritises systematic bits and $N_{t,sys} = \max\{N_{data} - (N_{p1} + N_{p2}), 0\}$ for a transmission that prioritises non systematic bits.

For $N_{data} > N_{sys} + N_{p1} + N_{p2}$ repetition is performed in the second rate matching stage. A similar repetition rate in all bit streams is achieved by setting the number of transmitted systematic bits to $N_{t,sys} = \left\lfloor N_{sys} \cdot \frac{N_{data}}{N_{sys} + 2N_{p1}} \right\rfloor$.

The number of parity bits in a transmission is: $N_{t,p1} = \left\lfloor \frac{N_{data} - N_{t,sys}}{2} \right\rfloor$ and $N_{t,p2} = \left\lceil \frac{N_{data} - N_{t,sys}}{2} \right\rceil$ for the parity 1 and parity 2 bits, respectively.

Table ~~15~~14 below summarizes the resulting parameter choice for the second rate matching stage.

**Table ~~15~~14: Parameters for HARQ second rate matching**

| | $X_i$ | $e_{plus}$ | $e_{minus}$ |
|---|---|---|---|
| Systematic RM S | $N_{sys}$ | $N_{sys}$ | $\lvert N_{sys} - N_{t,sys} \rvert$ |
| Parity 1 RM P1_2 | $N_{p1}$ | $2 \cdot N_{p1}$ | $2 \cdot \lvert N_{p1} - N_{t,p1} \rvert$ |
| Parity 2 RM P2_2 | $N_{p2}$ | $N_{p2}$ | $\lvert N_{p2} - N_{t,p2} \rvert$ |

The rate matching parameter $e_{ini}$ is calculated for each bit stream according to the RV parameters r and s using

$e_{ini}(r) = \left\{\left(X_i - \lfloor r \cdot e_{plus} / r_{\max} \rfloor - 1\right) \bmod e_{plus}\right\} + 1$ in the case of puncturing, i.e., $N_{data} \le N_{sys} + N_{p1} + N_{p2}$,
and

$e_{ini}(r) = \left\{\left(X_i - \lfloor (s + 2 \cdot r) \cdot e_{plus} / (2 \cdot r_{\max}) \rfloor - 1\right) \bmod e_{plus}\right\} + 1$ for repetition, i.e., $N_{data} > N_{sys} + N_{p1} + N_{p2}$.

Where $r \in \{0, 1, \cdots, r_{\max} - 1\}$ and $r_{\max}$ is the total number of redundancy versions allowed by varying $r$ as defined in 4.6.1.4. Note that $r_{max}$ varies depending on the modulation mode, i.e. for 16QAM $r_{max} = 2$ and for QPSK $r_{max} = 4$.

Note: For the modulo operation the following clarification is used: the value of (x mod y) is strictly in the range of 0 to *y*-1 (i.e. -1 mod 10 = 9).

#### 4.5.4.4 HARQ bit collection

The HARQ bit collection is achieved using a rectangular interleaver of size $N_{row} \times N_{col}$.

The number of rows and columns are determined from:

$$N_{row} = 4 \text{ for 16QAM and } N_{row} = 2 \text{ for QPSK}$$

$$N_{col} = N_{data} / N_{row}$$

where $N_{data}$ is used as defined in 4.5.4.3 above.

Data is written into the interleaver column by column, and read out of the interleaver column by column.

$N_{t,sys}$ is the number of transmitted systematic bits. Intermediate values $N_r$ and $N_c$ are calculated using:

$$N_r = \left\lfloor \frac{N_{t,sys}}{N_{col}} \right\rfloor \text{ and } N_c = N_{t,sys} - N_r \cdot N_{col}.$$

If $N_c$=0, the systematic bits are written into rows 1…$N_r$.

Otherwise systematic bits are written into rows 1…$N_r+1$ in the first $N_c$ columns and, if $N_r > 0$, also into rows 1…$N_r$ in the remaining $N_{col}$-$N_c$ columns.

The remaining space is filled with parity bits. The parity bits are written column wise into the remaining rows of the respective columns. Parity 1 and 2 bits are written in alternating order, starting with a parity 2 bit in the first available column with the lowest index number.

In the case of 16QAM for each column the bits are read out of the interleaver in the order row 1, row 2, row 3, row 4. In the case of QPSK for each column the bits are read out of the interleaver in the order row1, row2.

### 4.5.5 Bit scrambling

The bit scrambling for HS-DSCH shall be done with the general method described in subclause 4.2.9.

### 4.5.6 Interleaving for HS-DSCH

The interleaving for TDD is done over all bits in the TTI, as shown in figure 17~~18a~~ when QPSK modulation is being used for the HS-DSCH, and figure ~~18b~~18 when 16-QAM modulation is being used. The bits input to the block interleaver are denoted by $s_1, s_2, s_3, \ldots, s_R$, where $R$ is the number of bits in one TTI.

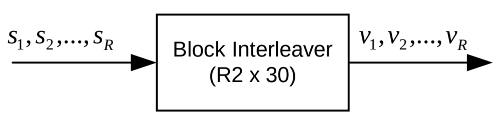


**Figure 17~~18a~~: Interleaver structure for HS-DSCH with QPSK modulation**

For QPSK, the interleaver is a block interleaver and consists of bits input to a matrix with padding, the inter-column permutation for the matrix and bits output from the matrix with pruning. The output bit sequence from the block interleaver is derived as follows:

(1) The number of columns of the matrix is 30. The columns of the matrix are numbered 0, 1, 2, …, 29 from left to right.

(2) Determine the number of rows of the matrix, $R2$, by finding minimum integer $R2$ such that $R \le 30 \times R2$. The rows of rectangular matrix are numbered 0, 1, 2, …, $R2 - 1$ from top to bottom.

(3) Write the input bit sequence $s_1, s_2, s_3, ..., s_R$ into the $R2 \times 30$ matrix row by row starting with bit $y_1$ in column 0 of row 0:

$$\begin{bmatrix} y_1 & y_2 & y_3 & \cdots & y_{30} \\ y_{31} & y_{32} & y_{33} & \cdots & y_{60} \\ \vdots & \vdots & \vdots & & \vdots \\ y_{30\cdot(R2-1)+1} & y_{30\cdot(R2-1)+2} & y_{30\cdot(R2-1)+3} & \cdots & y_{30\cdot R2} \end{bmatrix}$$

where $y_k = s_k$ for $k$ = 1, 2, …, $R$ and, if $R < 30 \times R2$, dummy bits are inserted for $k = R+1, R+2, …, 30 \times R2$. These dummy bits are pruned away from the output of the matrix after the inter-column permutation.

(4) Perform the inter-column permutation for the matrix based on the pattern $\langle P2(j) \rangle_{j \in \{0,1,...,29\}}$ that is shown in Table 78, where P2($j$) is the original column position of the $j$-th permuted column. After permutation of the columns, the bits are denoted by $y'_k$.

$$\begin{bmatrix} y'_1 & y'_{R2+1} & y'_{2\cdot R2+1} & \cdots & y'_{29\cdot R2+1} \\ y'_2 & y'_{R2+2} & y'_{2\cdot R2+2} & \cdots & y'_{29\cdot R2+2} \\ \vdots & \vdots & \vdots & & \vdots \\ y'_{R2} & y'_{2\cdot R2} & y'_{3\cdot R2} & \cdots & y'_{30\cdot R2} \end{bmatrix}$$

(5) The output of the block interleaver is the bit sequence read out column by column from the inter-column permuted $30 \times R2$ matrix. The output is pruned by deleting dummy bits that were padded to the input of the matrix before the inter-column permutation, i.e. bits $y'_k$ that corresponds to bits $y_k$ with $k > R$ are removed from the output. The bits after interleaving are denoted by $v_1, v_2, v_3, ..., v_R$, where $v_1$ corresponds to the bit $y'_k$ with smallest index $k$ after pruning, $v_2$ to the bit $y'_k$ with second smallest index $k$ after pruning, and so on.

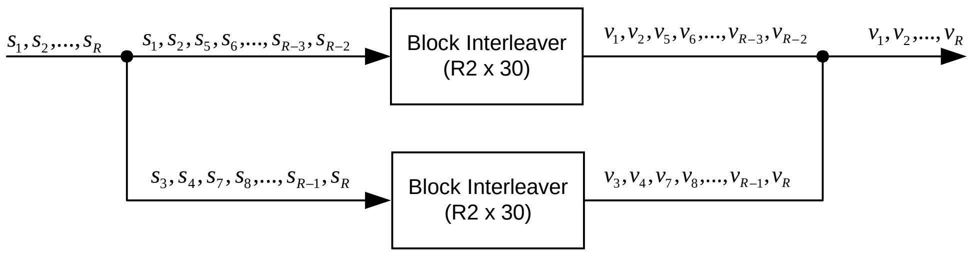


**Figure 1818b: Interleaver structure for HS-DSCH with 16-QAM modulation**

For 16QAM, a second identical interleaver operates in parallel to the first. For both interleavers, $R2$ is chosen to be the minimum integer that satisfies $R \le 60 \times R2$. The output bits from the bit scrambling operation are divided pairwise between the interleavers: bits $s_k$ and $s_{k+1}$ go to the first interleaver and bits $s_{k+2}$ and $s_{k+3}$ go to the second interleaver, where $k$ mod 4 = 1. Bits are collected pairwise from the interleavers: bits $v_k$ and $v_{k+1}$ are obtained from the first interleaver and bits $v_{k+2}$ and $v_{k+3}$ are obtained from the second interleaver, where again k mod 4 = 1.

## 4.5.7 Constellation re-arrangement for 16 QAM

This function only applies to 16 QAM modulated bits. In case of QPSK it is transparent.

The following table 1516 describes the operations that produce the different rearrangements.

The bits of the input sequence are mapped in groups of 4 so that $v_k$, $v_{k+1}$, $v_{k+2}$, $v_{k+3}$ are used, where k mod 4 = 1.

**Table 1516: Constellation re-arrangement for 16 QAM**

| Constellation version parameter *b* | Output bit sequence | Operation |
|---|---|---|
| 0 | $v_k v_{k+1} v_{k+2} v_{k+3}$ | None |
| 1 | $v_{k+2} v_{k+3} v_k v_{k+1}$ | Swapping MSBs with LSBs |
| 2 | $v_k v_{k+1} \overline{v_{k+2}}\, \overline{v_{k+3}}$ | Inversion of the logical values of LSBs |
| 3 | $v_{k+2} v_{k+3} \overline{v_k}\, \overline{v_{k+1}}$ | Swapping MSBs with LSBs, and inversion of the logical values of LSBs |

The output bit sequences from the table above map to the output bits in groups of 4, i.e. $r_k$, $r_{k+1}$, $r_{k+2}$, $r_{k+3}$, where k mod 4 = 1.

## 4.5.8 Physical channel mapping for HS-DSCH

The HS-PDSCH is defined in [7]. The bits input to the physical channel mapping are denoted by $r_1, r_2, ..., r_R$, where $R$ is the number of physical channel bits in the allocation for the current TTI. These bits are mapped to the physical channel bits, $\{w_{t,p,j} : t = 1, 2, ..., T; p = 1, 2, ..., C; j = 1, 2, ..., U_t\}$, where $t$ is the timeslot index, $T$ is the number of timeslots in the allocation message, $p$ is the physical channel index, $C$ is the number of codes per timeslot in the allocation message, $j$ is the physical channel bit index and $U_t$ is the number of bits per physical channel in timeslot $t$. The timeslot index, $t$, increases with increasing timeslot number; the physical channel index, $p$, increases with increasing channelisation code index, and the physical channel bit index, $j$, increases with increasing physical channel bit position in time.

The bits $r_k$ shall be mapped to the PhCHs according to the following rule :

Define $\{y_{t,k} : k = 1, 2, ..., C\cdot U_t\}$ to be the set of bits to be transmitted in timeslot $t$ as follows :

$y_{1,k} = r_k$ for $k = 1, 2, ..., C\cdot U_1$

$y_{2,k} = r_{k+C\cdot U_1}$ for $k = 1, 2, ..., C\cdot U_2$

…

$y_{T,k} = r_{k+C\sum_{t=1}^{T-1} U_t}$ for $k = 1, 2, ..., C\cdot U_T$

When the modulation level applied to the physical channels is 16- QAM :

The physical channel $p$ used to transmit the $k^{th}$ bit in the sequence $y_{t,k}$ is :

$$p = \left\lfloor \frac{k-1}{4} \right\rfloor \bmod C + 1$$

If $p$ is odd then :

$$w_{t,p,j} = y_{t,k} \text{ where } j = 4\cdot\left\lfloor \frac{k-1}{4\cdot C} \right\rfloor + (k-1) \bmod 4 + 1$$

If $p$ is even then :

$$w_{t,p,j} = y_{t,k} \text{ where } j = U_t - 4\cdot\left\lfloor \frac{k-1}{4\cdot C} \right\rfloor - 3 + (k-1) \bmod 4$$

Otherwise, when the modulation level applied to the physical channels is QPSK :

The physical channel $p$ used to transmit the $k^{\text{th}}$ bit in the sequence $y_{t,k}$ is :

$$p = (k-1) \bmod C + 1$$

If $p$ is odd then :

$$w_{t,p,j} = y_{t,k} \text{ where } j = \left\lfloor \frac{k-1}{C} \right\rfloor + 1$$

If $p$ is even then :

$$w_{t,p,j} = y_{y,k} \text{ where } j = U_t - \left\lfloor \frac{k-1}{C} \right\rfloor$$

# 4.6 Coding/Multiplexing for HS-SCCH

The following information, provided by higher layers, is transmitted by means of the HS-SCCH physical channel.

- Channelisation-code-set information (8 bits): $x_{ccs,1}$, $x_{ccs,2}$, …, $x_{ccs,8}$
- Time slot information ($n$ bits where $n$ = 5 for 1.28 Mcps TDD and $n$ = 13 for 3.84 Mcps TDD): $x_{ts,1}$, $x_{ts,2}$, …, $x_{ts,n}$
- Modulation scheme information (1 bit): $x_{ms,1}$
- Transport-block size information (m bits where m = 6 for 1.28 Mcps TDD and m = 9 for 3.84 Mcps TDD): $x_{tbs,1}$, $x_{tbs,2}$, …, $x_{tbs,m}$
- Hybrid-ARQ process information (3 bits): $x_{hap,1}$, $x_{hap,2}$, $x_{hap,3}$
- Redundancy version information (3 bits): $x_{rv,1}$, $x_{rv,2}$,$x_{rv,3}$
- New data indicator (1 bit): $x_{nd,1}$
- HS-SCCH cyclic sequence number (3 bits): $x_{hcsn,1}$, $x_{hcsn,2}$, $x_{hcsn,3}$
- UE identity (16 bits): $x_{ue,1}$, $x_{ue,2}$, …, $x_{ue,16}$

The following coding/multiplexing steps can be identified:

- multiplexing of HS-SCCH information (see subclause 4.6.2)
- CRC attachment (see subclause 4.6.3);
- channel coding (see subclause 4.6.4);
- rate matching (see subclause 4.6.5);
- interleaving for HS-SCCH (see subclause 4.6.6);
- mapping to physical channels (see subclauses 4.6.7 and 4.6.8).

The general coding/multiplexing flow is shown in Figure 19~~18c~~.

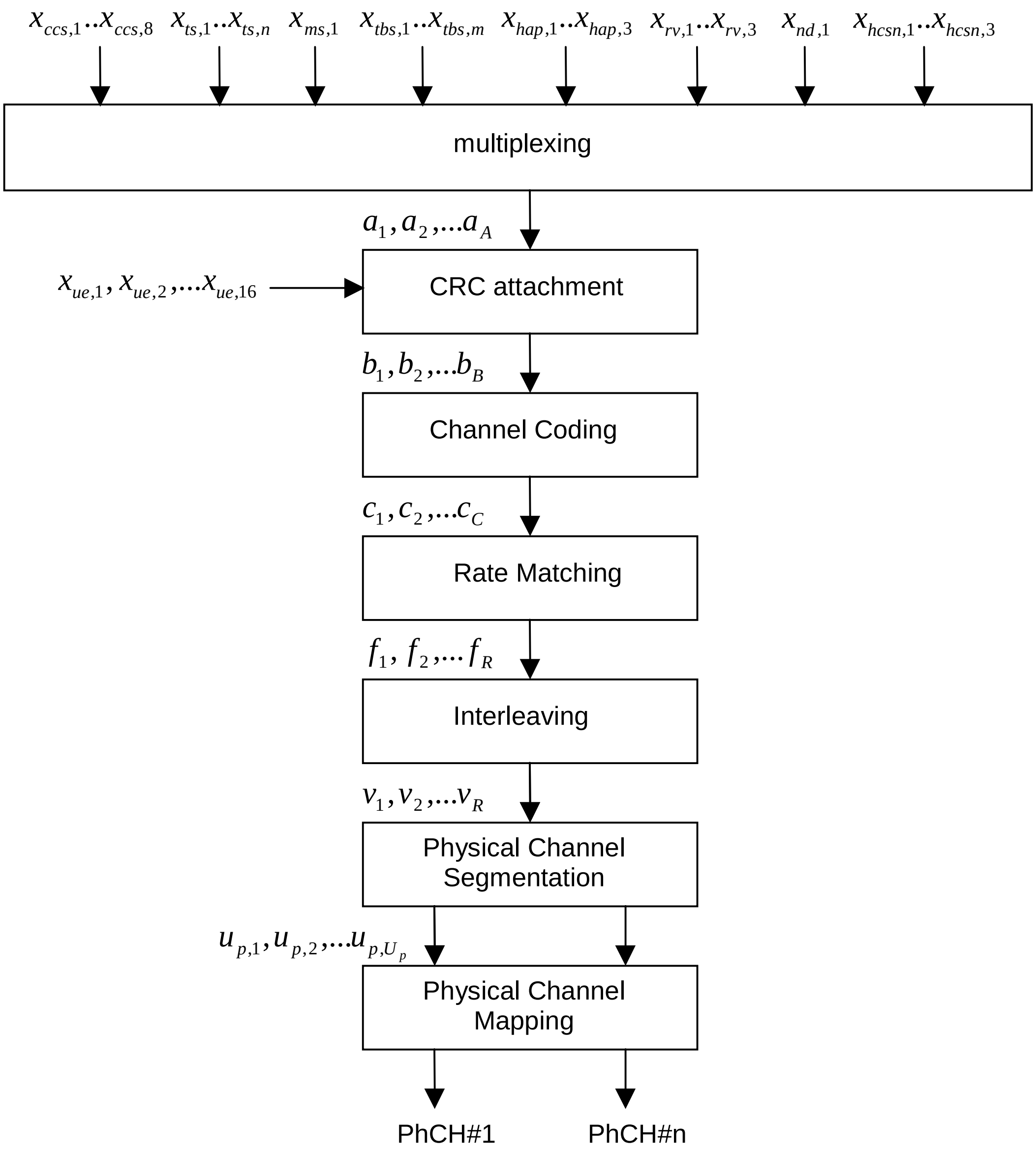


**Figure 18c19 Coding and Multiplexing for HS-SCCH**

## 4.6.1 HS-SCCH information field mapping

### 4.6.1.1 Channelisation code set information mapping

HS-PDSCH channelisation codes are allocated contiguously from a signalled start code to a signalled stop code, and the allocation includes both the start and stop code. The start code $k_{start}$ is signalled by the bits $x_{ccs,1}$, $x_{ccs,2}$, $x_{ccs,3}$, $x_{ccs,4}$ and the stop code $k_{stop}$ by the bits $x_{ccs,5}$, $x_{ccs,6}$, $x_{ccs,7}$, $x_{ccs,8}$. The mapping in Table 1617 below applies.

**Table 1617: Channelisation code set information mapping**

| $k_{start}$ | $x_{ccs,1}$ | $x_{ccs,2}$ | $x_{ccs,3}$ | $x_{ccs,4}$ | $k_{stop}$ | $x_{ccs,5}$ | $x_{ccs,6}$ | $x_{ccs,7}$ | $x_{ccs,8}$ |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 1 |
| 3 | 0 | 0 | 1 | 0 | 3 | 0 | 0 | 1 | 0 |
| 4 | 0 | 0 | 1 | 1 | 4 | 0 | 0 | 1 | 1 |
| 5 | 0 | 1 | 0 | 0 | 5 | 0 | 1 | 0 | 0 |
| 6 | 0 | 1 | 0 | 1 | 6 | 0 | 1 | 0 | 1 |
| 7 | 0 | 1 | 1 | 0 | 7 | 0 | 1 | 1 | 0 |
| 8 | 0 | 1 | 1 | 1 | 8 | 0 | 1 | 1 | 1 |
| 9 | 1 | 0 | 0 | 0 | 9 | 1 | 0 | 0 | 0 |
| 10 | 1 | 0 | 0 | 1 | 10 | 1 | 0 | 0 | 1 |
| 11 | 1 | 0 | 1 | 0 | 11 | 1 | 0 | 1 | 0 |
| 12 | 1 | 0 | 1 | 1 | 12 | 1 | 0 | 1 | 1 |
| 13 | 1 | 1 | 0 | 0 | 13 | 1 | 1 | 0 | 0 |
| 14 | 1 | 1 | 0 | 1 | 14 | 1 | 1 | 0 | 1 |
| 15 | 1 | 1 | 1 | 0 | 15 | 1 | 1 | 1 | 0 |
| 16 | 1 | 1 | 1 | 1 | 16 | 1 | 1 | 1 | 1 |

If a value of $k_{start}$ = 16 and $k_{stop}$ = 1 is signalled, a spreading factor of SF=1 shall be used for the HS-PDSCH resources. Other than this case, $k_{start} > k_{stop}$ shall be treated as an error by the UE.

#### 4.6.1.2 Timeslot information mapping

##### 4.6.1.2.1 1.28 Mcps TDD

For 1.28 Mcps, the timeslots to be used for HS-PDSCH resources are signalled by the bits $x_{ts,1}$, $x_{ts,2}$, …, $x_{ts,5}$, where bit $x_{ts,n}$ carries the information for timeslot n+1. Timeslots 0 and 1 cannot be used for HS-DSCH resources. If the signalling bit is set (i.e. equal to 1), then the corresponding timeslot shall be used for HS-PDSCH resources. Otherwise, the timeslot shall not be used. All used timeslots shall use the same channelisation code set, as signalled by the channelisation code set information bits.

##### 4.6.1.2.2 3.84 Mcps TDD

For 3.84 Mcps, the timeslots to be used for HS-PDSCH resources are signalled by the bits $x_{ts,1}$, $x_{ts,2}$, …, $x_{ts,13}$, where bit $x_{ts,n}$ carries the information for the n$^{th}$ available timeslot for HS-PDSCH resources, where the order of the timeslots available for HS-PDSCH resources shall be the same as the order of the 15 time slots within each frame with the following two slots removed:

- The slot containing the P-CCPCH
- The first slot in a frame containing the PRACH

If the P-CCPCH and/or PRACH are assigned to some, but not all frames, then the corresponding time slots shall remain unavailable for these frames as well..

If the bit is set (i.e. equal to 1), then the corresponding timeslot shall be used for HS-PDSCH resources. Otherwise, the timeslot shall not be used. All used timeslots shall use the same channelisation code set, as signalled by the channelisation code set information bits.

#### 4.6.1.3 Modulation scheme information mapping

The modulation scheme to be used by the HS-PDSCH resources shall be signalled by bit $x_{ms,1}$. The mapping scheme in Table 1718 shall apply.

**Table 1718: Modulation scheme information mapping**

| $x_{ms,1}$ | Modulation Scheme |
|---|---|
| 0 | QPSK |
| 1 | 16-QAM |

### 4.6.1.4 Redundancy and constellation version information mapping

The redundancy version (RV) parameters *r*, *s* and constellation version parameter *b* are mapped jointly to produce the value $X_{rv}$. $X_{rv}$ is alternatively represented as the sequence $x_{rv,1}$, $x_{rv,2}$, $x_{rv,3}$ where $x_{rv,1}$ is the MSB. This is done according to the following tables according to the modulation mode used:

**Table 1819: RV mapping for 16 QAM**

| $X_{rv}$ (value) | s | r | b |
|---|---|---|---|
| 0 | 1 | 0 | 0 |
| 1 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 |
| 3 | 0 | 1 | 1 |
| 4 | 1 | 0 | 1 |
| 5 | 1 | 0 | 2 |
| 6 | 1 | 0 | 3 |
| 7 | 1 | 1 | 0 |

**Table 1920: RV mapping for QPSK**

| $X_{rv}$ (value) | s | r |
|---|---|---|
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 2 | 1 | 1 |
| 3 | 0 | 1 |
| 4 | 1 | 2 |
| 5 | 0 | 2 |
| 6 | 1 | 3 |
| 7 | 0 | 3 |

### 4.6.1.5 HS-SCCH cyclic sequence number

The HS-SCCH cyclic sequence number is mapped such that $x_{hcsn,1}$ corresponds to the MSB and $x_{hcsn,3}$ to the LSB.

### 4.6.1.6 UE identity

The UE identity is the HS-DSCH Radio Network Identifier (H-RNTI) defined in [12]. This is mapped such that $x_{ue,1}$ corresponds to the MSB and $x_{ue,16}$ to the LSB.

## 4.6.2 Multiplexing of HS-SCCH information

The information carried on the HS-SCCH is multiplexed onto the bits $a_1, a_2, ...a_A$ according to the following rule :

$$a_1, a_2 ... a_8 = x_{ccs,1}, x_{ccs,2} ... x_{ccs,8}$$

$$a_9, a_{10} ... a_{9+n-1} = x_{ts,1}, x_{ts,2} ... x_{ts,n}$$

$$a_{9+n} = x_{ms,1}$$

$$a_{9+n+1}, a_{9+n+2} ... a_{9+n+m} = x_{tbs,1}, x_{tbs,2} ... x_{tbs,m}$$

$$a_{10+n+m}, a_{11+n+m}, a_{12+n+m} = x_{hap,1}, x_{hap,2}, x_{hap,3}$$

$$a_{13+n+m}, a_{14+n+m}, a_{15+n+m} = x_{rv,1}, x_{rv,2}, x_{rv,3}$$

$$a_{16+n+m} = x_{nd,1}$$

$$a_{17+n+m}, a_{18+n+m}, a_{19+n+m} = x_{hcsn,1}, x_{hcsn,2}, x_{hcsn,3}$$

### 4.6.3 CRC attachment for HS-SCCH

From the sequence of bits $a_1, a_2, ...a_A$ a 16 bit CRC is calculated according to Section 4.2.1.1. This gives a sequence of bits $y_1, y_2, ...y_{16}$. This latter sequence of bits is then masked with the UE identity and appended to the sequence of bits $a_1, a_2, ...a_A$. The bits at the output of the CRC attachment block is the sequence of bits $b_1, b_2, ...b_B$, where

$b_i = a_i$ $\quad$ *i=1,2,…,A*

$b_i = \left(y_{i-A} + x_{ue,i-A}\right) \bmod 2$ $\quad$ *i=A+1…B*

### 4.6.4 Channel coding for HS-SCCH

Channel coding for the HS-SCCH shall be done with the general method described in 4.2.3 with the following specific parameters:

The rate 1/3 convolutional coding shall be used for HS-SCCH.

### 4.6.5 Rate matching for HS-SCCH

Rate matching for HS-SCCH shall be done with the general method described in 4.2.7.

### 4.6.6 Interleaving for HS-SCCH

Interleaving for HS-SCCH shall be done with the general method described in 4.2.11.1.

### 4.6.7 Physical Channel Segmentation for HS-SCCH

Physical channel segmentation for HS-SCCH shall be done with the general method described in 4.2.10. For 1.28 Mcps TDD, the HS-SCCH consists of two physical channels HS-SCCH1 and HS-SCCH2; for 3.84 Mcps TDD the HS-SCCH only uses one physical channel, see [7].

### 4.6.8 Physical channel mapping for HS-SCCH

Physical channel mapping for the HS-SCCH shall be done with the general method described in subclause 4.2.12~~13~~.

## 4.7 Coding for HS-SICH

The following information, provided by higher layers, is transmitted by means of the HS-SICH physical channel.

- Recommended Modulation Format (RMF) (1 bit): $x_{rmf,1}$
- Recommended Transport-block size (RTBS) (n bits where n = 6 for 1.28 Mcps TDD and n = 9 for 3.84 Mcps TDD): $x_{tbs,1}$, $x_{tbs,2}$, …, $x_{tbs,n}$
- Hybrid-ARQ information ACK/NACK (1 bit): $x_{an,1}$

The following coding/multiplexing steps can be identified:

- separate coding of RMF, RTBS and ACK/NACK (see subclause 4.7.2);
- multiplexing of HS-SICH information (4.7.3);
- interleaving for HS-SICH (see subclause 4.7.4);

- mapping to physical channels (see subclause 4.7.5).

The general coding/multiplexing flow is shown in the figure 20~~19~~.

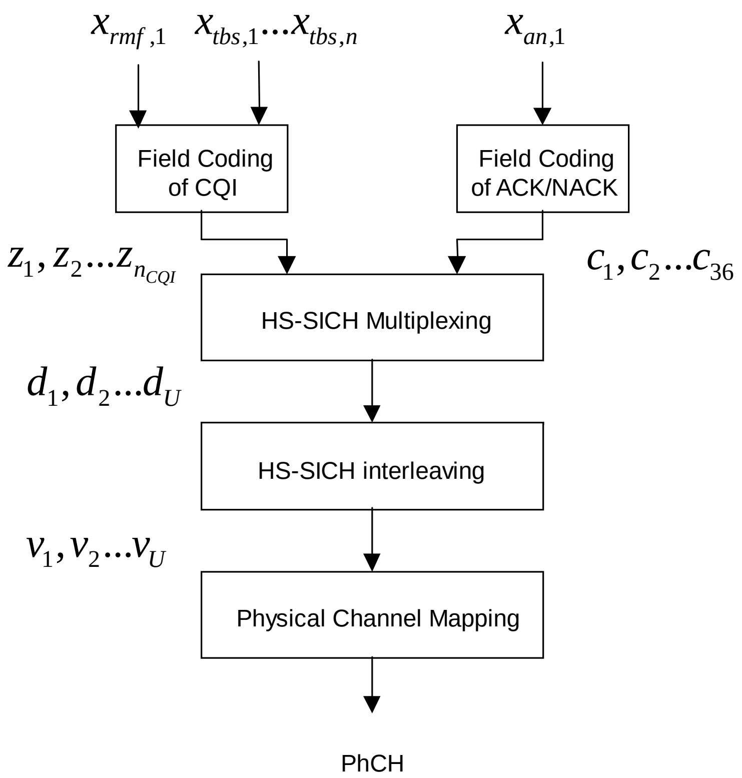


**Figure 20~~19~~ Coding and multiplexing for HS-SICH**

## 4.7.1 HS-SICH information field mapping

### 4.7.1.1 RMF information mapping

The RMF information bit, $x_{rmf,1}$, shall be mapped according to the mapping specified in subclause 4.6.1.3.

### 4.7.1.2 RTBS information mapping

The RTBS information bits, $x_{tbs,1}$, $x_{tbs,2}$, …, $x_{tbs,n}$, shall be mapped according to the same mapping as is used for the transport block size information bits in subclause 4.6. This mapping is defined by higher layers [12].

### 4.7.1.3 ACK/NACK information mapping

The ACK/NACK information bit $x_{an,1}$ shall be mapped according to the mapping given in Table 20~~21~~ below.

**Table 20~~21~~: ACK/NACK information mapping**

| ACK/NACK | $x_{an,1}$ |
|---|---|
| ACK | 1 |
| NACK | 0 |

## 4.7.2 Coding for HS-SICH

### 4.7.2.1 Field Coding of ACK/NACK

The ACK/NACK bit $x_{an,1}$ shall be repetition coded to 36 bits. The coded bits are defined as $c_1 \ldots c_{36}$

### 4.7.2.2 Field Coding of CQI

#### 4.7.2.2.1 Field Coding of CQI for 1.28 Mcps TDD

The quality information consists of Recommended Transport Block Size (RTBS) and Recommended Modulation Format (RMF) fields. The 6 bits of the RTBS field are coded to 32 bits using a (32, 6) 1st order Reed-Muller code. The coding procedure is as shown in figure 21~~20~~.

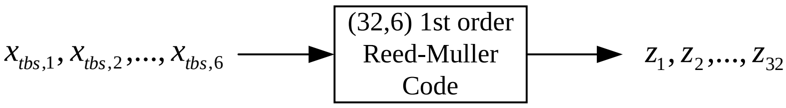


**Figure 21~~20~~ Field coding of RTBS information bits**

The coding uses a subset basis sequences as the TFCI coder as described in subclause 4.3.1.1. The basis sequences that are used for RTBS coding are as follows in table 21~~22~~.

**Table 21~~22~~: Basis sequences for (32,6) RTBS code**

| i | $M_{i,0}$ | $M_{i,1}$ | $M_{i,2}$ | $M_{i,3}$ | $M_{i,4}$ | $M_{i,5}$ |
|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| 2 | 1 | 1 | 0 | 0 | 0 | 1 |
| 3 | 0 | 0 | 1 | 0 | 0 | 1 |
| 4 | 1 | 0 | 1 | 0 | 0 | 1 |
| 5 | 0 | 1 | 1 | 0 | 0 | 1 |
| 6 | 1 | 1 | 1 | 0 | 0 | 1 |
| 7 | 0 | 0 | 0 | 1 | 0 | 1 |
| 8 | 1 | 0 | 0 | 1 | 0 | 1 |
| 9 | 0 | 1 | 0 | 1 | 0 | 1 |
| 10 | 1 | 1 | 0 | 1 | 0 | 1 |
| 11 | 0 | 0 | 1 | 1 | 0 | 1 |
| 12 | 1 | 0 | 1 | 1 | 0 | 1 |
| 13 | 0 | 1 | 1 | 1 | 0 | 1 |
| 14 | 1 | 1 | 1 | 1 | 0 | 1 |
| 15 | 1 | 0 | 0 | 0 | 1 | 1 |
| 16 | 0 | 1 | 0 | 0 | 1 | 1 |
| 17 | 1 | 1 | 0 | 0 | 1 | 1 |
| 18 | 0 | 0 | 1 | 0 | 1 | 1 |
| 19 | 1 | 0 | 1 | 0 | 1 | 1 |
| 20 | 0 | 1 | 1 | 0 | 1 | 1 |
| 21 | 1 | 1 | 1 | 0 | 1 | 1 |
| 22 | 0 | 0 | 0 | 1 | 1 | 1 |
| 23 | 1 | 0 | 0 | 1 | 1 | 1 |
| 24 | 0 | 1 | 0 | 1 | 1 | 1 |
| 25 | 1 | 1 | 0 | 1 | 1 | 1 |
| 26 | 0 | 0 | 1 | 1 | 1 | 1 |
| 27 | 1 | 0 | 1 | 1 | 1 | 1 |
| 28 | 0 | 1 | 1 | 1 | 1 | 1 |
| 29 | 1 | 1 | 1 | 1 | 1 | 1 |
| 30 | 0 | 0 | 0 | 0 | 0 | 1 |
| 31 | 0 | 0 | 0 | 0 | 1 | 1 |

The output RTBS code word bits $\{z_i : i = 1, ... , 32\}$ are given by:

$$z_i = \left( \sum_{n=1}^{6} x_{tbs,n} \cdot M_{i-1,n-1} \right) \mathrm{mod}\, 2$$

The RMF bit $x_{rmf,1}$ is repetition coded to 16 bits to produce the bits . $z_{33}, z_{34},..., z_{n_{CQI}}$ where $n_{CQI} = 48$.

#### 4.7.2.2.2 Field Coding of CQI for 3.84 Mcps TDD

RTBS and RMF bits are multiplexed onto the bits $y_1, y_2...y_{10}$ according to the following rule :

$$y_1 = x_{rmf,1}$$

$$y_2, y_3...y_{10} = x_{tbs,1}, x_{tbs,2}...x_{tbs,9}$$

The bits $y_1, y_2...y_{10}$ are coded to produce the CQI bits $z_1, z_2...z_{n_{CQI}}$ using a (32,10) sub-code of the second order Reed-Muller code as defined in subclause 4.3.1.1, where $n_{CQI} = 32$.

## 4.7.3 Multiplexing of HS-SICH information fields

The CQI bits $z_1, z_2...z_{n_{CQI}}$ are multiplexed with the repetition coded ACK/NACK bits $c_1...c_{36}$ to produce the bits $d_1, d_2...d_U$ where $U$ is the number of physical channel bits carried by HS-SICH, according to the following rule.:

$$d_1, d_2...d_{n_{CQI}} = z_{1,} z_2...z_{n_{CQI}}$$

$$d_{n_{CQI}+1}, d_{n_{CQI}+2}...d_{n_{CQI}+36} = c_{1,} c_2...c_{36}$$

$$d_{n_{CQI}+37}, d_{n_{CQI}+38}...d_U = 0,0....0$$

## 4.7.4 Interleaver for HS-SICH

Interleaver for HS-SICH shall be done with the general method described in 4.2.11.1.

## 4.7.5 Physical channel mapping for HS-SICH

Physical channel mapping for HS-SICH shall be done with the general method described in 4.2.1213.

# Annex A (informative): Change history

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 14/01/00 | RAN_05 | RAN_05 | - | | Approved at TSG RAN #5 and placed under Change Control | - | 3.0.0 |
| 14/01/00 | RAN_06 | RP-99694 | 001 | 3 | Correction of rate matching parameters for repetition after 1st Interleaving in 25.222 | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99694 | 002 | 1 | Clarification of bit separation and collection | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99694 | 003 | - | Changing the initial offset value for convolutional code rate matching | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99693 | 004 | 1 | Editorial corrections to TS 25.222 | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99694 | 007 | - | Update of rate matching rule for TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99694 | 009 | 1 | Modified physical channel mapping scheme | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99694 | 013 | - | Introduction of TFCI for S-CCPCH in TDD mode | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99694 | 015 | - | TFCI coding and mapping in TDD | 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-000068 | 017 | - | Corrections to TS 25.222 | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 018 | - | Refinements of Physical Channel Mapping | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 019 | 1 | TFCI coding specification in TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 021 | - | Modification of Turbo code internal interleaver | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 023 | - | Update of TS 25.222 - clarification of BTFD for TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 025 | - | Change of TFCI basis for TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 026 | - | Padding Function for Turbo coding of small blocks | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 027 | - | Editorial modification of shifting parameter calculation for turbo code puncturing | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000068 | 029 | 1 | Editorial changes of channel coding section | 3.1.1 | 3.2.0 |
| 26/06/00 | RAN_08 | RP-000272 | 030 | - | Parity bit attachment to 0 size transport block | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000272 | 031 | - | Correction of the mapping formula | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000272 | 034 | - | Alignment of Multiplexing for TDD | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000272 | 036 | 2 | Bit separation of the Turbo encoded data | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000272 | 038 | 2 | Revision of code block segmentation description | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000272 | 039 | - | Editorial corrections in channel coding section | 3.2.0 | 3.3.0 |
| 23/09/00 | RAN_09 | RP-000345 | 040 | 1 | Update of TS 25.222 | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000345 | 041 | 1 | Editorial corrections in Turbo code internal interleaver section | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000345 | 042 | - | Paging Indicator Terminology | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000345 | 043 | 1 | Bit separation and collection for rate matching | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000345 | 048 | - | Puncturing Limit definition in WG1 specification | 3.3.0 | 3.4.0 |
| 15/12/00 | RAN_10 | RP-000543 | 049 | - | Clarification on the Ci formula | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000543 | 050 | - | Correction on TFCI & TPC Transmission | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000543 | 053 | 1 | Editorial corrections in TS 25.222 | 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-010063 | 051 | 1 | Bit Scrambling for TDD | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010063 | 054 | 1 | Corrections & Clarifications for TS25.222 | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010071 | 055 | 1 | Inclusion of 1.28Mcps TDD in TS 25.222 | 3.5.0 | 4.0.0 |
| 21/09/01 | RAN_13 | RP-010523 | 057 | - | TFCI Terminology | 4.0.0 | 4.1.0 |
| 21/09/01 | RAN_13 | RP-010529 | 058 | - | 5ms TTI for PRACH for 1.28 Mcps TDD | 4.0.0 | 4.1.0 |
| 21/09/01 | RAN_13 | RP-010529 | 060 | - | A correction on the meaning of FPACH in TS 25.222 | 4.0.0 | 4.1.0 |
| 14/12/01 | RAN_14 | RP-010747 | 059 | - | Bit Scrambling for TDD | 4.1.0 | 4.2.0 |
| 14/12/01 | RAN_14 | RP-010747 | 061 | - | Corrections in clause 4.1 and 4.2 of TS 25.222 | 4.1.0 | 4.2.0 |
| 08/03/02 | RAN_15 | RP-020050 | 063 | 1 | Correction to addition of padding zeros to PICH in TDD | 4.2.0 | 4.3.0 |
| 08/03/02 | RAN_15 | RP-020050 | 065 | 3 | Clarification of the requirement for the determination of the rate matching parameters and editorial corrections to 25.222 | 4.2.0 | 4.3.0 |
| 08/03/02 | RAN_15 | RP-020058 | 066 | 2 | Inclusion of HSDPA in 25.222 | 4.2.0 | 5.0.0 |
| 07/06/02 | RAN_16 | RP-020311 | 077 | - | Second Stage Interleaving and Physical Channel Mapping | 5.0.0 | 5.1.0 |
| 07/06/02 | RAN_16 | RP-020311 | 076 | 1 | Zero padding for TFCI (3.84Mcps TDD) | 5.0.0 | 5.1.0 |
| 07/06/02 | RAN_16 | RP-020314 | 073 | - | Correction to addition of padding zeros to PICH in 1.28 Mcps TDD | 5.0.0 | 5.1.0 |
| 07/06/02 | RAN_16 | RP-020314 | 086 | - | Zero padding for TFCI (1.28Mcps TDD) | 5.0.0 | 5.1.0 |
| 07/06/02 | RAN_16 | RP-020317 | 078 | 2 | Removal of inconsistencies and ambiguities in the HARQ description | 5.0.0 | 5.1.0 |
| 07/06/02 | RAN_16 | RP-020317 | 079 | 4 | Corrections to HS-DSCH coding | 5.0.0 | 5.1.0 |
| 07/06/02 | RAN_16 | RP-020317 | 082 | 1 | Corrections to HSDPA Multiplexing and Coding | 5.0.0 | 5.1.0 |
| 07/06/02 | RAN_16 | RP-020317 | 084 | - | Introduction of HS-SCCH Cyclic Sequence Counter for TDD | 5.0.0 | 5.1.0 |
| 19/09/02 | RAN_17 | RP-020570 | 097 | 1 | Clarification of the definition of layer 1 transport channel numbers | 5.1.0 | 5.2.0 |
| 19/09/02 | RAN_17 | RP-020585 | 093 | - | HS-DSCH Interleaving for TDD | 5.1.0 | 5.2.0 |
| 19/09/02 | RAN_17 | RP-020585 | 091 | 1 | HS-SCCH corrections for TDD | 5.1.0 | 5.2.0 |
| 19/09/02 | RAN_17 | RP-020585 | 089 | 1 | Clarification of TFRI bits for 3.84Mcps HSDPA TDD | 5.1.0 | 5.2.0 |
| 15/10/02 | - | - | - | - | Moving of misplaced sections 4.6.1.5 and 4.6.1.6 | 5.2.0 | 5.2.1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |

**3GPP TSG-RAN1 Meeting #29**
**Shanghai, China, 5 – 8 November 2002**

***R1-02-1391***

*CR-Form-v7*

# CHANGE REQUEST

| | | | | | | |
|---|---|---|---|---|---|---|
| ⌘ | **25.223** | **CR 32** | ⌘ **rev** | **-** | ⌘ Current version: | **4.4.0** ⌘ |

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

***Proposed change affects:*** UICC apps⌘ [ ] ME [X] Radio Access Network [X] Core Network [ ]

| | | | | |
|---|---|---|---|---|
| ***Title:*** | ⌘ | Editorial modification to the section numberings | | |
| ***Source:*** | ⌘ | TSG RAN WG1 | | |
| ***Work item code:*** | ⌘ | TEI4 | ***Date:*** ⌘ | 30/10/2002 |
| ***Category:*** | ⌘ | **D** | ***Release:*** ⌘ | Rel-4 |
| | | *Use one of the following categories:*<br>***F*** *(correction)*<br>***A*** *(corresponds to a correction in an earlier release)*<br>***B*** *(addition of feature),*<br>***C*** *(functional modification of feature)*<br>***D*** *(editorial modification)*<br>Detailed explanations of the above categories can be found in 3GPP TR 21.900. | | *Use one of the following releases:*<br>*2 (GSM Phase 2)*<br>*R96 (Release 1996)*<br>*R97 (Release 1997)*<br>*R98 (Release 1998)*<br>*R99 (Release 1999)*<br>*Rel-4 (Release 4)*<br>*Rel-5 (Release 5)*<br>*Rel-6 (Release 6)* |

| | | |
|---|---|---|
| ***Reason for change:*** | ⌘ | The numbering used is not consistent with TS21.801. |
| ***Summary of change:*** | ⌘ | The sections, figures, and tables numberings are adjusted to follow the guidlines given in TS21.801. |
| ***Consequences if not approved:*** | ⌘ | Confusion and misunderstanding, not consistent with specification guidelines and the rest of the document. |

| | | | | | |
|---|---|---|---|---|---|
| ***Clauses affected:*** | ⌘ | All the document | | | |
| | | **Y** | **N** | | |
| ***Other specs affected:*** | ⌘ | | **X** | Other core specifications | ⌘ |
| | | | **X** | Test specifications | |
| | | | **X** | O&M Specifications | |
| ***Other comments:*** | ⌘ | | | | |

## How to create CRs using this form:

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

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

# Contents

# Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

# 1 Scope

The present document describes spreading and modulation for UTRA Physical Layer TDD mode.

# 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 25.201: "Physical layer - general description".

[2] 3GPP TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)".

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

[4] 3GPP TS 25.213: "Spreading and modulation (FDD)".

[5] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[6] 3GPP TS 25.215: "Physical layer – Measurements (FDD)".

[7] 3GPP TS 25.221: "Physical channels and mapping of transport channels onto physical channels (TDD)".

[8] 3GPP TS 25.222: "Multiplexing and channel coding (TDD)".

[9] 3GPP TS 25.102: "UTRA (UE) TDD; Radio Transmission and Reception".

[10] 3GPP TS 25.105: "UTRA (BS) TDD; Radio Transmission and Reception".


# 3 Symbols and abbreviations

## 3.1 Symbols

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

$C_p$: PSC
$C_i$: i:th secondary SCH code
$C_{CSC,\,m}^{(k)}$: CSC derived as *k*:th offset version from *m*:th applicable constituent Golay complementary pair

## 3.2 Abbreviations

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

CCTrCH Coded Composite Transport Channel
DPCH Dedicated Physical Channel
CDMA Code Division Multiple Access

| | |
|---|---|
| CSC | Cell Synchronisation Code |
| FDD | Frequency Division Duplex |
| MIB | Master Information Block |
| OVSF | Orthogonal Variable Spreading Factor |
| P-CCPCH | Primary Common Control Physical Channel |
| PN | Pseudo Noise |
| PRACH | Physical Random Access Channel |
| PSC | Primary Synchronisation Code |
| QPSK | Quadrature Phase Shift Keying |
| RACH | Random Access Channel |
| SCH | Synchronisation Channel |
| SF | Spreading Factor |
| SFN | System Frame Number |
| TDD | Time Division Duplex |
| TFC | Transport Format Combination |
| UE | User Equipment |
| UL | Uplink |

# 4 General

In the following, a separation between the data modulation and the spreading modulation has been made. The data modulation for 3.84Mcps TDD is defined in clause 5 'Data modulation for the 3.84 Mcps option', the data modulation for 1.28Mcps TDD is defined in clause ~~6~~5A 'Data modulation for the 1.28 Mcps option' and the spreading modulation in clause ~~7~~6 'Spreading modulation'.

**Table 1: Basic modulation parameters**

| | | |
|---|---|---|
| Chip rate | same as FDD basic chiprate: 3.84 Mchip/s | Low chiprate: 1.28 Mchip/s |
| Data modulation | QPSK | QPSK, 8PSK |
| Spreading characteristics | Orthogonal Q chips/symbol, where $Q = 2^p$, $0 <= p <= 4$ | Orthogonal Q chips/symbol, where $Q = 2^p$, $0 <= p <= 4$ |

# 5 Data modulation for the 3.84 Mcps option

## 5.1 Symbol rate

The symbol duration $T_S$ depends on the spreading factor Q and the chip duration $T_C$: $T_s = Q \times T_c$, where $T_c = \frac{1}{chiprate}$.

## 5.2 Mapping of bits onto signal point constellation

### 5.2.1 Mapping for burst type 1 and 2

The data modulation is performed to the bits from the output of the physical channel mapping procedure in [8] and combines always 2 consecutive binary bits to a complex valued data symbol. Each user burst has two data carrying parts, termed data blocks:

$$\underline{\mathbf{d}}^{(k,i)} = \left(\underline{d}_1^{(k,i)}, \underline{d}_2^{(k,i)}, ..., \underline{d}_{N_k}^{(k,i)}\right)^T, \quad i = 1,2; k = 1,...,K_{Code} \qquad (1)$$

$K_{Code}$ is the number of used codes in a time slot, max $K_{Code}$ =16. $N_k$ is the number of symbols per data field for the code k. This number is linked to the spreading factor $Q_k$ as described in table 1 of [7].

Data block $\underline{\mathbf{d}}^{(k,1)}$ is transmitted before the midamble and data block $\underline{\mathbf{d}}^{(k,2)}$ after the midamble. Each of the $N_k$ data symbols $\underline{d}_n^{(k,i)}$; i=1, 2; k=1,...,$K_{Code}$; n=1,...,$N_k$; of equation 1 has the symbol duration $T_S^{(k)}=Q_k.T_c$ as already given.

The data modulation is QPSK, thus the data symbols $\underline{d}_n^{(k,i)}$ are generated from two consecutive data bits from the output of the physical channel mapping procedure in [8]:

$$b_{l,n}^{(k,i)} \in \{0,1\}, \quad l = 1,2; k = 1,..., K_{Code}; n = 1,..., N_k; i = 1,2 \qquad (2)$$

using the following mapping to complex symbols:

| consecutive binary bit pattern | complex symbol |
|---|---|
| $^{(k,i)}_{1,n}\ \ ^{(k,i)}_{2,n}$ | $\underline{d}_n^{(k,i)}$ |
| 00 | +j |
| 01 | +1 |
| 10 | -1 |
| 11 | -j |

The mapping corresponds to a QPSK modulation of the interleaved and encoded data bits $b_{l,n}^{(k,i)}$ of equation 2.

### 5.2.2 Mapping for burst type 3

In case of burst type 3, the definitions in subclause 5.2.1 apply with a modified number of symbols in the second data block. For the burst type 3, the number of symbols in the second data block $\underline{\mathbf{d}}^{(k,2)}$ is decreased by $\frac{96}{Q_K}$ symbols.

# ~~6~~5A Data modulation for the 1.28 Mcps option

## ~~6~~5A.1 Symbol rate

The symbol duration $T_S$ depends on the spreading factor Q and the chip duration $T_C$: $T_s = Q \times T_c$, where $T_c = \frac{1}{chiprate}$.

## ~~6~~5A.2 Mapping of bits onto signal point constellation

### ~~6~~5A.2.1 QPSK modulation

The mapping of bits onto the signal point constellation for QPSK modulation is the same as in the 3.84Mcps TDD cf. [5.2.1 Mapping for burst type 1 and 2].

### ~~6~~5A.2.2 8PSK modulation

The data modulation is performed to the bits from the output of the physical channel mapping procedure. In case of 8PSK modulation 3 consecutive binary bits are represented by one complex valued data symbol. Each user burst has two data carrying parts, termed data blocks:

$$\underline{\mathbf{d}}^{(k,i)} = \left(\underline{d}_1^{(k,i)}, \underline{d}_2^{(k,i)}, ..., \underline{d}_{N_k}^{(k,i)}\right)^T, \quad i = 1,2; k = 1,..., K_{Code} \qquad (1a)$$

$N_k$ is the number of symbols per data field for the code k. This number is linked to the spreading factor $Q_k$.

Data block $\underline{\mathbf{d}}^{(k,1)}$ is transmitted before the midamble and data block $\underline{\mathbf{d}}^{(k,2)}$ after the midamble. Each of the $N_k$ data symbols $\underline{d}_n^{(k,i)}$; i=1, 2; k=1,...,$K_{Code}$; n=1,...,$N_k$; of equation 1 has the symbol duration $T_S^{(k)}=Q_k.T_C$ as already given.

The data modulation is 8PSK, thus the data symbols $\underline{d}_n^{(k,i)}$ are generated from 3 consecutive data bits from the output of the physical channel mapping procedure in [8]:

$$b_{l,n}^{(k,i)} \in \{0,1\} \quad l=1,2,3;\ k=1,...,K_{Code};\ n=1,...,N_k;\ i=1,2 \qquad (2a)$$

using the following mapping to complex symbols:

| Consecutive binary bit pattern | complex symbol |
|---|---|
| $b_{1,n}^{(k,i)}\ b_{2,n}^{(k,i)}\ b_{3,n}^{(k,i)}$ | $\underline{d}_n^{(k,i)}$ |
| 000 | cos(11pi/8)+ jsin(11pi/8) |
| 001 | cos(9pi/8)+ jsin(9pi/8) |
| 010 | cos(5pi/8)+ jsin(5pi/8) |
| 011 | cos(7pi/8)+ jsin(7pi/8) |
| 100 | cos(13pi/8)+ jsin(13pi/8) |
| 101 | cos(15pi/8)+ jsin(15pi/8) |
| 110 | cos(3pi/8)+ jsin(3pi/8) |
| 111 | cos(pi/8)+ jsin(pi/8) |

The mapping corresponds to a 8PSK modulation of the interleaved and encoded data bits $b_{l,n}^{(k,i)}$ of the table above and $\underline{d}_n^{(k,i)}$ of equation 1a.

# ~~7~~6 Spreading modulation

## ~~7~~6.1 Basic spreading parameters

Spreading of data consists of two operations: Channelisation and Scrambling. Firstly, each complex valued data symbol $\underline{d}_n^{(k,i)}$ of equation 1 is spread with a real valued channelisation code $\mathbf{c}^{(k)}$ of length $Q_k \in \{1,2,4,8,16\}$. The resulting sequence is then scrambled by a complex sequence $\underline{\mathbf{v}}$ of length 16.

## ~~7~~6.2 Channelisation codes

The elements $c_q^{(k)}$; k=1,...,$K_{Code}$; q=1,...,$Q_k$; of the real valued channelisation codes

$$\mathbf{c}^{(k)}=(c_1^{(k)},c_2^{(k)},...,c_{Q_k}^{(k)})\ ;\ k=1,...,K_{Code};$$

shall be taken from the set

$$V_c = \{1, -1\} \qquad (3)$$

The $\mathbf{c}_{Q_k}^{(k)}$ are Orthogonal Variable Spreading Factor (OVSF) codes, allowing to mix in the same timeslot channels with different spreading factors while preserving the orthogonality. The OVSF codes can be defined using the code tree of figure 1.

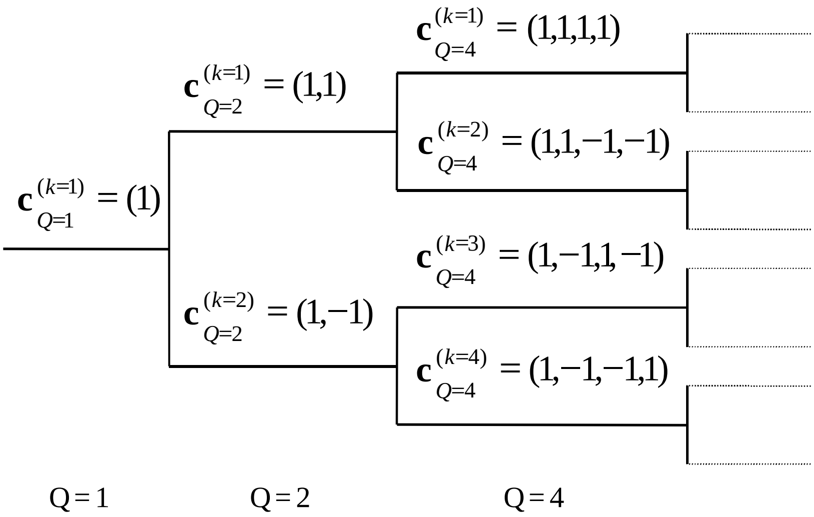


**Figure 1: Code-tree for generation of Orthogonal Variable Spreading Factor (OVSF) codes for Channelisation Operation**

Each level in the code tree defines a spreading factor indicated by the value of Q in the figure. All codes within the code tree cannot be used simultaneously in a given timeslot. A code can be used in a timeslot if and only if no other code on the path from the specific code to the root of the tree or in the sub-tree below the specific code is used in this timeslot. This means that the number of available codes in a slot is not fixed but depends on the rate and spreading factor of each physical channel.

The spreading factor goes up to $Q_{MAX}$=16.

## ~~7~~6.3 Channelisation Code Specific Multiplier

Associated with each channelisation code is a multiplier $w_{Q_k}^{(k)}$ taking values from the set $\left\{e^{j\pi/2 \cdot p_k}\right\}$, where $p_k$ is a permutation of the integer set {0, ..., $Q_k$ -1} and $Q_k$ denotes the spreading factor. The multiplier is applied to the data sequence modulating each channelisation code. The values of the multiplier for each channelisation code are given in the table below:

| **k** | $w_{Q=1}^{(k)}$ | $w_{Q=2}^{(k)}$ | $w_{Q=4}^{(k)}$ | $w_{Q=8}^{(k)}$ | $w_{Q=16}^{(k)}$ |
|---|---|---|---|---|---|
| 1 | 1 | 1 | -j | 1 | -1 |
| 2 | | +j | 1 | +j | -j |
| 3 | | | +j | +j | 1 |
| 4 | | | -1 | -1 | 1 |
| 5 | | | | -j | +j |
| 6 | | | | -1 | -1 |
| 7 | | | | -j | -1 |
| 8 | | | | 1 | 1 |
| 9 | | | | | -j |
| 10 | | | | | +j |
| 11 | | | | | 1 |
| 12 | | | | | +j |
| 13 | | | | | -j |
| 14 | | | | | -j |
| 15 | | | | | +j |
| 16 | | | | | -1 |

If the UE autonomously changes the SF, as described in [7], it shall always use the multiplier associated with the channelisation code allocated by higher layers.

## ~~7~~6.4 Scrambling codes

The spreading of data by a real valued channelisation code $\mathbf{c}^{(k)}$ of length $Q_k$ is followed by a cell specific complex scrambling sequence $\underline{\mathbf{v}} = (\underline{v}_1, \underline{v}_2, \ldots, \underline{v}_{16})$. The elements $\underline{v}_i; i = 1,\ldots,16$ of the complex valued scrambling codes shall be taken from the complex set

$$\underline{V}_{\underline{v}} = \{1, \mathrm{j}, -1, -\mathrm{j}\} \qquad (4)$$

In equation 4 the letter j denotes the imaginary unit. A complex scrambling code $\underline{\mathbf{v}}$ is generated from the binary scrambling codes $\mathbf{v} = (v_1, v_2, \ldots, v_{16})$ of length 16 shown in Annex A. The relation between the elements $\underline{\mathbf{v}}$ and $\mathbf{v}$ is given by:

$$\underline{v}_i = (\mathrm{j})^i \cdot v_i \qquad v_i \in \{1, -1\}, \ \mathrm{i} = 1,\ldots,16 \qquad (5)$$

Hence, the elements $\underline{v}_i$ of the complex scrambling code $\underline{\mathbf{v}}$ are alternating real and imaginary.

The length matching is obtained by concatenating $Q_{MAX}/Q_k$ spread words before the scrambling. The scheme is illustrated in figure 2 and is described in more detail in subclause 6.4.

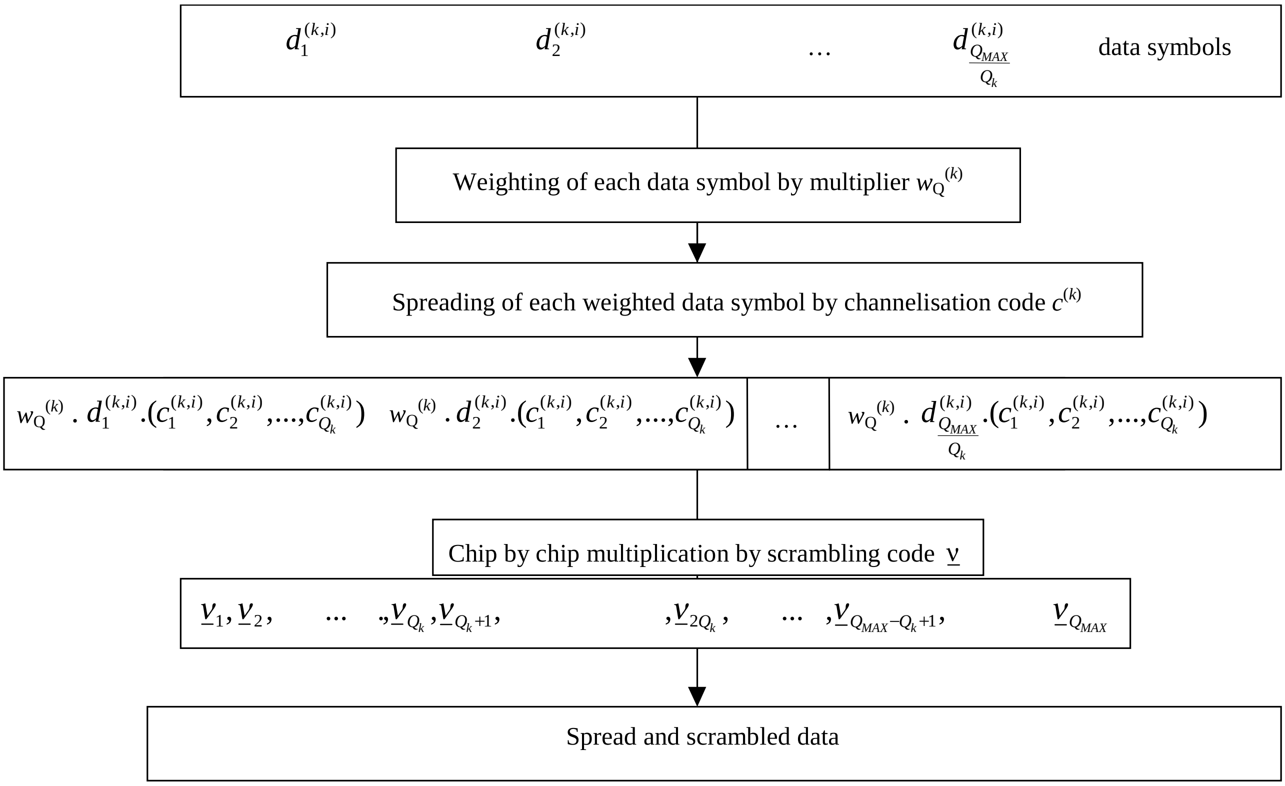


**Figure 2: Spreading of data symbols**

## ~~7~~6.5 Spread signal of data symbols and data blocks

The combination of the user specific channelisation and cell specific scrambling codes can be seen as a user and cell specific spreading code $\mathbf{s}^{(k)} = (s_p^{(k)})$ with

$$s_p^{(k)} = c^{(k)}_{1+[(p-1)\bmod Q_k]} \cdot \underline{v}_{1+[(p-1)\bmod Q_{MAX}]}, \quad k=1,\ldots,K_{Code},\ p=1,\ldots,N_kQ_k.$$

With the root raised cosine chip impulse filter $Cr_0(t)$ the transmitted signal belonging to the data block $\underline{\mathbf{d}}^{(k,1)}$ of equation 1 transmitted before the midamble is

$$d^{(k,1)}(t) = \sum_{n=1}^{N_k} d_n^{(k,1)} w_{Q_k}^{(k)} \sum_{q=1}^{Q_k} s_{(n-1)Q_k+q}^{(k)} .Cr_0(t-(q-1)T_c-(n-1)Q_k T_c) \qquad (6)$$

and for the data block $\underline{\mathbf{d}}^{(k,2)}$ of equation 1 transmitted after the midamble

$$d^{(k,2)}(t) = \sum_{n=1}^{N_k} d_n^{(k,2)} w_{Q_k}^{(k)} \sum_{q=1}^{Q_k} s_{(n-1)Q_k+q}^{(k)} .Cr_0(t-(q-1)T_c-(n-1)Q_k T_c - N_k Q_k T_c - L_m T_c) \qquad (7)$$

where $L_m$ is the number of midamble chips.

## ~~7~~6.6 Modulation for the 3.84 Mcps option

The complex-valued chip sequence is QPSK modulated as shown in figure 3.

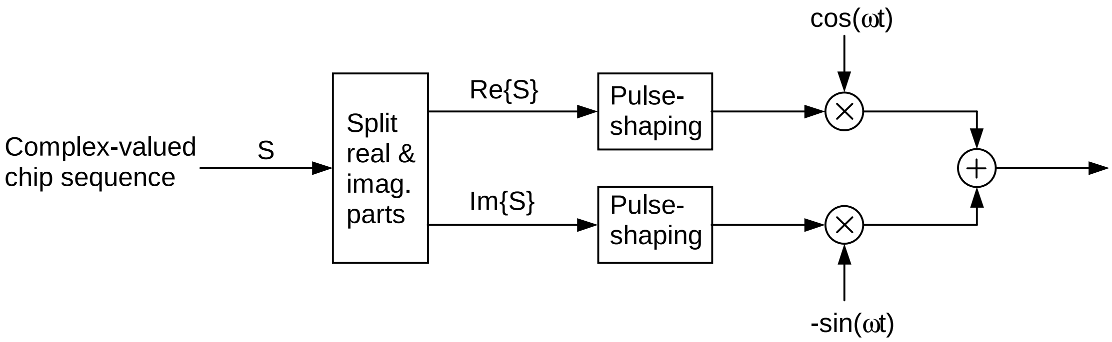


**Figure 3: Modulation of complex valued chip sequences**

The pulse-shaping characteristics are described in [9] and [10].

### ~~7~~6.6.1 Combination of physical channels in uplink

Figure 4 illustrates the principle of combination of two different physical uplink channels within one timeslot. The DPCHs to be combined belong to same CCTrCH, did undergo spreading as described in sections before and are thus represented by complex-valued sequences. First, the amplitude of all DPCHs is adjusted according to UL open loop power control as described in [10]. Each DPCH is then separately weighted by a weight factor $\gamma_i$ and combined using complex addition. After combination of Physical Channels the gain factor $\beta_j$ is applied, depending on the actual TFC as described in [10].

In case of different CCTrCH, principle shown in Figure 4 applies to each CCTrCH separately.

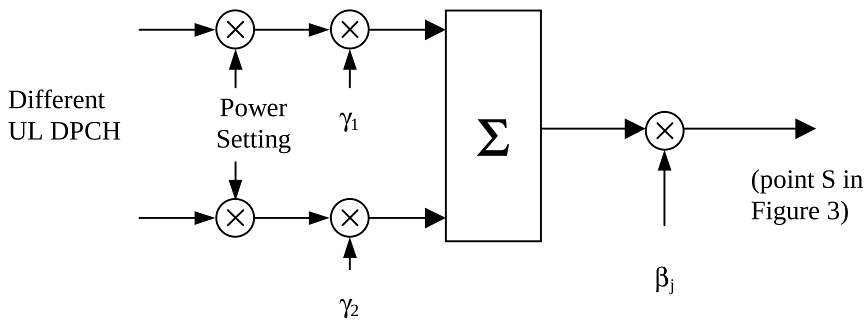


**Figure 4: Combination of different physical channels in uplink**

The values of weight factors $\gamma_i$ are depending on the spreading factor SF of the corresponding DPCH:

| SF of $DPCH_i$ | $\gamma_i$ |
|---|---|
| 16 | $1/4$ |
| 8 | $\sqrt{2}/4$ |
| 4 | $1/2$ |
| 2 | $\sqrt{2}/2$ |
| 1 | $1$ |

In the case that $\beta_j$ (corresponding to the *j*–th TFC) has been explicitly signalled to the UE, the possible values that $\beta_j$ can assume are listed in the table below. In the case that $\beta_j$ has been calculated by the UE from a reference TFC, $\beta_j$ shall not be restricted to the quantised values.

| Signalling value for $\beta_j$ | Quantized value $\beta_j$ |
|---|---|
| 15 | 16/8 |
| 14 | 15/8 |
| 13 | 14/8 |
| 12 | 13/8 |
| 11 | 12/8 |
| 10 | 11/8 |
| 9 | 10/8 |
| 8 | 9/8 |
| 7 | 8/8 |
| 6 | 7/8 |
| 5 | 6/8 |
| 4 | 5/8 |
| 3 | 4/8 |
| 2 | 3/8 |
| 1 | 2/8 |
| 0 | 1/8 |

### ~~7~~6.6.2 Combination of physical channels in downlink

Figure 5 illustrates how different physical downlink channels are combined within one timeslot. Each complex-valued spread channel is separately weighted by a weight factor $G_i$. If a timeslot contains the SCH, the complex-valued SCH, as described in [7] is separately weighted by a weight factor $G_{SCH}$. All downlink physical channels are then combined using complex addition.

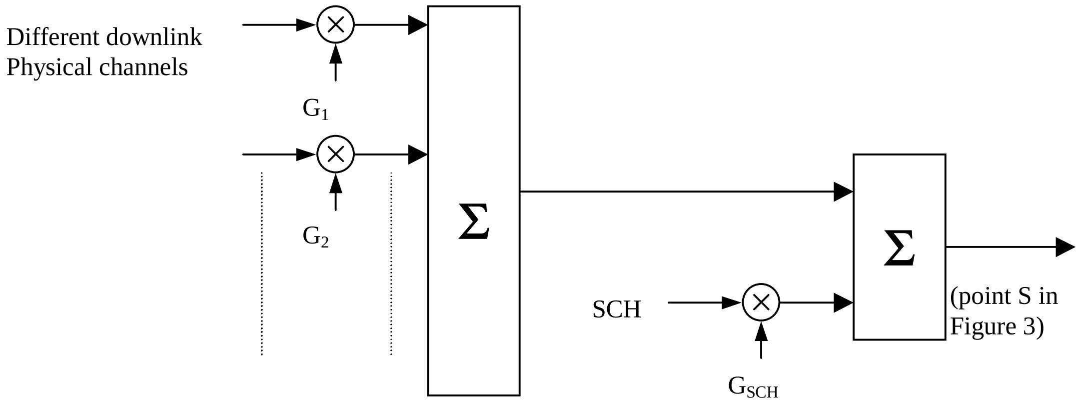


**Figure 5: Combination of different physical channels in downlink in case of SCH timeslot**

## ~~7~~6.7 Modulation for the 1.28 Mcps option

The complex-valued chip sequence is modulated as shown in figure 6.

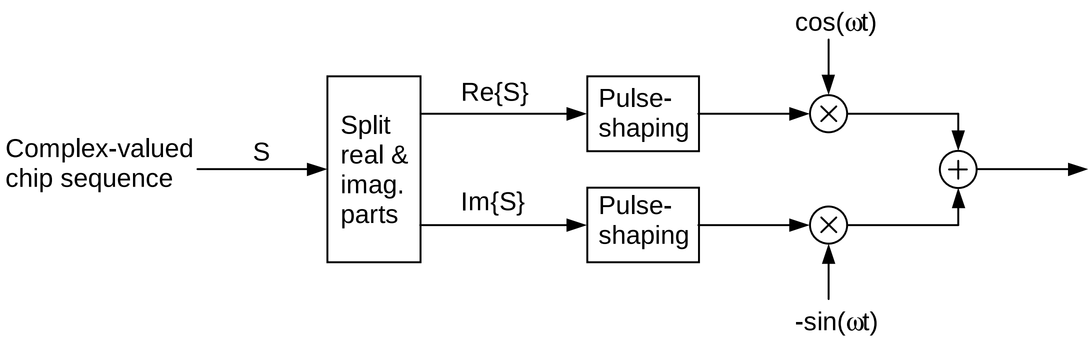


**Figure 6: Modulation of complex valued chip sequences**

The pulse-shaping characteristics are described in [9] and [10].

### ~~7~~6.7.1 Combination of physical channels in uplink

The combination of physical channels in uplink is the same as in the 3.84 Mcps TDD cf. [~~7~~6.6~~5~~.1 Combination of physical channels in uplink]

### ~~7~~6.7.2 Combination of physical channels in downlink

Figure 7 illustrates how different physical downlink channels are combined within one timeslot. Each spread channel is separately weighted by a weight factor $G_i$.. All downlink physical channels are then combined using complex addition.

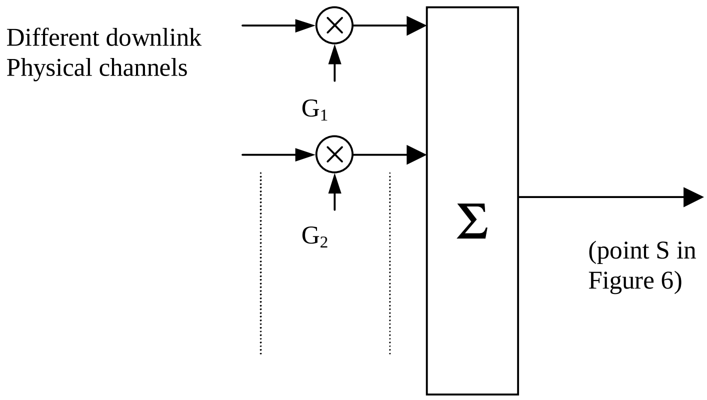


**Figure 7: Combination of different physical channels in downlink**

# ~~8~~7 Synchronisation codes for the 3.84 Mcps option

## ~~8~~7.1 Code Generation

The primary synchronisation code (PSC), $C_p$ , is constructed as a so-called generalised hierarchical Golay sequence. The PSC is furthermore chosen to have good aperiodic auto correlation properties.

Define a = < $x_1$, $x_2$, $x_3$, …, $x_{16}$ > = < 1, 1, 1, 1, 1, 1, -1, -1, 1, -1, 1, -1, 1, -1, -1, 1 >

The PSC is generated by repeating the sequence 'a' modulated by a Golay complementary sequence and creating a complex-valued sequence with identical real and imaginary components.

The PSC, $C_p$ , is defined as $C_p = < y(0), y(1), y(2), \ldots, y(255) >$

where $y = (1+\mathrm{j})\times < a, a, a, -a, -a, a, -a, -a, a, a, a, -a, a, -a, a, a >$

and the left most index corresponds to the chip transmitted first in time.

The 12 secondary synchronization codes, {$C_0$, $C_1$, $C_3$, $C_4$, $C_5$, $C_6$, $C_8$, $C_{10}$, $C_{12}$, $C_{13}$, $C_{14}$, $C_{15}$ } are complex valued with identical real and imaginary components, and are constructed from the position wise multiplication of a Hadamard sequence and a sequence z, defined as

z = $< b, b, b, -b, b, b, -b, -b, b, -b, b, -b, -b, -b, -b, -b >$ , where

b = $< x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, -x_9, -x_{10}, -x_{11}, -x_{12}, -x_{13}, -x_{14}, -x_{15}, -x_{16} >$

and $x_1$, $x_2$, $x_3$, …, $x_{16}$ are the same as in the definition of the sequence 'a' above.

The Hadamard sequences are obtained as the rows in a matrix $H_8$ constructed recursively by:

$$H_0 = (1)$$
$$H_k = \begin{pmatrix} H_{k-1} & H_{k-1} \\ H_{k-1} & -H_{k-1} \end{pmatrix}, \quad k \geq 1$$

The rows are numbered from the top starting with row *0* (the all ones sequence).

Denote the *n*:th Hadamard sequence $h_n$ as a row of $H_8$ numbered from the top, n = 0, 1, 2, …, 255, in the sequel.

Furthermore, let $h_m(l)$ and $z(l)$ denote the *l*th symbol of the sequence $h_m$ and *z*, respectively where *l* = 0, 1, 2, …, 255 and *l* = 0 corresponds to the leftmost symbol.

The i:th secondary SCH code word, $C_i$, i = 0, 1, 3, 4, 5, 6, 8, 10, 12, 13, 14, 15 is then defined as

$C_i = (1 + j) \times \langle h_m(0) \times z(0), h_m(1) \times z(1), h_m(2) \times z(2), \ldots, h_m(255) \times z(255) \rangle$,

where $m$ = (16×i) and the leftmost chip in the sequence corresponds to the chip transmitted first in time.

## 87.2 Code Allocation

Three secondary SCH codes are QPSK modulated and transmitted in parallel with the primary synchronization code. The QPSK modulation carries the following information:

- the code group that the base station belongs to (32 code groups:5 bits; Cases 1, 2);
- the position of the frame within an interleaving period of 20 msec (2 frames:1 bit, Cases 1, 2);
- the position of the SCH slot(s) within the frame (2 SCH slots:1 bit, Case 2).

The modulated secondary SCH codes are also constructed such that their cyclic-shifts are unique, i.e. a non-zero cyclic shift less than 2 (Case 1) and 4 (Case 2) of any of the sequences is not equivalent to some cyclic shift of any other of the sequences. Also, a non-zero cyclic shift less than 2 (Case 1) and 4 (Case 2) of any of the sequences is not equivalent to itself with any other cyclic shift less than 8. The secondary synchronization codes are partitioned into two code sets for Case 1 and four code sets for Case 2. The set is used to provide the following information:

Case 1:

**Table 2: Code Set Allocation for Case 1**

| Code Set | Code Group |
|---|---|
| 1 | 0-15 |
| 2 | 16-31 |

The code group and frame position information is provided by modulating the secondary codes in the code set.

Case 2:

**Table 3: Code Set Allocation for Case 2**

| Code Set | Code Group |
|---|---|
| 1 | 0-7 |
| 2 | 8-15 |
| 3 | 16-23 |
| 4 | 24-31 |

The slot timing and frame position information is provided by the comma free property of the code word and the Code group is provided by modulating some of the secondary codes in the code set.

The following SCH codes are allocated for each code set:

Case 1

Code set 1: $C_1$, $C_3$, $C_5$.

Code set 2: $C_{10}$, $C_{13}$, $C_{14}$.

Case 2

Code set 1: $C_1$, $C_3$, $C_5$.

Code set 2: $C_{10}$, $C_{13}$, $C_{14}$.

Code set 3: $C_0$, $C_6$, $C_{12}$.

Code set 4: $C_4$, $C_8$, $C_{15}$.

The following subclauses 7.2.1 to 7.2.2 refer to the two cases of SCH/P-CCPCH usage as described in [7].

Note that in the tables 4 and 5 corresponding to Cases 1 and 2, respectively, Frame 1 implies the frame with an odd SFN and Frame 2 implies the frame with an even SFN.

### 87.2.1 Code allocation for Case 1

**Table 4: Code Allocation for Case 1**

| Code Group | Code Set | Frame 1 | | | Frame 2 | | | Associated $t_{offset}$ |
|---|---|---|---|---|---|---|---|---|
| 0 | 1 | $C_1$ | $C_3$ | $C_5$ | $C_1$ | $C_3$ | $-C_5$ | $t_0$ |
| 1 | 1 | $C_1$ | $-C_3$ | $C_5$ | $C_1$ | $-C_3$ | $-C_5$ | $t_1$ |
| 2 | 1 | $-C_1$ | $C_3$ | $C_5$ | $-C_1$ | $C_3$ | $-C_5$ | $t_2$ |
| 3 | 1 | $-C_1$ | $-C_3$ | $C_5$ | $-C_1$ | $-C_3$ | $-C_5$ | $t_3$ |
| 4 | 1 | $jC_1$ | $jC_3$ | $C_5$ | $jC_1$ | $jC_3$ | $-C_5$ | $t_4$ |
| 5 | 1 | $jC_1$ | $-jC_3$ | $C_5$ | $jC_1$ | $-jC_3$ | $-C_5$ | $t_5$ |
| 6 | 1 | $-jC_1$ | $jC_3$ | $C_5$ | $-jC_1$ | $jC_3$ | $-C_5$ | $t_6$ |
| 7 | 1 | $-jC_1$ | $-jC_3$ | $C_5$ | $-jC_1$ | $-jC_3$ | $-C_5$ | $t_7$ |
| 8 | 1 | $jC_1$ | $jC_5$ | $C_3$ | $jC_1$ | $jC_5$ | $-C_3$ | $t_8$ |
| 9 | 1 | $jC_1$ | $-jC_5$ | $C_3$ | $jC_1$ | $-jC_5$ | $-C_3$ | $t_9$ |
| 10 | 1 | $-jC_1$ | $jC_5$ | $C_3$ | $-jC_1$ | $jC_5$ | $-C_3$ | $t_{10}$ |
| 11 | 1 | $-jC_1$ | $-jC_5$ | $C_3$ | $-jC_1$ | $-jC_5$ | $-C_3$ | $t_{11}$ |
| 12 | 1 | $jC_3$ | $jC_5$ | $C_1$ | $jC_3$ | $jC_5$ | $-C_1$ | $t_{12}$ |
| 13 | 1 | $jC_3$ | $-jC_5$ | $C_1$ | $jC_3$ | $-jC_5$ | $-C_1$ | $t_{13}$ |
| 14 | 1 | $-jC_3$ | $jC_5$ | $C_1$ | $-jC_3$ | $jC_5$ | $-C_1$ | $t_{14}$ |
| 15 | 1 | $-jC_3$ | $-jC_5$ | $C_1$ | $-jC_3$ | $-jC_5$ | $-C_1$ | $t_{15}$ |
| 16 | 2 | $C_{10}$ | $C_{13}$ | $C_{14}$ | $C_{10}$ | $C_{13}$ | $-C_{14}$ | $t_{16}$ |
| 17 | 2 | $C_{10}$ | $-C_{13}$ | $C_{14}$ | $C_{10}$ | $-C_{13}$ | $-C_{14}$ | $t_{17}$ |
| … | … | … | … | … | … | … | … | … |
| 20 | 2 | $jC_{10}$ | $jC_{13}$ | $C_{14}$ | $jC_{10}$ | $jC_{13}$ | $-C_{14}$ | $t_{20}$ |
| … | … | … | … | … | … | … | … | … |
| 24 | 2 | $jC_{10}$ | $jC_{14}$ | $C_{13}$ | $jC_{10}$ | $jC_{14}$ | $-C_{13}$ | $t_{24}$ |
| … | … | … | … | … | … | … | … | … |
| 31 | 2 | $-jC_{13}$ | $-jC_{14}$ | $C_{10}$ | $-jC_{13}$ | $-jC_{14}$ | $-C_{10}$ | $t_{31}$ |

NOTE: The code construction for code groups 0 to 15 using only the SCH codes from code set 1 is shown. The construction for code groups 16 to 31 using the SCH codes from code set 2 is done in the same way.

## ~~8~~7.2.2 Code allocation for Case 2

**Table 5: Code Allocation for Case 2**

| Code Group | Code Set | Frame 1 | | | | | | Frame 2 | | | | | | Associated $t_{offset}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Slot k | | | Slot k+8 | | | Slot k | | | Slot k+8 | | | |
| 0 | 1 | $C_1$ | $C_3$ | $C_5$ | $C_1$ | $C_3$ | $-C_5$ | $-C_1$ | $-C_3$ | $C_5$ | $-C_1$ | $-C_3$ | $-C_5$ | $t_0$ |
| 1 | 1 | $C_1$ | $-C_3$ | $C_5$ | $C_1$ | $-C_3$ | $-C_5$ | $-C_1$ | $C_3$ | $C_5$ | $-C_1$ | $C_3$ | $-C_5$ | $t_1$ |
| 2 | 1 | $jC_1$ | $jC_3$ | $C_5$ | $jC_1$ | $jC_3$ | $-C_5$ | $-jC_1$ | $-jC_3$ | $C_5$ | $-jC_1$ | $-jC_3$ | $-C_5$ | $t_2$ |
| 3 | 1 | $jC_1$ | $-jC_3$ | $C_5$ | $jC_1$ | $-jC_3$ | $-C_5$ | $-jC_1$ | $jC_3$ | $C_5$ | $-jC_1$ | $jC_3$ | $-C_5$ | $t_3$ |
| 4 | 1 | $jC_1$ | $jC_5$ | $C_3$ | $jC_1$ | $jC_5$ | $-C_3$ | $-jC_1$ | $-jC_5$ | $C_3$ | $-jC_1$ | $-jC_5$ | $-C_3$ | $t_4$ |
| 5 | 1 | $jC_1$ | $-jC_5$ | $C_3$ | $jC_1$ | $-jC_5$ | $-C_3$ | $-jC_1$ | $jC_5$ | $C_3$ | $-jC_1$ | $jC_5$ | $-C_3$ | $t_5$ |
| 6 | 1 | $jC_3$ | $jC_5$ | $C_1$ | $jC_3$ | $jC_5$ | $-C_1$ | $-jC_3$ | $-jC_5$ | $C_1$ | $-jC_3$ | $-jC_5$ | $-C_1$ | $t_6$ |
| 7 | 1 | $jC_3$ | $-jC_5$ | $C_1$ | $jC_3$ | $-jC_5$ | $-C_1$ | $-jC_3$ | $jC_5$ | $C_1$ | $-jC_3$ | $jC_5$ | $-C_1$ | $t_7$ |
| 8 | 2 | $C_{10}$ | $C_{13}$ | $C_{14}$ | $C_{10}$ | $C_{13}$ | $-C_{14}$ | $-C_{10}$ | $-C_{13}$ | $C_{14}$ | $-C_{10}$ | $-C_{13}$ | $-C_{14}$ | $t_8$ |
| 9 | 2 | $C_{10}$ | $-C_{13}$ | $C_{14}$ | $C_{10}$ | $-C_{13}$ | $-C_{14}$ | $-C_{10}$ | $C_{13}$ | $C_{14}$ | $-C_{10}$ | $C_{13}$ | $-C_{14}$ | $t_9$ |
| 10 | 2 | $jC_{10}$ | $jC_{13}$ | $C_{14}$ | $jC_{10}$ | $jC_{13}$ | $-C_{14}$ | $-jC_{10}$ | $-jC_{13}$ | $C_{14}$ | $-jC_{10}$ | $-jC_{13}$ | $-C_{14}$ | $t_{10}$ |
| 11 | 2 | $jC_{10}$ | $-jC_{13}$ | $C_{14}$ | $jC_{10}$ | $-jC_{13}$ | $-C_{14}$ | $-jC_{10}$ | $jC_{13}$ | $C_{14}$ | $-jC_{10}$ | $jC_{13}$ | $-C_{14}$ | $t_{11}$ |
| 12 | 2 | $jC_{10}$ | $jC_{14}$ | $C_{13}$ | $jC_{10}$ | $jC_{14}$ | $-C_{13}$ | $-jC_{10}$ | $-jC_{14}$ | $C_{13}$ | $-jC_{10}$ | $-jC_{14}$ | $-C_{13}$ | $t_{12}$ |
| 13 | 2 | $jC_{10}$ | $-jC_{14}$ | $C_{13}$ | $jC_{10}$ | $-jC_{14}$ | $-C_{13}$ | $-jC_{10}$ | $jC_{14}$ | $C_{13}$ | $-jC_{10}$ | $jC_{14}$ | $-C_{13}$ | $t_{13}$ |
| 14 | 2 | $jC_{13}$ | $jC_{14}$ | $C_{10}$ | $jC_{13}$ | $jC_{14}$ | $-C_{10}$ | $-jC_{13}$ | $-jC_{14}$ | $C_{10}$ | $-jC_{13}$ | $-jC_{14}$ | $-C_{10}$ | $t_{14}$ |
| 15 | 2 | $jC_{13}$ | $-jC_{14}$ | $C_{10}$ | $jC_{13}$ | $-jC_{14}$ | $-C_{10}$ | $-jC_{13}$ | $jC_{14}$ | $C_{10}$ | $-jC_{13}$ | $jC_{14}$ | $-C_{10}$ | $t_{15}$ |
| 16 | 3 | $C_0$ | $C_6$ | $C_{12}$ | $C_0$ | $C_6$ | $-C_{12}$ | $-C_0$ | $-C_6$ | $C_{12}$ | $-C_0$ | $-C_6$ | $-C_{12}$ | $t_{16}$ |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |
| 23 | 3 | $jC_6$ | $-jC_{12}$ | $C_0$ | $jC_6$ | $-jC_{12}$ | $-C_0$ | $-jC_6$ | $jC_{12}$ | $C_0$ | $-jC_6$ | $jC_{12}$ | $-C_0$ | $t_{20}$ |
| 24 | 4 | $C_4$ | $C_8$ | $C_{15}$ | $C_4$ | $C_8$ | $-C_{15}$ | $-C_4$ | $-C_8$ | $C_{15}$ | $-C_4$ | $-C_8$ | $-C_{15}$ | $t_{24}$ |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |
| 31 | 4 | $jC_8$ | $-jC_{15}$ | $C_4$ | $jC_8$ | $-jC_{15}$ | $-C_4$ | $-jC_8$ | $jC_{15}$ | $C_4$ | $-jC_8$ | $jC_{15}$ | $-C_4$ | $t_{31}$ |

NOTE: The code construction for code groups 0 to 15 using the SCH codes from code sets 1 and 2 is shown. The construction for code groups 16 to 31 using the SCH codes from code sets 3 and 4 is done in the same way.

# ~~8~~7.3 Evaluation of synchronisation codes

The evaluation of information transmitted in SCH on code group and frame timing is shown in table 6, where the 32 code groups are listed. Each code group is containing 4 specific scrambling codes (cf. subclause ~~6~~5A.3), each scrambling code associated with a specific short and long basic midamble code.

Each code group is additionally linked to a specific $t_{Offset}$, thus to a specific frame timing. By using this scheme, the UE can derive the position of the frame border due to the position of the SCH sequence and the knowledge of $t_{Offset}$. The complete mapping of Code Group to Scrambling Code, Midamble Codes and $t_{Offset}$ is depicted in table 6.

**Table 6: Mapping scheme for Cell Parameters, Code Groups, Scrambling Codes, Midambles and $t_{Offset}$**

| CELL PARA-METER | Code Group | Associated Codes | | | Associated $t_{Offset}$ |
|---|---|---|---|---|---|
| | | Scrambling Code | Long Basic Midamble Code | Short Basic Midamble Code | |
| 0 | Group 0 | Code 0 | $m_{PL0}$ | $m_{SL0}$ | $t_0$ |
| 1 | | Code 1 | $m_{PL1}$ | $m_{SL1}$ | |
| 2 | | Code 2 | $m_{PL2}$ | $m_{SL2}$ | |
| 3 | | Code 3 | $m_{PL3}$ | $m_{SL3}$ | |
| 4 | Group 1 | Code 4 | $m_{PL4}$ | $m_{SL4}$ | $t_1$ |
| 5 | | Code 5 | $m_{PL5}$ | $m_{SL5}$ | |
| 6 | | Code 6 | $m_{PL6}$ | $m_{SL6}$ | |
| 7 | | Code 7 | $m_{PL7}$ | $m_{SL7}$ | |
| . . . . | | | | | |
| 124 | Group 31 | Code 124 | $m_{PL124}$ | $m_{SL124}$ | $t_{31}$ |
| 125 | | Code 125 | $m_{PL125}$ | $m_{SL125}$ | |
| 126 | | Code 126 | $m_{PL126}$ | $m_{SL126}$ | |
| 127 | | Code 127 | $m_{PL127}$ | $m_{SL127}$ | |

For basic midamble codes $m_P$ cf. [7], annex A 'Basic Midamble Codes'.

Each cell shall cycle through two sets of cell parameters in a code group with the cell parameters changing each frame. Table 7 shows how the cell parameters are cycled according to the SFN.

**Table 7: Alignment of cell parameter cycling and SFN**

| Initial Cell Parameter Assignment | Code Group | Cell Parameter used when SFN mod 2 = 0 | Cell Parameter used when SFN mod 2 = 1 |
|---|---|---|---|
| 0 | Group 0 | 0 | 1 |
| 1 | | 1 | 0 |
| 2 | | 2 | 3 |
| 3 | | 3 | 2 |
| 4 | Group 1 | 4 | 5 |
| 5 | | 5 | 4 |
| 6 | | 6 | 7 |
| 7 | | 7 | 6 |
| . . . . | | | |
| 124 | Group 31 | 124 | 125 |
| 125 | | 125 | 124 |
| 126 | | 126 | 127 |
| 127 | | 127 | 126 |

# ~~9~~8 Synchronisation codes for the 1.28 Mcps option

## ~~9~~8.1 The downlink pilot timeslot (DwPTS)

The contents of DwPTS is composed of 64 chips of a SYNC-DL sequence, cf.[~~B~~AA.1 Basic SYNC-DL sequence] and 32 chips of guard period (GP). The SYNC-DL code is not scrambled

There should be 32 different basic SYNC-DL codes for the whole system.

For the generation of the complex valued SYNC-DL codes of length 64 , the basic binary SYNC-DL codes $= (s_1, s_2, \ldots, s_{64})$ of length 64 shown in Table~~-~~AA.1 ~~9~~ are used. The relation between the elements $\underline{\mathbf{s}}$ and $\mathbf{s}$ is given by:

$$\underline{s}_i = (\mathrm{j})^i \cdot s_i \qquad s_i \in \{1, -1\} \quad \mathrm{i} = 1, \ldots, 64 \tag{1}$$

Hence, the elements $\underline{\mathbf{s}}_i$ of the complex SYNC-DL code $\underline{\mathbf{s}}$ are alternating real and imaginary.

The SYNC-DL is QPSK modulated and the phase of the SYNC-DL is used to signal the presence of the P-CCPCH in the multi-frame of the resource units of code $c_{Q=16}^{(k=1)}$ and $c_{Q=16}^{(k=2)}$ in time slot #0.

### ~~9~~8.1.1 Modulation of the SYNC-DL

The SYNC-DL sequences are modulated with respect to the midamble ($m^{(1)}$) in time slot #0.

Four consecutive phases (phase quadruple) of the SYNC-DL are used to indicate the presence of the P-CCPCH in the following 4 sub-frames. In case the presence of a P-CCPCH is indicated, the next following sub-frame is the first sub-frame of the interleaving period. As QPSK is used for the modulation of the SYNC-DL, the phases 45, 135, 225, and 315° are used.

The total number of different phase quadruples is 2 (S1 and S2). A quadruple always starts with an even system frame number ((SFN mod 2) =0). Table 8 is showing the quadruples and their meaning.

**Table 8: Sequences for the phase modulation for the SYNC-DL**

| Name | Phase quadruple | Meaning |
|---|---|---|
| S1 | 135, 45, 225, 135 | There is a P-CCPCH in the next 4 sub-frames |
| S2 | 315, 225, 315, 45 | There is no P-CCPCH in the next 4 sub-frames |

## ~~9~~8.2 The uplink pilot timeslot (UpPTS)

The contents in UpPTS is composed of 128chips of a SYNC-UL sequence, cf. [~~B~~AA.2 Basic SYNC-UL sequence] and 32chips of guard period (GP) .The SYNC-UL code is not scrambled.

There should be 256 different basic SYNC-UL codes (see Table AA.2~~10~~) for the whole system.

For the generation of the complex valued SYNC-UL codes of length 128, the basic binary SYNC-UL codes $= (s_1, s_2, \ldots, s_{128})$ of length 128 shown in Table AA.2~~10~~ are used. The relation between the elements $\underline{\mathbf{s}}$ and $\mathbf{s}$ is given by:

$$\underline{s}_i = (\mathrm{j})^i \cdot s_i \qquad s_i \in \{1, -1\} \quad \mathrm{i} = 1, \ldots, 128 \tag{2}$$

Hence, the elements $\underline{\mathbf{s}}_i$ of the complex SYNC-UL code $\underline{\mathbf{s}}$ are alternating real and imaginary.

## ~~9~~8.3 Code Allocation

Relationship between the SYNC-DL and SYNC-UL sequences, the scrambling codes and the midamble codes

| **Code Group** | **Associated Codes** | | | |
|---|---|---|---|---|
| | SYNC-DL ID | SYNC-UL ID | Scrambling Code ID | Basic Midamble Code ID |
| Group 1 | 0 | 0...7 | 0 | 0 |
| | | | 1 | 1 |
| | | | 2 | 2 |
| | | | 3 | 3 |
| Group 2 | 1 | 8...15 | 4 | 4 |
| | | | 5 | 5 |
| | | | 6 | 6 |
| | | | 7 | 7 |
| . . . | | | | |
| Group 32 | 31 | 248...255 | 124 | 124 |
| | | | 125 | 125 |
| | | | 126 | 126 |
| | | | 127 | 127 |

# ~~10~~9 Cell synchronisation codes

The cell synchronisation codes (CSCs) are constructed as so-called CEC sequences, i.e. concatenated and periodically extended complementary sequences. They are complex-valued sequences that are derived as cyclically offset versions from a set of possible constituent Golay complementary pairs.

The CSCs are chosen to have good aperiodic auto correlation properties. The aperiodic auto correlations of the applicable constituent Golay complementary pairs and every pair of their derived cyclically offset versions are complementary. Furthermore, orthogonality is preserved for all CSCs which are derived from the same constituent Golay complementary pair due to this complementary property.

The delay and weight matrices for the set of M = 8 possible constituent Golay complementary pairs are listed in the table below:

| **Code ID *m*** | **Delay matrices $D_m$ and weight matrices $W_m$ of constituent Golay complementary pairs** |
|---|---|
| 0 | $D_0$ = <512, 64, 128, 1, 16, 4, 256, 32, 8, 2>, $W_0$ = <1, 1, 1, 1, -1, -1, 1, 1, 1, 1> |
| 1 | $D_1$ = <2, 16, 32, 256, 1, 8, 128, 4, 512, 64>, $W_1$ = <1, -1, 1, -1, 1, -1, -1, 1, -1, -1> |
| 2 | $D_2$ = <16, 512, 32, 256, 4, 1, 64, 8, 2, 128>, $W_2$ = <-1, 1, 1, -1, -1, 1, -1, 1, -1, -1> |
| 3 | $D_3$ = <512, 16, 8, 4, 2, 256, 128, 64, 32, 1>, $W_3$ = <-1, -1, -1, -1, -1, 1, -1, 1, 1, 1> |
| 4 | $D_4$ = <512, 128, 256, 32, 2, 4, 64, 1, 16, 8>, $W_4$ = <1, -1, 1, -1, -1, -1, -1, -1, -1, 1> |
| 5 | $D_5$ = <1, 2, 4, 64, 512, 16, 32, 256, 128, 8>, $W_5$ = <-1, 1, 1, 1, 1, -1, -1, 1, -1, 1> |
| 6 | $D_6$ = <8, 16, 128, 2, 32, 1, 256, 512, 4, 64>, $W_6$ = <-1, -1, 1, 1, 1, 1, -1, -1, -1, 1> |
| 7 | $D_7$ = <1, 2, 128, 16, 256, 32, 8, 512, 64, 4>, $W_7$ = <1, 1, -1, -1, -1, -1, 1, -1, -1, -1> |

A constituent Golay complementary pair of length N = 1024, defined as:

$$\mathrm{s}_m = \langle s_m(0), s_m(1), s_m(2), \ldots, s_m(1023)\rangle \text{ and } \mathrm{g}_m = \langle g_m(0), g_m(1), g_m(2), \ldots, g_m(1023)\rangle$$

shall be derived from the selected delay and weight matrices:

$$\mathrm{D}_m = \langle D_m(0), D_m(1), D_m(2), \ldots, D_m(9) \rangle \text{ and } \mathrm{W}_m = \langle W_m(0), W_m(1), W_m(2), \ldots, W_m(9) \rangle$$

as follows.

Define:

$$\mathrm{a}^{(0)} = \langle a^{(0)}(0), a^{(0)}(1), a^{(0)}(2), \ldots, a^{(0)}(1023) \rangle = \langle 1, 0, 0, \ldots, 0 \rangle \text{ and}$$

$$\mathrm{b}^{(0)} = \langle b^{(0)}(0), b^{(0)}(1), b^{(0)}(2), \ldots, b^{(0)}(1023) \rangle = \langle 1, 0, 0, \ldots, 0 \rangle.$$

Then, the elements of the set of auxiliary sequences:

$$\mathrm{a}^{(n)} = \langle a^{(n)}(0), a^{(n)}(1), a^{(n)}(2), \ldots, a^{(n)}(1023) \rangle \text{ and } \mathrm{b}^{(n)} = \langle b^{(n)}(0), b^{(n)}(1), b^{(n)}(2), \ldots, b^{(n)}(1023) \rangle$$

are given by the recursive relations:

$$a^{(n+1)}(i) = a^{(n)}(i) + W_m(n) \times b^{(n)}(i - D_m(n)) \text{ and}$$

$$b^{(n+1)}(i) = a^{(n)}(i) - W_m(n) \times b^{(n)}(i - D_m(n))$$

with element index $i = 0, 1, 2, \ldots, 1023$ and iteration index $n = 0, 1, 2, \ldots, 9$. Operations on the element index shall be performed modulo 1024.

The elements of the constituent Golay complementary pairs $\mathrm{s}_m$ and $\mathrm{g}_m$ are then obtained from the output of the last iteration step using:

$$s_m(i) = a^{(10)}(i) \text{ and } g_m(i) = b^{(10)}(i) \text{ for } i = 0, 1, 2, \ldots, 1023$$

From each applicable constituent Golay complementary pair $\mathrm{s}_m$ and $\mathrm{g}_m$, up to K = 8 different cyclically offset pairs $\mathrm{s}_m^{(k)}$ and $\mathrm{g}_m^{(k)}$, with offset index $k = 0, 1, 2, \ldots, \mathrm{K}-1$, of length 1152 chips can be derived. The complementary property of the respective aperiodic auto correlation is preserved for each particular pair of sequences $\mathrm{s}_m^{(k)}$ and $\mathrm{g}_m^{(k)}$. The generation of the K cyclically offset pairs from $\mathrm{s}_m$ and $\mathrm{g}_m$ is done in a similar way as the generation of the user midambles from a periodic basic midamble sequence as described in [7].

With N = 1024, K = 8, W = 128, the elements of a cyclically offset pair:

$$\mathrm{s}_m^{(k)} = \langle s_m^{(k)}(0), s_m^{(k)}(1), s_m^{(k)}(2), \ldots, s_m^{(k)}(1151) \rangle \text{ and } \mathrm{g}_m^{(k)} = \langle \mathrm{g}_m^{(k)}(0), \mathrm{g}_m^{(k)}(1), \mathrm{g}_m^{(k)}(2), \ldots, \mathrm{g}_m^{(k)}(1151) \rangle$$

for a particular offset $k$, with $k = 0, 1, 2, \ldots, \mathrm{K}-1$, shall be derived from the elements of the constituent Golay complementary pairs $\mathrm{s}_m$ and $\mathrm{g}_m$ using:

$$s_m^{(k)}(i) = (\mathrm{j})^i \times s_m(i + k \times \mathrm{W}) \text{ and } g_m^{(k)}(i) = (\mathrm{j})^i \times g_m(i + k \times \mathrm{W}) \text{ for } i = 0, 1, 2, \ldots, \mathrm{N} - k \times \mathrm{W} - 1,$$

$$s_m^{(k)}(i) = (\mathrm{j})^i \times s_m(i - \mathrm{N} + k \times \mathrm{W}) \text{ and } g_m^{(k)}(i) = (\mathrm{j})^i \times g_m(i - \mathrm{N} + k \times \mathrm{W}) \text{ for } i = \mathrm{N} - k \times \mathrm{W}, \mathrm{N} - k \times \mathrm{W} + 1, \ldots, 1151.$$

Hence, the elements of $\mathrm{s}_m^{(k)}$ and $\mathrm{g}_m^{(k)}$ are alternating real and imaginary.

Note that both $\mathrm{s}_m^{(0)}$ and $\mathrm{g}_m^{(0)}$ simply correspond to $\mathrm{s}_m$ and $\mathrm{g}_m$ respectively, followed by its first W elements as post extension and that both $\mathrm{s}_m^{(7)}$ and $\mathrm{g}_m^{(7)}$ simply correspond to the last W elements of $\mathrm{s}_m$ and $\mathrm{g}_m$ in form of a pre extension, followed by $\mathrm{s}_m$ and $\mathrm{g}_m$ respectively.

Finally, the CSC $\mathrm{C}_{CSC,\, m}^{(k)}$ derived from the $m$:th applicable constituent Golay complementary pair $\mathrm{s}_m$ and $\mathrm{g}_m$, and for the $k$:th offset is then defined as a concatenation of $\mathrm{s}_m^{(k)}$ and $\mathrm{g}_m^{(k)}$ by:

$$\mathrm{C}_{CSC,\, m}^{(k)} = \langle s_m^{(k)}(0), s_m^{(k)}(1), s_m^{(k)}(2), \ldots, s_m^{(k)}(1151), g_m^{(k)}(0), g_m^{(k)}(1), g_m^{(k)}(2), \ldots, g_m^{(k)}(1151) \rangle$$

where the leftmost element $s_m^{(k)}(0)$ in the sequence corresponds to the chip to be first transmitted in time. An CSC has therefore length 2304 chips.

Note that due to this construction method, the auto correlations for all CSCs derived from one particular constituent Golay complementary pair $\mathrm{s}_m$ and $\mathrm{g}_m$ can be obtained simultaneously and in sequential order from the sum of partial correlations with $\mathrm{s}_m$ and $\mathrm{g}_m$, these CSCs remaining orthogonal.

CSCs derived according to above have complex values and shall not be subject to the channelisation or scrambling process, i.e. its elements represent complex chips for usage in the pulse shaping process at modulation.

# Annex A (normative): Scrambling Codes

The applicable scrambling codes are listed below. Code numbers are referring to table 6 'Mapping scheme for Cell Parameters, Code Groups, Scrambling Codes, Midambles and $t_{offset}$' in subclause 7.3 'Evaluation of synchronisation codes'.

| Scrambling Code | $v_1$ | $v_2$ | $v_3$ | $v_4$ | $v_5$ | $v_6$ | $v_7$ | $v_8$ | $v_9$ | $v_{10}$ | $v_{11}$ | $v_{12}$ | $v_{13}$ | $v_{14}$ | $v_{15}$ | $v_{16}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code 0 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 |
| Code 1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 |
| Code 2 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 |
| Code 3 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 |
| Code 4 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 |
| Code 5 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 |
| Code 6 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 |
| Code 7 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 |
| Code 8 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 |
| Code 9 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 |
| Code 10 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 |
| Code 11 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 |
| Code 12 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 |
| Code 13 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 |
| Code 14 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 |
| Code 15 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 |
| Code 16 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 |
| Code 17 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 |
| Code 18 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 |
| Code 19 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 |
| Code 20 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 |
| Code 21 | 1 | 1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 |
| Code 22 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 |
| Code 23 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 |
| Code 24 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 |
| Code 25 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 |
| Code 26 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 |
| Code 27 | -1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 |
| Code 28 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 |
| Code 29 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 |
| Code 30 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 |
| Code 31 | 1 | 1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 |
| Code 32 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 |
| Code 33 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 |
| Code 34 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 |
| Code 35 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 |
| Code 36 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 |
| Code 37 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 |
| Code 38 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 |
| Code 39 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 |
| Code 40 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 |
| Code 41 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 |
| Code 42 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 |
| Code 43 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 |
| Code 44 | -1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 |
| Code 45 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 |

| Scrambling Code | $v_1$ | $v_2$ | $v_3$ | $v_4$ | $v_5$ | $v_6$ | $v_7$ | $v_8$ | $v_9$ | $v_{10}$ | $v_{11}$ | $v_{12}$ | $v_{13}$ | $v_{14}$ | $v_{15}$ | $v_{16}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code 46 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 |
| Code 47 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 |
| Code 48 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 |
| Code 49 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 |
| Code 50 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 |
| Code 51 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 |
| Code 52 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 |
| Code 53 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 |
| Code 54 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 |
| Code 55 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 |
| Code 56 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 |
| Code 57 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 |
| Code 58 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 |
| Code 59 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 |
| Code 60 | -1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 |
| Code 61 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 |
| Code 62 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 |
| Code 63 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 |
| Code 64 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 |
| Code 65 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 |
| Code 66 | -1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 |
| Code 67 | -1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 |
| Code 68 | 1 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 |
| Code 69 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 |
| Code 70 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 |
| Code 71 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 |
| Code 72 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 |
| Code 73 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 |
| Code 74 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 |
| Code 75 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 |
| Code 76 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 |
| Code 77 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 |
| Code 78 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 |
| Code 79 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 |
| Code 80 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 |
| Code 81 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 |
| Code 82 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 |
| Code 83 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 |
| Code 84 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 |
| Code 85 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | -1 |
| Code 86 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 |
| Code 87 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 |
| Code 88 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 |
| Code 89 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 |
| Code 90 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 |
| Code 91 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 |
| Code 92 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 |
| Code 93 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 |
| Code 94 | 1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 |
| Code 95 | 1 | 1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 |
| Code 96 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 |
| Code 97 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 |
| Code 98 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 |

| Scrambling Code | $v_1$ | $v_2$ | $v_3$ | $v_4$ | $v_5$ | $v_6$ | $v_7$ | $v_8$ | $v_9$ | $v_{10}$ | $v_{11}$ | $v_{12}$ | $v_{13}$ | $v_{14}$ | $v_{15}$ | $v_{16}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code 99 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 |
| Code 100 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 |
| Code 101 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 |
| Code 102 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 |
| Code 103 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 |
| Code 104 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 |
| Code 105 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 |
| Code 106 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 |
| Code 107 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 |
| Code 108 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | -1 |
| Code 109 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 |
| Code 110 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 |
| Code 111 | 1 | 1 | 1 | -1 | -1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 |
| Code 112 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 |
| Code 113 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 |
| Code 114 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 |
| Code 115 | 1 | -1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 |
| Code 116 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 |
| Code 117 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 |
| Code 118 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 |
| Code 119 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 |
| Code 120 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 |
| Code 121 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 |
| Code 122 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 |
| Code 123 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 |
| Code 124 | -1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 |
| Code 125 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | -1 |
| Code 126 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 |
| Code 127 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 |

# Annex ~~B~~AA (normative): Synchronisation sequence

## ~~B~~AA.1 Basic SYNC-DL sequence

**Table AA.1~~9~~: Basic SYNC-DL Codes**

| Code ID | SYNC-DL Codes of length 64 |
|---|---|
| 0 | B3A7CC05A98688E4 |
| 1 | 9D559BD290606791 |
| 2 | 2CE7BA12A017C3A2 |
| 3 | 34511D20672F4712 |
| 4 | 9A772841474603F2 |
| 5 | 9109B1A5CE01F228 |
| 6 | 8FD429B3594501C0 |
| 7 | 25251354AA3F8C19 |
| 8 | C9A3B8E0C043EA56 |
| 9 | BA04B888E5BC1802 |
| 10 | A735354299370207 |
| 11 | 74C3C8DA4415AE51 |
| 12 | F4FD0458A0124663 |
| 13 | A011D4E16C3D6064 |
| 14 | BDA0661B0CAA8C68 |
| 15 | 8E31123F28928698 |
| 16 | F095C1632E2906AB |
| 17 | B60B4A8A664071CF |
| 18 | AA094DCCE91E041A |
| 19 | C0C31CDA8A256807 |
| 20 | D516964FB18C1890 |
| 21 | 30DE01834F4AACCE |
| 22 | 8F700323BA5CAD34 |
| 23 | 1B50F4DEE0C1380C |
| 24 | 443382164F56F2D1 |
| 25 | E1E4005D49B846B4 |
| 26 | 040A97165330BFAA |
| 27 | C48E26881693AD78 |
| 28 | D4354B2FE02361CC |
| 29 | 5383AB6C8A10CE84 |
| 30 | D417A730F2F12244 |
| 31 | ABF0A0D905A939C4 |

## ~~B~~AA.2 Basic SYNC-UL Codes

**Table AA.2~~10~~: Basic SYNC-UL Codes**

| Code ID | SYNC-UL Codes of length 128 |
|---|---|
| 0 | C11C20F0D1807DB8859175B798EC094A |
| 1 | 91278068081EC8E74543DBC1C9AD4235 |
| 2 | 38F5AEE2E513DB12A663BA04160103E5 |
| 3 | 7AA8A0A210F12A1E4332F2EDD33011FC |
| 4 | C180EA3B9BA1774EB9611BD249C4A508 |
| 5 | B072A2C839489D496B98CE9D0132FBC9 |
| 6 | B2723EAC6EB01667F2B33961C8074234 |
| 7 | C4144AD060F0EC095E227B92CF7C8280 |
| 8 | 653036A10D3054146FCF815986C63A14 |
| 9 | F899CA61435D64DC07FDF04C4A0C053A |
| 10 | B56F2D6893A8051407F4C341D88DC7DC |
| 11 | DC0BE838242142EDE6413A72C88D74AA |
| 12 | 22A2FD86E4086C70A4860B13C76E579F |
| 13 | A3CBC21322C97D2A02728E7875F39588 |
| 14 | D4EC4F694A082CB38E3B1558A0FCC89F |
| 15 | CC891141C4E216D235C15CF5D3F9B002 |
| 16 | A1993114C50B77CB0C0725D1E22FD016 |
| 17 | 24F73A979DE52F82E8800CCB93842A59 |
| 18 | 8F878FA04659842E294D8DEAB20BA2FD |
| 19 | AC90B0442D70662B028CF76A6BECDF09 |
| 20 | D94A284DF64D7B0102F0E084C29C88C8 |
| 21 | 8603200C7596F24E865FD3815693358D |
| 22 | B466B12CF433642BD8B08F1F452E0550 |
| 23 | 86A3A1772C1C99FCA7DBBA0C312E34A0 |
| 24 | 622A1889F72A9A2C042D46F08EFEE1AC |
| 25 | BF220A362BC0D3B0D7CE400954C6CFAE |
| 26 | D28D73C52E89CF57905C502244F63616 |
| 27 | AD4E1C2103697D64D8B9D4C035D90548 |
| 28 | 8F081A9BA12B6C6BD024531AA984D21C |
| 29 | E4092429BE82988E1E3585BF6A6AE550 |
| 30 | 08BD36E0A9C061782CB38B35B335CA56 |
| 31 | 1CDFF3CC2685D1C44F4A1059AB03F40A |
| 32 | 506ED4E88FB1CECE3243F2A27A0221A4 |
| 33 | 846CF58A7AB613C83A24130B5778C0E2 |
| 34 | A2711A99E26A0C75AC026F4CFAECE893 |
| 35 | D846EEEBA2432AC05A01043C62579DCF |
| 36 | 6B16B4E851CAF2121FC4CF88820C89E7 |
| 37 | AA4889A78207674A74E10C6F2BE11D48 |
| 38 | 8534CF8145BC991052814ED5C72709EE |
| 39 | 01AEF15D2290A84A607425746D9963C7 |

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|---|---|
| 40 | 999188F758245D5164FE16D852942C71 |
| 41 | CF71C008599287E446E30745BD56E2D2 |
| 42 | 248414BA0DF8CDC4711FE7C8707ED0AD |
| 43 | EB2E263EC016191C81AB714BFE4D2B30 |
| 44 | 862082A7482FAC1C499793A0D8CED670 |
| 45 | DE2C22B2783AB75A7342608DE413840A |
| 46 | E31AA60B727F2CA2A78DAAC10665011D |
| 47 | CEF6CD06509870AC9E0177ACD550921D |
| 48 | E52C84D499FFCDC287581691471540F2 |
| 49 | B33BF6551A4322504BEE0930BCA1EC68 |
| 50 | 555BE6886D0FC43D72315E6C6D384148 |
| 51 | 8444F67451EE23CE1240C90F0B52A492 |
| 52 | 5C290D28E84060E69D09788A261B10FF |
| 53 | 337E0C35E83CD38CCC5D45804241F952 |
| 54 | A7879F0D31A8982A01EE6AC4952984DC |
| 55 | A37F506508928C70A83D69A2373781B9 |
| 56 | 42F55208EE12909803A7CBEB19B5419E |
| 57 | 57E5E268A328FCC9ED04B9E5420AC702 |
| 58 | EB033AD1222F84D8642C4E3FAAD28206 |
| 59 | 98EE1415F026AC0E862C520451697DD0 |
| 60 | 6A0528AEA4B7CD6702660D81F8821E19 |
| 61 | 763D626A87C603BCB09E1A4C800A378F |
| 62 | EEA61897879289340C23F669D6A03762 |
| 63 | A6571B3CC2D0E04F017ACC808B92DCE7 |
| 64 | DDF88B52EA1831D293A803CF23C8C471 |
| 65 | 6CA4D333A2684140475DAB491F61C17A |
| 66 | A7D2AD23043989A13289F7C3E135580A |
| 67 | B1C752FA66B41C81904EDE27EA000E2E |
| 68 | 8694BE3CC1CB36BE2A095F89CC619080 |
| 69 | 9C20334E1BBC596B25E151180BF99940 |
| 70 | 484256214F81070DD9C49A2B05A43DCE |
| 71 | 401A20BCBE29B7438A7AEE44635A9E23 |
| 72 | 8858585C3239CBF628033FA0DF189378 |
| 73 | EFA36404C1BA5118CC5F9052FD28D9C3 |
| 74 | 155609873D8A042D496E6477B747C4F8 |
| 75 | 8446077883A6D7D2549CC9742E3FD023 |
| 76 | E630142B189AA209371A6F0FFDBC30A7 |
| 77 | C46060535AC6DBB2095F1D7826D0CD5C |
| 78 | E00D19E48797148B28DEDA9D429362E2 |
| 79 | 645DE447E938485489416CAFCC1C571F |
| 80 | DA10AFBF2AE61C593A1D88584DE30598 |
| 81 | BB248AEA5FD3FE210CD48FC401E1A686 |
| 82 | A89F146BD9191F445301C081CB6F5625 |
| 83 | 15BBF04F247C59150208949EB6B9CC58 |

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|---|---|
| 84 | 08F48BFA7804B5B2CC2E96510232E062 |
| 85 | 9AA2BE74005A3679C626B209580B8D03 |
| 86 | 9D40664A2C808F2F293E255398B37E6A |
| 87 | 6869C98A8AAD81CAE41A23C83FF9EEA0 |
| 88 | 576E8948E61BD0927C4140C3C04C4CF3 |
| 89 | 0F942C67A1137B6EAA058C2A74872C73 |
| 90 | 9D058E27ED546C10632684BBC84E5BC1 |
| 91 | 79D4B840E20148B134F90B51164BCBD0 |
| 92 | 0E35E1D8D1214C05FAC790B69B239150 |
| 93 | FFA1BB0232CD71480BE5CA1C2A269F89 |
| 94 | B2956F5F4E270446F9211584792628DB |
| 95 | F56CCA23421C8EC8F8A41F7DA4A41EA2 |
| 96 | 0B5ECA04F1789A7148C80C39D57D05F6 |
| 97 | A10B538E8A8CFC8F8925C485F2A88660 |
| 98 | 9925C2C715001D9FC78ACCC51DA1AF34 |
| 99 | 0DAC9CFDEA40429A8B12C7D320D60F70 |
| 100 | 377FC9A097017958440914E83118E39D |
| 101 | 8421096FA8B47E4E943B6473671955CC |
| 102 | 574086183477C4F68540CB7E858263B1 |
| 103 | 895B6A8980C6703C779F49F40C5CFC19 |
| 104 | D0D253E157BC19262150CEA668679E71 |
| 105 | B8889C60EBA812BD7F0B6498823296D2 |
| 106 | A13FB9F3A08528E44B13C12CF0D461AA |
| 107 | 8D4DCFBE43D6E2024B1F8470224AA330 |
| 108 | 536D159E119E0893838657B12A074E64 |
| 109 | DCFD49C504AD3A2F049A0CB70238EC8A |
| 110 | D363DB4C46C11757FA8FB18139789102 |
| 111 | 424A1E8A1D4DA256E4CA3BC8C2201BE3 |
| 112 | 417B619ED30FEB0A847CC3A191A20398 |
| 113 | 843FBBC95453C61786D1332612B45B4D |
| 114 | F26CACC0732CF8ED0C5BC1462B1620B4 |
| 115 | 88E0FE440C70E9249A92A7AF94638880 |
| 116 | 99A52B7D8C950308057E0661D7459960 |
| 117 | A5C28218BF5D16E63E42698A0A6B0896 |
| 118 | B2763BEEC784A12E8C50778536921806 |
| 119 | 987B2B6A3A77A059B30A082457AB84E0 |
| 120 | 820DB500F1B206358D7A7F210AB85AA8 |
| 121 | 97760A5CFC5E03EB439C914590045938 |
| 122 | 896A720E8857C8708A59F8C94DE0841E |
| 123 | 2D101F0CF95263843412577340DEBB11 |
| 124 | E8E5214B4DCF5D11A245B0149D49C87C |
| 125 | 51224EAA10099ACDE384834A5ADF03D8 |
| 126 | 64E51253554A230C186FDE4E8781BC09 |
| 127 | A499E391E69ED08890AC1A82A6115BEC |

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|---|---|
| 128 | EE54C6E1834210D3EC1B07A456B92AA8 |
| 129 | 949DB5CA82420B54C1E0BCC111E704D9 |
| 130 | 9439EE9A9E4C447D1AA350926495047F |
| 131 | AD095CC0E7438AECE38D60980B3F2D00 |
| 132 | 83089C254C5EE9788072BC3D9282F798 |
| 133 | A27DC1A457BC5A56563D8A9B11203615 |
| 134 | 713053A9C0B1B08B14705FF5A7244DB4 |
| 135 | D36D4B9F4007354E0EC1B0CA8C8C7124 |
| 136 | 82E7C990612114F1CCE1BD9509FD4386 |
| 137 | C8D83FF0B48B14830D2015D53F8C0672 |
| 138 | 08AF223C869A36B169148FDDABB7D120 |
| 139 | B6C284C600AD0A99F86C449F8F4C53A6 |
| 140 | DC741B320C07682AF92AC4DBDE0C28C2 |
| 141 | 89B8D84FA902265850C0FA6FF0EB2C4F |
| 142 | A69445B3A52201DB984BC03D1956D7F3 |
| 143 | 0FE0F7224B7AD72E4D4530D0223F590C |
| 144 | 1B8C06F051434048EB925133AD3BD3F9 |
| 145 | E133D4C3C942726A351300C37E55D0DF |
| 146 | 9E09481D1881A66F562D8B453BC83AB2 |
| 147 | 2397B04B60A3C5700907BDBBA4E818C8 |
| 148 | 8F81F7A08CC6C8DA3D692AD34F50C012 |
| 149 | 9AB325352981BCCFA072F8FDE3009221 |
| 150 | 4FA88B7F1F8A620C31B0D486C52AC2F6 |
| 151 | 097AF0ADD16D7D39851049F0130EE444 |
| 152 | A5027732DACFF11C388D5820A4A9BA49 |
| 153 | 1CD981EA2EDB46218A407C7E20D4BE84 |
| 154 | D0FD94279FA67EC61A3904C0AD8ACA04 |
| 155 | EA73A9415EC2004D49E9D0F645961C75 |
| 156 | 005AF0614A7552041194DEECBF8DD016 |
| 157 | B514481533DA0A731705B93CF634E40D |
| 158 | 983054521841A6E4FF34B2C07B5684FE |
| 159 | C46D927D0FD2B2F509550025677C6871 |
| 160 | 2AD85C08127487C87ECE014D65169102 |
| 161 | 0F617852FA3930AA7EE74B400B2CC831 |
| 162 | AE9D395004C6E27540C378625D36E0D6 |
| 163 | DC4FA55750F10B0636248F12C212FFE4 |
| 164 | D3602B8D6CBF1809C88B827185631ECF |
| 165 | A94825850708E7723EA8F22C44BF78B2 |
| 166 | A62D231C16AEEFE0B0026B306662945A |
| 167 | 9C7BE810A86465A50551F89125D93B12 |
| 168 | 9712D9338B9CC60485C10172F50F121F |
| 169 | A3902CE0E0B9912591FF28C695728257 |
| 170 | 4167057891AB29473A9E0F67F3658921 |
| 171 | B3368B91EC12A284BC414C8F0D7F8D20 |

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|---|---|
| 172 | EE21888101ABF06C1175828CB58B598D |
| 173 | E43923A00ECC32CCC2D162A4A44BD7F4 |
| 174 | CC9E30B8538AD51703EEB6F70801AB22 |
| 175 | B908AD2F1501DA1C156811736CD798CD |
| 176 | 2B46302ACCC2F808797FC648A614326D |
| 177 | 8A54494F1BE27235B8764023AA0FBCFA |
| 178 | BC1041E6F636421E89277DC154439103 |
| 179 | 275B39A63029B974E3561AE0A8FC8032 |
| 180 | 9283F6FE819B80492A22B85CE5CE5DC4 |
| 181 | 4CCB52C0CE058A78022C22DF5788CBCC |
| 182 | B0DF9608DE549A6F6C581516919A81E6 |
| 183 | 2CA185163CC36060D1E85BB0A7FBB988 |
| 184 | 66101D2846155CAC986FC790D2124EFC |
| 185 | 8016E3904644D2093579B83BD7AB5071 |
| 186 | 531CAB7085BEC1425743965802364 7CF |
| 187 | DF2910165AA5051E41F6EB198E4D491C |
| 188 | BA32052042B0FB2188DE7857DA1B6788 |
| 189 | 9E6D075AFF0EA4153615E140BF380666 |
| 190 | 9ACC5A037902534642A3BE391AA40F9B |
| 191 | 4D741A3B4499843010D7E5FA8988DC80 |
| 192 | FA1421C96EDC6092726154560B1C2FC8 |
| 193 | 882946076223CAE0B0BFE3EDA59826D5 |
| 194 | CEBB288C28B7472A0D3917012276C034 |
| 195 | BD35A6E00C9528DB38289CF823C34F30 |
| 196 | E2C93618B6B2800D51171A5F85746A55 |
| 197 | B43EF39A1A64F0E220AF740F9494291B |
| 198 | AC537817C2612744A58132A8AFBC44A3 |
| 199 | 98A321249A821DDBF81C38235A371A14 |
| 200 | AE1D46069090D81BB6B08FED9E687285 |
| 201 | 7EAE2415DC2CD60AE083249A33B56E05 |
| 202 | 3D942AAA9BC9F27289421CE0B301FB98 |
| 203 | 1548BA6D08530727AC6D059C005C6C42 |
| 204 | FF47C21142C65B502DA70647BAE831D1 |
| 205 | C83AA7FEAC5E51A08091E10DB0C233D9 |
| 206 | E86EDD2EC2DAA3104229EDC43471A16A |
| 207 | 22FAFB9C184B78B56EE91B6602C03244 |
| 208 | E45631DC509B1290C08D2C1A1F15DBFE |
| 209 | D203C51207092B56568FDAD9E2D44473 |
| 210 | 2AA87F31A7D1AB1C90024F936006C4A5 |
| 211 | 913136153593DEABC7305BF0C5A62180 |
| 212 | D8DA5FE401F2758642A082C53A6A5CB8 |
| 213 | 23C2295213147F324DE8EC1C103BAE88 |
| 214 | 883AF097FCDE82B366A1844245E0D727 |
| 215 | 79E5E9F8C933159ACADC22A06F900A70 |

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|---|---|
| 216 | FE40502B44A9E44B2C336250D47538CC |
| 217 | 670452E19172C843176F1278FE41D584 |
| 218 | B7EAA436078E6886A3024F593AD57580 |
| 219 | 1044D4CDD7230E7B1953AD1232DF07E2 |
| 220 | 4D821ECAC3D845A2E1011695624576FF |
| 221 | 96622ED2FBD44D1B859D70601999F438 |
| 222 | CCC31C3D6D5B41B8D82FF4522A4C0146 |
| 223 | 4A84F7CD62E0C712980E6A0C89BF394F |
| 224 | 10E56751F000927284DBE174E68ECC4C |
| 225 | A3DE70921356F026E084CFE302A210A9 |
| 226 | B12DA0621B343A8C3FE941A32EA5D571 |
| 227 | D653135DE825A74B743E275C19020C71 |
| 228 | 5CAD301BF846B2EE921D33A3D4BB1220 |
| 229 | 1292445ACBB548C668FC3853578474E6 |
| 230 | B94B4B89C0654688C9E007D9061DF5FE |
| 231 | 75A2C91E76061A8680884E8BFD14A64A |
| 232 | 83726F3070B47ECE21504A5065D74A36 |
| 233 | 964A471444A270840919F7FE07382D14 |
| 234 | A582701EBFCA899B8497088C3560F300 |
| 235 | 64FCB63E21CAC63002D1E09FD1543274 |
| 236 | B1E1C83F689ADF422C865F98D288838A |
| 237 | A06A0D822165D3F3416B47419ECCB547 |
| 238 | 1D2068039A32B7EF728914ECE07CB416 |
| 239 | 64C0CF81F78E8823ECC8661A5295422A |
| 240 | 902A7243F593F2180E5A306A8438E6A9 |
| 241 | A4CCED356D56BF1B41C28E1504301FE8 |
| 242 | 82AE90E2F76B3055A2E3A966025CC01A |
| 243 | 8B90D5A62364E18574145C5895CEFF60 |
| 244 | 43F7EA1AB0D19032551AD9DE21307353 |
| 245 | DD5D8424AC60360B1C14E65815C9B15E |
| 246 | C632A67382ECB2681DFB8525140E2878 |
| 247 | 3A6ACF212B6F8B9C53FF224C2E00C16C |
| 248 | 86A90C267B1171093F362FE5CB14E3A0 |
| 249 | EA262EC36E6589C3BB005426AF2590F4 |
| 250 | 200F03126C5B0D7B901128E7757C5F70 |
| 251 | 68FC090C2221AA98BF0D24E85066EFC2 |
| 252 | 9E26CEC67832FC42A87E92FA1015212E |
| 253 | ACD889634F79506F2582EA03240F2A07 |
| 254 | AA65407E1F4A33BF9A62860A3D6A4CC0 |
| 255 | B1B950AC76A608AA32D04B03C7FF24D3 |

# Annex ~~C~~B (informative): Generalised Hierarchical Golay Sequences

## ~~C~~B.1 Alternative generation

The generalised hierarchical Golay sequences for the PSC described in 7.1 may be also viewed as generated (in real valued representation) by the following methods:

Method 1.

The sequence y is constructed from two constituent sequences $x_1$ and $x_2$ of length $n_1$ and $n_2$ respectively using the following formula:

- $y(i) = x_2(i \bmod n_2) * x_1(i \operatorname{div} n_2)$, $i = 0 \ldots (n_1 * n_2) - 1$.

The constituent sequences $x_1$ and $x_2$ are chosen to be the following length 16 (i.e. $n_1 = n_2 = 16$) sequences:

- $x_1$ is defined to be the length 16 ($N^{(1)}=4$) Golay complementary sequence obtained by the delay matrix $D^{(1)} = [8, 4, 1,2]$ and weight matrix $W^{(1)} = [1, -1, 1,1]$.
- $x_2$ is a generalised hierarchical sequence using the following formula, selecting s=2 and using the two Golay complementary sequences $x_3$ and $x_4$ as constituent sequences. The length of the sequence $x_3$ and $x_4$ is called $n_3$ respectively $n_4$.
- $x_2(i) = x_4(i \bmod s + s*(i \operatorname{div} sn_3)) * x_3((i \operatorname{div} s) \bmod n_3)$, $i = 0 \ldots (n_3 * n_4) - 1$.
- $x_3$ and $x_4$ are defined to be identical and the length 4 ($N^{(3)}= N^{(4)}=2$) Golay complementary sequence obtained by the delay matrix $D^{(3)} = D^{(4)} = [1, 2]$ and weight matrix $W^{(3)} = W^{(4)} = [1, 1]$.

The Golay complementary sequences $x_1$,$x_3$ and $x_4$ are defined using the following recursive relation:

$$a_0(k) = \delta(k) \text{ and } b_0(k) = \delta(k);$$

$$a_n(k) = a_{n-1}(k) + W^{(j)}_n \cdot b_{n-1}(k-D^{(j)}_n);$$

$$b_n(k) = a_{n-1}(k) - W^{(j)}_n \cdot b_{n-1}(k-D^{(j)}_n);$$

$$k = 0, 1, 2, \ldots, 2^{**}N^{(j)} -1;$$

$$n = 1, 2, \ldots, N^{(j)}.$$

The wanted Golay complementary sequence $x_j$ is defined by $a_n$ assuming $n=N^{(j)}$. The Kronecker delta function is described by $\delta$, k,j and n are integers.

Method 2

The sequence y can be viewed as a pruned Golay complementary sequence and generated using the following parameters which apply to the generator equations for a and b above:

(a) Let j = 0, $N^{(0)} = 8$.

(b) $[D_1^0,D_2^0,D_3^0,D_4^0,D_5^0,D_6^0,D_7^0,D_8^0] = [128, 64, 16, 32, 8, 1, 4, 2]$.

(c) $[W_1^0,W_2^0,W_3^0,W_4^0,W_5^0,W_6^0,W_7^0,W_8^0] = [1, -1, 1, 1, 1, 1, 1, 1]$.

(d) For n = 4, 6, set $b_4(k) = a_4(k)$, $b_6(k) = a_6(k)$.

# Annex ~~D~~C (informative): Change history

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 14/01/00 | RAN_05 | RP-99593 | - | | Approved at TSG RAN #5 and placed under Change Control | - | 3.0.0 |
| 14/01/00 | RAN_06 | RP-99696 | 001 | 01 | Primary and Secondary CCPCH in TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99695 | 003 | 1 | Alignment of Terminology Regarding Spreading for TDD Mode | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99696 | 004 | - | Code allocation for Case 3 | 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-000069 | 002 | 3 | Cycling of cell parameters | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000069 | 005 | - | Removal of Synchronisation Case 3 in TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000069 | 006 | 1 | Signal Point Constellation | 3.1.1 | 3.2.0 |
| 03/05/00 | - | - | - | - | Revision marks accepted to create clean version | 3.2.0 | 3.2.1 |
| 26/06/00 | RAN_08 | RP-000273 | 008 | - | Editorial Modifications for 25.223 | 3.2.1 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000273 | 009 | - | Editorial modification of 25.223 | 3.2.1 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000273 | 010 | - | Editorial modification of 25.223 | 3.2.1 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000273 | 011 | 2 | Editorial modification of 25.223 | 3.2.1 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000273 | 012 | 2 | Modified code sets on SCH for cell search in UTRA TDD | 3.2.1 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000273 | 013 | 1 | Editorial update of TS25.223 | 3.2.1 | 3.3.0 |
| 23/09/00 | RAN_09 | RP-000346 | 007 | 1 | Gain Factors for TDD Mode | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000346 | 014 | - | Synchronisation codes | 3.3.0 | 3.4.0 |
| 16/03/01 | RAN_11 | - | - | - | Approved as Release 4 specification (v4.0.0) at TSG RAN #11 | 3.4.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010064 | 015 | 1 | Code specific phase offsets for TDD | 3.4.0 | 4.0..0 |
| 16/03/01 | RAN_11 | RP-010073 | 016 | - | Cell synchronisation codes for R'4 Node B sync over air interface in UTRA TDD | 3.4.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010071 | 017 | 1 | Inclusion of 1.28Mcps TDD in TS 25.223 | 3.4.0 | 4.0.0 |
| 15/06/01 | RAN_12 | RP-010337 | 019 | - | Addition to the abbreviation list and definition of a constant | 4.0.0 | 4.1.0 |
| 21/09/01 | RAN_13 | RP-010524 | 021 | 1 | Clarification of notations in TS25.221 and TS25.223 | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010530 | 022 | 1 | Clarification of notations in TS25.221 and TS25.223 | 4.1.0 | 4.2.0 |
| 14/12/01 | RAN_14 | RP-010748 | 023 | - | A correction of Figure 7 in subclause 7.7.2 of TS 25.223 | 4.2.0 | 4.3.0 |
| 08/03/03 | RAN_15 | RP-020051 | 025 | 1 | Removal of quantisation of bj gain factor when calculated from a reference TFC | 4.3.0 | 4.4.0 |
| 08/03/03 | RAN_15 | RP-020051 | 028 | - | Channelisation code-specific multiplier operation under autonomous SF change | 4.3.0 | 4.4.0 |
| 08/03/03 | RAN_15 | RP-020051 | 030 | - | Alignment of gamma(i) gains of 25.223 with SIR target of WG2 25.331 | 4.3.0 | 4.4.0 |
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**3GPP TSG-RAN1 Meeting #29**
**Shanghai, China, 5 – 8 November 2002**

***R1-02-1391***

*CR-Form-v7*

# CHANGE REQUEST

| | | | | | | |
|---|---|---|---|---|---|---|
| ⌘ | **25.223** | **CR 33** | ⌘ **rev** | **-** | ⌘ Current version: | **5.1.0** ⌘ |

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

***Proposed change affects:*** UICC apps⌘ [ ] ME [X] Radio Access Network [X] Core Network [ ]

| | | | | |
|---|---|---|---|---|
| ***Title:*** | ⌘ | Editorial modification to the section numberings | | |
| ***Source:*** | ⌘ | TSG RAN WG1 | | |
| ***Work item code:*** | ⌘ | TEI5 | ***Date:*** ⌘ | 30/10/2002 |
| ***Category:*** | ⌘ | **D** | ***Release:*** ⌘ | Rel-5 |
| | | *Use one of the following categories:*<br>***F*** *(correction)*<br>***A*** *(corresponds to a correction in an earlier release)*<br>***B*** *(addition of feature),*<br>***C*** *(functional modification of feature)*<br>***D*** *(editorial modification)*<br>Detailed explanations of the above categories can be found in 3GPP TR 21.900. | | *Use one of the following releases:*<br>*2 (GSM Phase 2)*<br>*R96 (Release 1996)*<br>*R97 (Release 1997)*<br>*R98 (Release 1998)*<br>*R99 (Release 1999)*<br>*Rel-4 (Release 4)*<br>*Rel-5 (Release 5)*<br>*Rel-6 (Release 6)* |

| | | |
|---|---|---|
| ***Reason for change:*** | ⌘ | The numbering used is not consistent with TS21.801, and subcaluses displaced. |
| ***Summary of change:*** | ⌘ | The sections, figures, and tables numberings are adjusted to follow the guidlines given in TS21.801, and subclauses in section 5.2 repositioned in line with R4. |
| ***Consequences if not approved:*** | ⌘ | Confusion and misunderstanding, not consistent with specification guidelines, the rest of the document, and also with R4. |

| | | | | | | |
|---|---|---|---|---|---|---|
| ***Clauses affected:*** | ⌘ | All the document | | | | |
| | | **Y** | **N** | | | |
| ***Other specs affected:*** | ⌘ | | **X** | Other core specifications | ⌘ | |
| | | | **X** | Test specifications | | |
| | | | **X** | O&M Specifications | | |
| ***Other comments:*** | ⌘ | | | | | |

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

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

# Contents

# Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

# 1 Scope

The present document describes spreading and modulation for UTRA Physical Layer TDD mode.

# 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 25.201: "Physical layer - general description".

[2] 3GPP TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)".

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

[4] 3GPP TS 25.213: "Spreading and modulation (FDD)".

[5] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[6] 3GPP TS 25.215: "Physical layer – Measurements (FDD)".

[7] 3GPP TS 25.221: "Physical channels and mapping of transport channels onto physical channels (TDD)".

[8] 3GPP TS 25.222: "Multiplexing and channel coding (TDD)".

[9] 3GPP TS 25.102: "UTRA (UE) TDD; Radio Transmission and Reception".

[10] 3GPP TS 25.105: "UTRA (BS) TDD; Radio Transmission and Reception".

[11] 3GPP TS25.308: High Speed Downlink Packet Access (HSDPA); Overall description; Stage 2

# 3 Symbols and abbreviations

## 3.1 Symbols

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

$C_p$: PSC
$C_i$: i:th secondary SCH code
$C_{CSC,\,m}^{(k)}$: CSC derived as *k*:th offset version from *m*:th applicable constituent Golay complementary pair

## 3.2 Abbreviations

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

16QAM 16 Quadrature Amplitude Modulation

| | |
|---|---|
| CCTrCH | Coded Composite Transport Channel |
| DPCH | Dedicated Physical Channel |
| CDMA | Code Division Multiple Access |
| CSC | Cell Synchronisation Code |
| FDD | Frequency Division Duplex |
| HS-PDSCH | High Speed Physical Downlink Shared Channel |
| MIB | Master Information Block |
| OVSF | Orthogonal Variable Spreading Factor |
| P-CCPCH | Primary Common Control Physical Channel |
| PN | Pseudo Noise |
| PRACH | Physical Random Access Channel |
| PSC | Primary Synchronisation Code |
| QPSK | Quadrature Phase Shift Keying |
| RACH | Random Access Channel |
| SCH | Synchronisation Channel |
| SF | Spreading Factor |
| SFN | System Frame Number |
| TDD | Time Division Duplex |
| TFC | Transport Format Combination |
| UE | User Equipment |
| UL | Uplink |

# 4 General

In the following, a separation between the data modulation and the spreading modulation has been made. The data modulation for 3.84Mcps TDD is defined in clause 5 'Data modulation for the 3.84 Mcps option', the data modulation for 1.28Mcps TDD is defined in clause 5A~~6~~ 'Data modulation for the 1.28 Mcps option' and the spreading modulation in clause 6~~7~~ 'Spreading modulation'.

**Table 1: Basic modulation parameters**

| | | |
|---|---|---|
| Chip rate | same as FDD basic chiprate: 3.84 Mchip/s | Low chiprate: 1.28 Mchip/s |
| Data modulation | QPSK,16QAM (HS-PDSCH only) | QPSK, 8PSK,16QAM (HS-PDSCH only) |
| Spreading characteristics | Orthogonal Q chips/symbol, where $Q = 2^p$, $0 <= p <= 4$ | Orthogonal Q chips/symbol, where $Q = 2^p$, $0 <= p <= 4$ |

# 5 Data modulation for the 3.84 Mcps option

## 5.1 Symbol rate

The symbol duration $T_S$ depends on the spreading factor Q and the chip duration $T_C$: $T_s = Q \times T_c$, where $T_c = \frac{1}{chiprate}$.

# 5.2 Mapping of bits onto signal point constellation

## 5.2.1 Mapping for burst type 1 and 2 ~~QPSK modulation~~

### 5.2.1.1 QPSK modulation ~~Mapping for burst type 1 and 2~~

The data modulation is performed to the bits from the output of the physical channel mapping procedure in [8] and combines always 2 consecutive binary bits to a complex valued data symbol. Each user burst has two data carrying parts, termed data blocks:

$$\underline{\mathbf{d}}^{(k,i)} = \left(\underline{d}_1^{(k,i)}, \underline{d}_2^{(k,i)}, \ldots, \underline{d}_{N_k}^{(k,i)}\right)^T, \quad i = 1,2; k = 1,\ldots,K_{Code} \qquad (1)$$

$K_{Code}$ is the number of used codes in a time slot, max $K_{Code}$ =16. $N_k$ is the number of symbols per data field for the code k. This number is linked to the spreading factor $Q_k$ as described in table 1 of [7].

Data block $\underline{\mathbf{d}}^{(k,1)}$ is transmitted before the midamble and data block $\underline{\mathbf{d}}^{(k,2)}$ after the midamble. Each of the $N_k$ data symbols $\underline{d}_n^{(k,i)}$; i=1, 2; k=1,...,$K_{Code}$; n=1,...,$N_k$; of equation 1 has the symbol duration $T_s^{(k)}$=$Q_k$.$T_c$ as already given.

The data modulation is QPSK, thus the data symbols $\underline{d}_n^{(k,i)}$ are generated from two consecutive data bits from the output of the physical channel mapping procedure in [8]:

$$b_{l,n}^{(k,i)} \in \{0,1\}, \quad l = 1,2; k = 1,\ldots,K_{Code}; n = 1,\ldots,N_k; i = 1,2 \qquad (2)$$

using the following mapping to complex symbols:

| consecutive binary bit pattern | complex symbol |
|---|---|
| $^{(k,i)}_{1,n}$ $^{(k,i)}_{2,n}$ | $\underline{d}_n^{(k,i)}$ |
| 00 | +j |
| 01 | +1 |
| 10 | -1 |
| 11 | -j |

The mapping corresponds to a QPSK modulation of the interleaved and encoded data bits $b_{l,n}^{(k,i)}$ of equation 2.

### 5.2.1.2 16QAM modulation ~~Mapping for burst type 3~~

The data modulation is performed to the bits from the output of the physical channel mapping procedure. In case of 16QAM, modulation 4 consecutive binary bits are represented by one complex valued data symbol. Each user burst has two data carrying parts, termed data blocks:

$$\underline{\mathbf{d}}^{(k,i)} = (\underline{d}_1^{(k,i)}, \underline{d}_2^{(k,i)}, \ldots, \underline{d}_{N_k}^{(k,i)})^{\mathrm{T}} \quad \mathrm{i} = 1, 2; \mathrm{k} = 1,\ldots,\mathrm{K}. \qquad (1)$$

$N_k$ is the number of symbols per data field for the user k. This number is linked to the spreading factor $Q_k$.

Data block $\underline{\mathbf{d}}^{(k,1)}$ is transmitted before the midamble and data block $\underline{\mathbf{d}}^{(k,2)}$ after the midamble. Each of the $N_k$ data symbols $\underline{d}_n^{(k,i)}$; i=1, 2; k=1,...,K; n=1,...,$N_k$; of equation 3 has the symbol duration $T_s^{(k)}$=$Q_k$.$T_c$ as already given.

The data modulation is 16QAM, thus the data symbols $\underline{d}_n^{(k,i)}$ are generated from 4 consecutive data bits from the output of the physical channel mapping procedure in [8]:

using the following mapping to complex symbols:

| Consecutive binary bit pattern | complex symbol |
|---|---|
| $b_{1,n}^{(k,i)}\, b_{2,n}^{(k,i)}\, b_{3,n}^{(k,i)}\, b_{4,n}^{(k,i)}$ | $\underline{d}_n^{(k,i)}$ |
| 0000 | $j\frac{1}{\sqrt{5}}$ |
| 0001 | $-\frac{1}{\sqrt{5}}+j\frac{2}{\sqrt{5}}$ |
| 0010 | $\frac{1}{\sqrt{5}}+j\frac{2}{\sqrt{5}}$ |
| 0011 | $j\frac{3}{\sqrt{5}}$ |
| 0100 | $\sqrt{\frac{1}{5}}$ |
| 0101 | $\frac{2}{\sqrt{5}}-j\frac{1}{\sqrt{5}}$ |
| 0110 | $\frac{2}{\sqrt{5}}+j\frac{1}{\sqrt{5}}$ |
| 0111 | $\frac{3}{\sqrt{5}}$ |
| 1000 | $-\frac{1}{\sqrt{5}}$ |
| 1001 | $-\frac{2}{\sqrt{5}}+j\frac{1}{\sqrt{5}}$ |
| 1010 | $-\frac{2}{\sqrt{5}}-j\frac{1}{\sqrt{5}}$ |
| 1011 | $-\frac{3}{\sqrt{5}}$ |
| 1100 | $-j\frac{1}{\sqrt{5}}$ |
| 1101 | $\frac{1}{\sqrt{5}}-j\frac{2}{\sqrt{5}}$ |
| 1110 | $-\frac{1}{\sqrt{5}}-j\frac{2}{\sqrt{5}}$ |
| 1111 | $-j\frac{3}{\sqrt{5}}$ |

The mapping corresponds to a 16QAM modulation of the interleaved and encoded data bits $b_{l,n}^{(k,i)}$ of the table above and $\underline{d}_n^{(k,i)}$ of equation 3.

~~In case of burst type 3, the definitions in subclause 5.2.1 apply with a modified number of symbols in the second data block. For the burst type 3, the number of symbols in the second data block $\underline{\mathbf{d}}^{(k,2)}$ is decreased by $\frac{96}{Q_K}$ symbols.~~

## 5.2.2 Mapping for burst type 316QAM modulation

In case of burst type 3, the definitions in subclause 5.2.1.1 apply with a modified number of symbols in the second data block. For the burst type 3, the number of symbols in the second data block $\underline{\mathbf{d}}^{(k,2)}$ is decreased by $\frac{96}{Q_k}$ symbols.

### 5.2.2.1 Mapping for burst type 1 and 2

The data modulation is performed to the bits from the output of the physical channel mapping procedure. In case of 16QAM, modulation 4 consecutive binary bits are represented by one complex valued data symbol. Each user burst has two data carrying parts, termed data blocks:

$$\underline{\mathbf{d}}^{(k,i)} = (\underline{d}_1^{(k,i)}, \underline{d}_2^{(k,i)}, ..., \underline{d}_{N_k}^{(k,i)})^{\mathrm{T}} \quad \mathrm{i} = 1, 2; \mathrm{k} = 1,..., \mathrm{K}. \qquad (1)$$

$N_k$ is the number of symbols per data field for the user k. This number is linked to the spreading factor $Q_k$.

Data block $\underline{\mathbf{d}}^{(k,1)}$ is transmitted before the midamble and data block $\underline{\mathbf{d}}^{(k,2)}$ after the midamble. Each of the $N_k$ data symbols $\underline{d}_n^{(k,i)}$; i=1, 2; k=1,...,K; n=1,...,$N_k$; of equation 3 has the symbol duration $T_S^{(k)} = Q_k.T_C$ as already given.

The data modulation is 16QAM, thus the data symbols $\underline{d}_n^{(k,i)}$ are generated from 4 consecutive data bits from the output of the physical channel mapping procedure in [8]:

using the following mapping to complex symbols:

| Consecutive binary bit pattern | complex symbol |
|---|---|
| $b_{1,n}^{(k,i)}\ b_{2,n}^{(k,i)}\ b_{3,n}^{(k,i)}\ b_{4,n}^{(k,i)}$ | $\underline{d}_n^{(k,i)}$ |
| 0000 | $j\frac{1}{\sqrt{5}}$ |
| 0001 | $-\frac{1}{\sqrt{5}}+j\frac{2}{\sqrt{5}}$ |
| 0010 | $\frac{1}{\sqrt{5}}+j\frac{2}{\sqrt{5}}$ |
| 0011 | $j\frac{3}{\sqrt{5}}$ |
| 0100 | $\sqrt{\frac{1}{5}}$ |
| 0101 | $\frac{2}{\sqrt{5}}-j\frac{1}{\sqrt{5}}$ |
| 0110 | $\frac{2}{\sqrt{5}}+j\frac{1}{\sqrt{5}}$ |
| 0111 | $\frac{3}{\sqrt{5}}$ |
| 1000 | $-\frac{1}{\sqrt{5}}$ |
| 1001 | $-\frac{2}{\sqrt{5}}+j\frac{1}{\sqrt{5}}$ |
| 1010 | $-\frac{2}{\sqrt{5}}-j\frac{1}{\sqrt{5}}$ |
| 1011 | $-\frac{3}{\sqrt{5}}$ |
| 1100 | $-j\frac{1}{\sqrt{5}}$ |
| 1101 | $\frac{1}{\sqrt{5}}-j\frac{2}{\sqrt{5}}$ |
| 1110 | $-\frac{1}{\sqrt{5}}-j\frac{2}{\sqrt{5}}$ |
| 1111 | $-j\frac{3}{\sqrt{5}}$ |

The mapping corresponds to a 16QAM modulation of the interleaved and encoded data bits $b_{l,n}^{(k,i)}$ of the table above and $\underline{d}_n^{(k,i)}$ of equation 3.

# 5A6 Data modulation for the 1.28 Mcps option

## 5A6.1 Symbol rate

The symbol duration $T_S$ depends on the spreading factor Q and the chip duration $T_C$: $T_s = Q \times T_c$, where $T_c = \frac{1}{chiprate}$.

# 5A6.2 Mapping of bits onto signal point constellation

## 5A6.2.1 QPSK modulation

The mapping of bits onto the signal point constellation for QPSK modulation is the same as in the 3.84Mcps TDD cf. [5.2.1.1 QPSK modulationMapping for burst type 1 and 2].

## 5A6.2.2 8PSK modulation

The data modulation is performed to the bits from the output of the physical channel mapping procedure. In case of 8PSK modulation 3 consecutive binary bits are represented by one complex valued data symbol. Each user burst has two data carrying parts, termed data blocks:

$$\underline{\mathbf{d}}^{(k,i)} = \left(\underline{d}_1^{(k,i)}, \underline{d}_2^{(k,i)}, \ldots, \underline{d}_{N_k}^{(k,i)}\right)^T, \quad i = 1,2; k = 1,\ldots, K_{Code} \qquad (1a)$$

$N_k$ is the number of symbols per data field for the code k. This number is linked to the spreading factor $Q_k$.

Data block $\underline{\mathbf{d}}^{(k,1)}$ is transmitted before the midamble and data block $\underline{\mathbf{d}}^{(k,2)}$ after the midamble. Each of the $N_k$ data symbols $\underline{d}_n^{(k,i)}$; i=1, 2; k=1,...,$K_{Code}$; n=1,...,$N_k$; of equation 1 has the symbol duration $T_s^{(k)} = Q_k . T_c$ as already given.

The data modulation is 8PSK, thus the data symbols $\underline{d}_n^{(k,i)}$ are generated from 3 consecutive data bits from the output of the physical channel mapping procedure in [8]:

$$b_{l,n}^{(k,i)} \in \{0,1\} \quad l = 1,2,3; k = 1,\ldots, K_{Code}; n = 1,\ldots, N_k; i = 1,2 \qquad (2a)$$

using the following mapping to complex symbols:

| Consecutive binary bit pattern | complex symbol |
|---|---|
| $b_{1,n}^{(k,i)}\ b_{2,n}^{(k,i)}\ b_{3,n}^{(k,i)}$ | $\underline{d}_n^{(k,i)}$ |
| 000 | cos(11pi/8)+ jsin(11pi/8) |
| 001 | cos(9pi/8)+ jsin(9pi/8) |
| 010 | cos(5pi/8)+ jsin(5pi/8) |
| 011 | cos(7pi/8)+ jsin(7pi/8) |
| 100 | cos(13pi/8)+ jsin(13pi/8) |
| 101 | cos(15pi/8)+ jsin(15pi/8) |
| 110 | cos(3pi/8)+ jsin(3pi/8) |
| 111 | cos(pi/8)+ jsin(pi/8) |

The mapping corresponds to a 8PSK modulation of the interleaved and encoded data bits $b_{l,n}^{(k,i)}$ of the table above and $\underline{d}_n^{(k,i)}$ of equation 1a.

## 5A6.2.3 16QAM modulation

The mapping of bits onto the signal point constellation for 16QAM modulation is the same as in the 3.84Mcps TDD cf. [5.2.1.25.2.2.1 16QAM modulation].

# 6~~7~~ Spreading modulation

## 6~~7~~.1 Basic spreading parameters

Spreading of data consists of two operations: Channelisation and Scrambling. Firstly, each complex valued data symbol $\underline{d}_n^{(k,i)}$ of equation 1 is spread with a real valued channelisation code $\mathbf{c}^{(k)}$ of length $Q_k \in \{1,2,4,8,16\}$. The resulting sequence is then scrambled by a complex sequence $\underline{\mathbf{v}}$ of length 16.

## 6~~7~~.2 Channelisation codes

The elements $c_q^{(k)}$; k=1,...,$K_{Code}$; q=1,...,$Q_k$; of the real valued channelisation codes

$$\mathbf{c}^{(k)}=(c_1^{(k)},c_2^{(k)},...,c_{Q_k}^{(k)}) \text{ ; k=1,...,} K_{Code};$$

shall be taken from the set

$$V_c = \{1, -1\} \quad (3)$$

The $\mathbf{c}_{Q_k}^{(k)}$ are Orthogonal Variable Spreading Factor (OVSF) codes, allowing to mix in the same timeslot channels with different spreading factors while preserving the orthogonality. The OVSF codes can be defined using the code tree of figure 1.

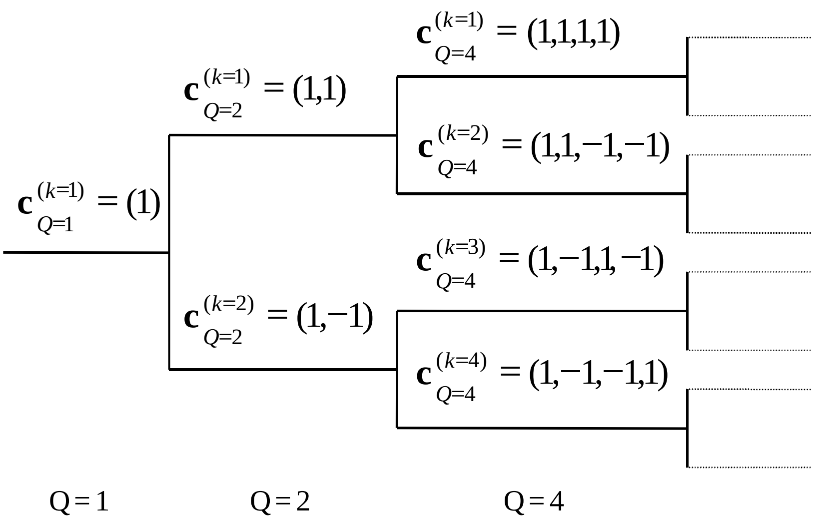


**Figure 1: Code-tree for generation of Orthogonal Variable Spreading Factor (OVSF) codes for Channelisation Operation**

Each level in the code tree defines a spreading factor indicated by the value of Q in the figure. All codes within the code tree cannot be used simultaneously in a given timeslot. A code can be used in a timeslot if and only if no other code on the path from the specific code to the root of the tree or in the sub-tree below the specific code is used in this timeslot. This means that the number of available codes in a slot is not fixed but depends on the rate and spreading factor of each physical channel.

The spreading factor goes up to $Q_{MAX}$=16.

## 67.3 Channelisation Code Specific Multiplier

Associated with each channelisation code is a multiplier $w_{Q_k}^{(k)}$ taking values from the set $\{e^{j\pi/2 \cdot p_k}\}$, where $p_k$ is a permutation of the integer set {0, ..., $Q_k$ -1} and $Q_k$ denotes the spreading factor. The multiplier is applied to the data sequence modulating each channelisation code. The values of the multiplier for each channelisation code are given in the table below:

| **k** | $w_{Q=1}^{(k)}$ | $w_{Q=2}^{(k)}$ | $w_{Q=4}^{(k)}$ | $w_{Q=8}^{(k)}$ | $w_{Q=16}^{(k)}$ |
|---|---|---|---|---|---|
| 1 | 1 | 1 | -j | 1 | -1 |
| 2 | | +j | 1 | +j | -j |
| 3 | | | +j | +j | 1 |
| 4 | | | -1 | -1 | 1 |
| 5 | | | | -j | +j |
| 6 | | | | -1 | -1 |
| 7 | | | | -j | -1 |
| 8 | | | | 1 | 1 |
| 9 | | | | | -j |
| 10 | | | | | +j |
| 11 | | | | | 1 |
| 12 | | | | | +j |
| 13 | | | | | -j |
| 14 | | | | | -j |
| 15 | | | | | +j |
| 16 | | | | | -1 |

If the UE autonomously changes the SF, as described in [7], it shall always use the multiplier associated with the channelisation code allocated by higher layers.

## 67.4 Scrambling codes

The spreading of data by a real valued channelisation code $\mathbf{c}^{(k)}$ of length $Q_k$ is followed by a cell specific complex scrambling sequence $\underline{\mathbf{v}} = (\underline{v}_1, \underline{v}_2, \ldots, \underline{v}_{16})$. The elements $\underline{v}_i; i = 1,\ldots,16$ of the complex valued scrambling codes shall be taken from the complex set

$$\underline{V}_{\underline{v}} = \{1, \mathrm{j}, -1, -\mathrm{j}\} \qquad (4)$$

In equation 4 the letter j denotes the imaginary unit. A complex scrambling code $\underline{\mathbf{v}}$ is generated from the binary scrambling codes $\mathbf{v} = (v_1, v_2, \ldots, v_{16})$ of length 16 shown in Annex A. The relation between the elements $\underline{\mathbf{v}}$ and $\mathbf{v}$ is given by:

$$\underline{v}_i = (\mathrm{j})^i \cdot v_i \qquad v_i \in \{1, -1\}, \; i = 1,\ldots,16 \qquad (5)$$

Hence, the elements $\underline{v}_i$ of the complex scrambling code $\underline{\mathbf{v}}$ are alternating real and imaginary.

The length matching is obtained by concatenating $Q_{MAX}/Q_k$ spread words before the scrambling. The scheme is illustrated in figure 2 and is described in more detail in subclause 6.4.

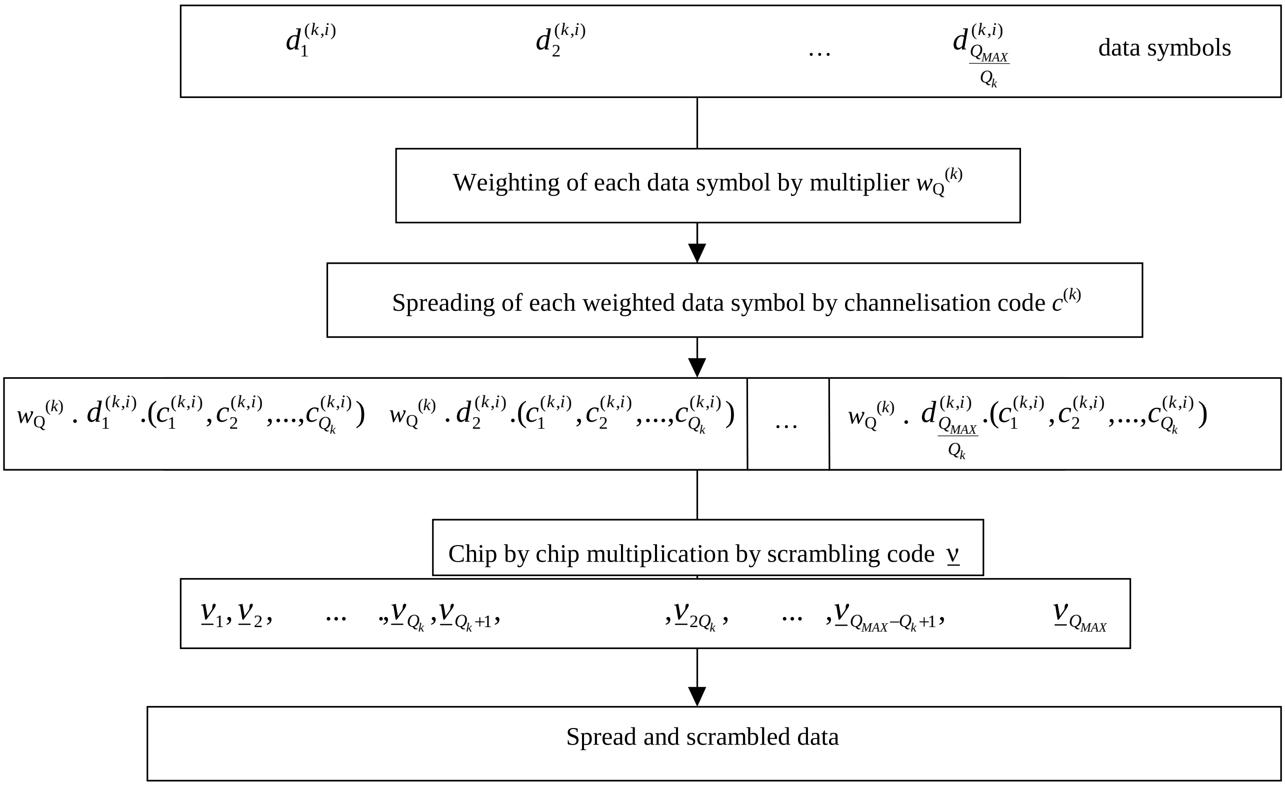


**Figure 2: Spreading of data symbols**

## 67.5 Spread signal of data symbols and data blocks

The combination of the user specific channelisation and cell specific scrambling codes can be seen as a user and cell specific spreading code $\mathbf{s}^{(k)} = \left(s_p^{(k)}\right)$ with

$$s_p^{(k)} = c^{(k)}_{1+[(p-1) \bmod Q_k]} \cdot \underline{v}_{1+[(p-1) \bmod Q_{MAX}]}$$
, k=1,…,$K_{Code}$, p=1,…,$N_kQ_k$.

With the root raised cosine chip impulse filter $Cr_0(t)$ the transmitted signal belonging to the data block $\underline{\mathbf{d}}^{(k,1)}$ of equation 1 transmitted before the midamble is

$$d^{(k,1)}(t) = \sum_{n=1}^{N_k} d_n^{(k,1)} w_{Q_k}^{(k)} \sum_{q=1}^{Q_k} s_{(n-1)Q_k+q}^{(k)} . Cr_0(t-(q-1)T_c-(n-1)Q_kT_c) \qquad (6)$$

and for the data block $\underline{\mathbf{d}}^{(k,2)}$ of equation 1 transmitted after the midamble

$$d^{(k,2)}(t) = \sum_{n=1}^{N_k} d_n^{(k,2)} w_{Q_k}^{(k)} \sum_{q=1}^{Q_k} s_{(n-1)Q_k+q}^{(k)} . Cr_0(t-(q-1)T_c-(n-1)Q_kT_c-N_kQ_kT_c-L_mT_c) \qquad (7)$$

where $L_m$ is the number of midamble chips.

## 67.6 Modulation for the 3.84 Mcps option

The complex-valued chip sequence is QPSK modulated as shown in figure 3.

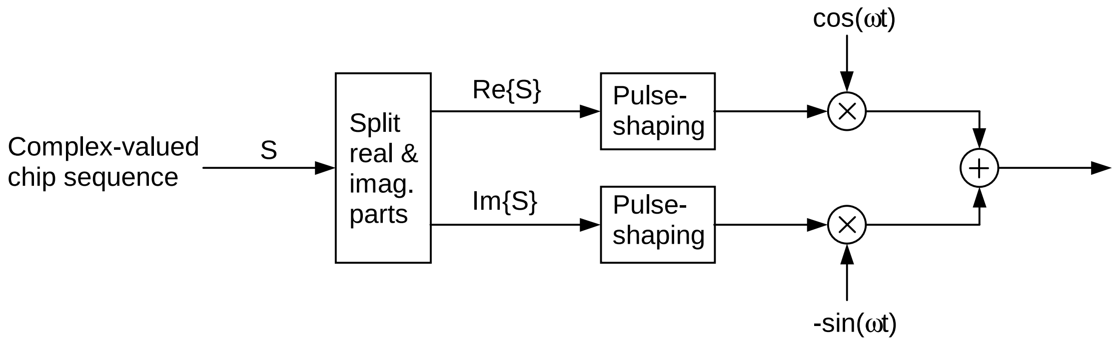


**Figure 3: Modulation of complex valued chip sequences**

The pulse-shaping characteristics are described in [9] and [10].

## 67.6.1 Combination of physical channels in uplink

Figure 4 illustrates the principle of combination of two different physical uplink channels within one timeslot. The DPCHs to be combined belong to same CCTrCH, did undergo spreading as described in sections before and are thus represented by complex-valued sequences. First, the amplitude of all DPCHs is adjusted according to UL open loop power control as described in [10]. Each DPCH is then separately weighted by a weight factor $\gamma_i$ and combined using complex addition. After combination of Physical Channels the gain factor $\beta_j$ is applied, depending on the actual TFC as described in [10].

In case of different CCTrCH, principle shown in Figure 4 applies to each CCTrCH separately.

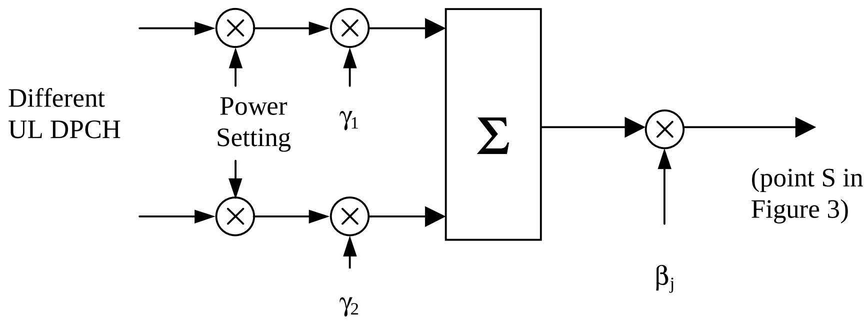


**Figure 4: Combination of different physical channels in uplink**

The values of weight factors $\gamma_i$ are depending on the spreading factor SF of the corresponding DPCH:

| SF of DPCH$_i$ | $\gamma_i$ |
|---|---|
| 16 | $1/4$ |
| 8 | $\sqrt{2}/4$ |
| 4 | $1/2$ |
| 2 | $\sqrt{2}/2$ |
| 1 | $1$ |

In the case that $\beta_j$ (corresponding to the *j*–th TFC) has been explicitly signalled to the UE, the possible values that $\beta_j$ can assume are listed in the table below. In the case that $\beta_j$ has been calculated by the UE from a reference TFC, $\beta_j$ shall not be restricted to the quantised values.

| Signalling value for $\beta_j$ | Quantized value $\beta_j$ |
|---|---|
| 15 | 16/8 |
| 14 | 15/8 |
| 13 | 14/8 |
| 12 | 13/8 |
| 11 | 12/8 |
| 10 | 11/8 |
| 9 | 10/8 |
| 8 | 9/8 |
| 7 | 8/8 |
| 6 | 7/8 |
| 5 | 6/8 |
| 4 | 5/8 |
| 3 | 4/8 |
| 2 | 3/8 |
| 1 | 2/8 |
| 0 | 1/8 |

### 67.6.2 Combination of physical channels in downlink

Figure 5 illustrates how different physical downlink channels are combined within one timeslot. Each complex-valued spread channel is separately weighted by a weight factor $G_i$. If a timeslot contains the SCH, the complex-valued SCH, as described in [7] is separately weighted by a weight factor $G_{SCH}$. All downlink physical channels are then combined using complex addition.

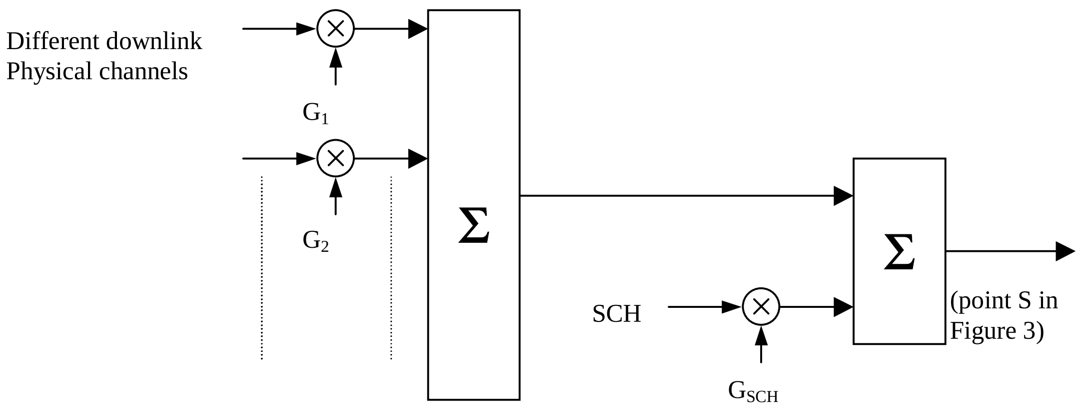


**Figure 5: Combination of different physical channels in downlink in case of SCH timeslot**

## 67.7 Modulation for the 1.28 Mcps option

The complex-valued chip sequence is modulated as shown in figure 6.

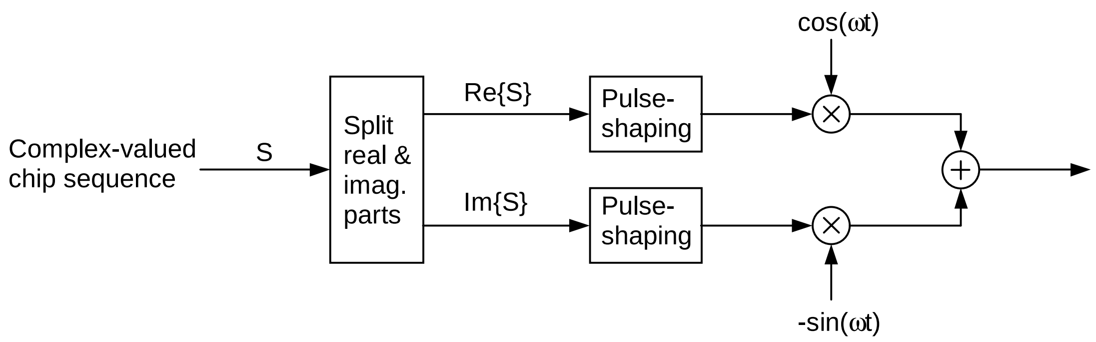


**Figure 6: Modulation of complex valued chip sequences**

The pulse-shaping characteristics are described in [9] and [10].

### 6~~7~~.7.1 Combination of physical channels in uplink

The combination of physical channels in uplink is the same as in the 3.84 Mcps TDD cf. [6~~7~~.6~~5~~.1 Combination of physical channels in uplink]

### 6~~7~~.7.2 Combination of physical channels in downlink

Figure 7 illustrates how different physical downlink channels are combined within one timeslot. Each spread channel is separately weighted by a weight factor $G_i$.. All downlink physical channels are then combined using complex addition.

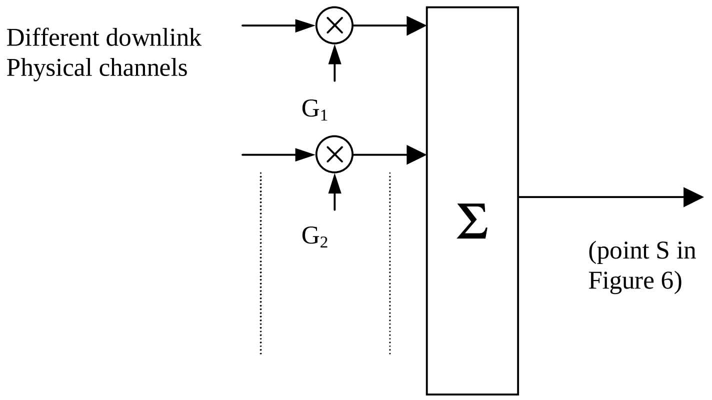


**Figure 7: Combination of different physical channels in downlink**

# 7~~8~~ Synchronisation codes for the 3.84 Mcps option

## 7~~8~~.1 Code Generation

The primary synchronisation code (PSC), $C_p$ , is constructed as a so-called generalised hierarchical Golay sequence. The PSC is furthermore chosen to have good aperiodic auto correlation properties.

Define a = < $x_1$, $x_2$, $x_3$, …, $x_{16}$ > = < 1, 1, 1, 1, 1, 1, -1, -1, 1, -1, 1, -1, 1, -1, -1, 1 >

The PSC is generated by repeating the sequence 'a' modulated by a Golay complementary sequence and creating a complex-valued sequence with identical real and imaginary components.

The PSC, $C_p$ , is defined as $C_p = < y(0),y(1),y(2),...,y(255) >$

where $y = (1+\mathrm{j})\times < a,a,a,-a,-a,a,-a,-a,a,a,a,-a,a,-a,a,a >$

and the left most index corresponds to the chip transmitted first in time.

The 12 secondary synchronization codes, {$C_0$, $C_1$, $C_3$, $C_4$, $C_5$, $C_6$, $C_8$, $C_{10}$, $C_{12}$, $C_{13}$, $C_{14}$,$C_{15}$ } are complex valued with identical real and imaginary components, and are constructed from the position wise multiplication of a Hadamard sequence and a sequence z, defined as

z = $< b,b,b,-b,b,b,-b,-b,b,-b,b,-b,-b,-b,-b,-b >$ , where

b = $< x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, -x_9, -x_{10}, -x_{11}, -x_{12}, -x_{13}, -x_{14}, -x_{15}, -x_{16} >$

and $x_1$, $x_2$, $x_3$, …, $x_{16}$ are the same as in the definition of the sequence 'a' above.

The Hadamard sequences are obtained as the rows in a matrix $H_8$ constructed recursively by:

$$H_0 = (1)$$
$$H_k = \begin{pmatrix} H_{k-1} & H_{k-1} \\ H_{k-1} & -H_{k-1} \end{pmatrix}, \quad k \geq 1$$

The rows are numbered from the top starting with row *0* (the all ones sequence).

Denote the *n*:th Hadamard sequence $h_n$ as a row of $H_8$ numbered from the top, n = 0, 1, 2, …, 255, in the sequel.

Furthermore, let $h_m(l)$ and $z(l)$ denote the $l$th symbol of the sequence $h_m$ and *z*, respectively where $l$ = 0, 1, 2, …, 255 and $l$ = 0 corresponds to the leftmost symbol.

The i:th secondary SCH code word, $C_i$, i = 0, 1, 3, 4, 5, 6, 8, 10, 12, 13, 14, 15 is then defined as

$$C_i = (1 + j) \times \langle h_m(0) \times z(0), h_m(1) \times z(1), h_m(2) \times z(2), \ldots, h_m(255) \times z(255)\rangle,$$

where $m = (16\times i)$ and the leftmost chip in the sequence corresponds to the chip transmitted first in time.

## 78.2 Code Allocation

Three secondary SCH codes are QPSK modulated and transmitted in parallel with the primary synchronization code. The QPSK modulation carries the following information:

- the code group that the base station belongs to (32 code groups:5 bits; Cases 1, 2);
- the position of the frame within an interleaving period of 20 msec (2 frames:1 bit, Cases 1, 2);
- the position of the SCH slot(s) within the frame (2 SCH slots:1 bit, Case 2).

The modulated secondary SCH codes are also constructed such that their cyclic-shifts are unique, i.e. a non-zero cyclic shift less than 2 (Case 1) and 4 (Case 2) of any of the sequences is not equivalent to some cyclic shift of any other of the sequences. Also, a non-zero cyclic shift less than 2 (Case 1) and 4 (Case 2) of any of the sequences is not equivalent to itself with any other cyclic shift less than 8. The secondary synchronization codes are partitioned into two code sets for Case 1 and four code sets for Case 2. The set is used to provide the following information:

Case 1:

**Table 2: Code Set Allocation for Case 1**

| Code Set | Code Group |
|---|---|
| 1 | 0-15 |
| 2 | 16-31 |

The code group and frame position information is provided by modulating the secondary codes in the code set.

Case 2:

**Table 3: Code Set Allocation for Case 2**

| Code Set | Code Group |
|---|---|
| 1 | 0-7 |
| 2 | 8-15 |
| 3 | 16-23 |
| 4 | 24-31 |

The slot timing and frame position information is provided by the comma free property of the code word and the Code group is provided by modulating some of the secondary codes in the code set.

The following SCH codes are allocated for each code set:

Case 1

Code set 1: $C_1$, $C_3$, $C_5$.

Code set 2: $C_{10}$, $C_{13}$, $C_{14}$.

Case 2

Code set 1: $C_1$, $C_3$, $C_5$.

Code set 2: $C_{10}$, $C_{13}$, $C_{14}$.

Code set 3: $C_0$, $C_6$, $C_{12}$.

Code set 4: $C_4$, $C_8$, $C_{15}$.

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The following subclauses 7.2.1 to 7.2.2 refer to the two cases of SCH/P-CCPCH usage as described in [7].

Note that in the tables 4 and 5 corresponding to Cases 1 and 2, respectively, Frame 1 implies the frame with an odd SFN and Frame 2 implies the frame with an even SFN.

### 7~~8~~.2.1 Code allocation for Case 1

**Table 4: Code Allocation for Case 1**

| Code Group | Code Set | Frame 1 | | | Frame 2 | | | Associated $t_{offset}$ |
|---|---|---|---|---|---|---|---|---|
| 0 | 1 | $C_1$ | $C_3$ | $C_5$ | $C_1$ | $C_3$ | $-C_5$ | $t_0$ |
| 1 | 1 | $C_1$ | $-C_3$ | $C_5$ | $C_1$ | $-C_3$ | $-C_5$ | $t_1$ |
| 2 | 1 | $-C_1$ | $C_3$ | $C_5$ | $-C_1$ | $C_3$ | $-C_5$ | $t_2$ |
| 3 | 1 | $-C_1$ | $-C_3$ | $C_5$ | $-C_1$ | $-C_3$ | $-C_5$ | $t_3$ |
| 4 | 1 | $jC_1$ | $jC_3$ | $C_5$ | $jC_1$ | $jC_3$ | $-C_5$ | $t_4$ |
| 5 | 1 | $jC_1$ | $-jC_3$ | $C_5$ | $jC_1$ | $-jC_3$ | $-C_5$ | $t_5$ |
| 6 | 1 | $-jC_1$ | $jC_3$ | $C_5$ | $-jC_1$ | $jC_3$ | $-C_5$ | $t_6$ |
| 7 | 1 | $-jC_1$ | $-jC_3$ | $C_5$ | $-jC_1$ | $-jC_3$ | $-C_5$ | $t_7$ |
| 8 | 1 | $jC_1$ | $jC_5$ | $C_3$ | $jC_1$ | $jC_5$ | $-C_3$ | $t_8$ |
| 9 | 1 | $jC_1$ | $-jC_5$ | $C_3$ | $jC_1$ | $-jC_5$ | $-C_3$ | $t_9$ |
| 10 | 1 | $-jC_1$ | $jC_5$ | $C_3$ | $-jC_1$ | $jC_5$ | $-C_3$ | $t_{10}$ |
| 11 | 1 | $-jC_1$ | $-jC_5$ | $C_3$ | $-jC_1$ | $-jC_5$ | $-C_3$ | $t_{11}$ |
| 12 | 1 | $jC_3$ | $jC_5$ | $C_1$ | $jC_3$ | $jC_5$ | $-C_1$ | $t_{12}$ |
| 13 | 1 | $jC_3$ | $-jC_5$ | $C_1$ | $jC_3$ | $-jC_5$ | $-C_1$ | $t_{13}$ |
| 14 | 1 | $-jC_3$ | $jC_5$ | $C_1$ | $-jC_3$ | $jC_5$ | $-C_1$ | $t_{14}$ |
| 15 | 1 | $-jC_3$ | $-jC_5$ | $C_1$ | $-jC_3$ | $-jC_5$ | $-C_1$ | $t_{15}$ |
| 16 | 2 | $C_{10}$ | $C_{13}$ | $C_{14}$ | $C_{10}$ | $C_{13}$ | $-C_{14}$ | $t_{16}$ |
| 17 | 2 | $C_{10}$ | $-C_{13}$ | $C_{14}$ | $C_{10}$ | $-C_{13}$ | $-C_{14}$ | $t_{17}$ |
| … | … | … | … | … | … | … | … | … |
| 20 | 2 | $jC_{10}$ | $jC_{13}$ | $C_{14}$ | $jC_{10}$ | $jC_{13}$ | $-C_{14}$ | $t_{20}$ |
| … | … | … | … | … | … | … | … | … |
| 24 | 2 | $jC_{10}$ | $jC_{14}$ | $C_{13}$ | $jC_{10}$ | $jC_{14}$ | $-C_{13}$ | $t_{24}$ |
| … | … | … | … | … | … | … | … | … |
| 31 | 2 | $-jC_{13}$ | $-jC_{14}$ | $C_{10}$ | $-jC_{13}$ | $-jC_{14}$ | $-C_{10}$ | $t_{31}$ |

NOTE: The code construction for code groups 0 to 15 using only the SCH codes from code set 1 is shown. The construction for code groups 16 to 31 using the SCH codes from code set 2 is done in the same way.

## 78.2.2 Code allocation for Case 2

**Table 5: Code Allocation for Case 2**

| Code Group | Code Set | Frame 1 | | | | | | Frame 2 | | | | | | Associated $t_{offset}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Slot k | | | Slot k+8 | | | Slot k | | | Slot k+8 | | | |
| 0 | 1 | $C_1$ | $C_3$ | $C_5$ | $C_1$ | $C_3$ | $-C_5$ | $-C_1$ | $-C_3$ | $C_5$ | $-C_1$ | $-C_3$ | $-C_5$ | $t_0$ |
| 1 | 1 | $C_1$ | $-C_3$ | $C_5$ | $C_1$ | $-C_3$ | $-C_5$ | $-C_1$ | $C_3$ | $C_5$ | $-C_1$ | $C_3$ | $-C_5$ | $t_1$ |
| 2 | 1 | $jC_1$ | $jC_3$ | $C_5$ | $jC_1$ | $jC_3$ | $-C_5$ | $-jC_1$ | $-jC_3$ | $C_5$ | $-jC_1$ | $-jC_3$ | $-C_5$ | $t_2$ |
| 3 | 1 | $jC_1$ | $-jC_3$ | $C_5$ | $jC_1$ | $-jC_3$ | $-C_5$ | $-jC_1$ | $jC_3$ | $C_5$ | $-jC_1$ | $jC_3$ | $-C_5$ | $t_3$ |
| 4 | 1 | $jC_1$ | $jC_5$ | $C_3$ | $jC_1$ | $jC_5$ | $-C_3$ | $-jC_1$ | $-jC_5$ | $C_3$ | $-jC_1$ | $-jC_5$ | $-C_3$ | $t_4$ |
| 5 | 1 | $jC_1$ | $-jC_5$ | $C_3$ | $jC_1$ | $-jC_5$ | $-C_3$ | $-jC_1$ | $jC_5$ | $C_3$ | $-jC_1$ | $jC_5$ | $-C_3$ | $t_5$ |
| 6 | 1 | $jC_3$ | $jC_5$ | $C_1$ | $jC_3$ | $jC_5$ | $-C_1$ | $-jC_3$ | $-jC_5$ | $C_1$ | $-jC_3$ | $-jC_5$ | $-C_1$ | $t_6$ |
| 7 | 1 | $jC_3$ | $-jC_5$ | $C_1$ | $jC_3$ | $-jC_5$ | $-C_1$ | $-jC_3$ | $jC_5$ | $C_1$ | $-jC_3$ | $jC_5$ | $-C_1$ | $t_7$ |
| 8 | 2 | $C_{10}$ | $C_{13}$ | $C_{14}$ | $C_{10}$ | $C_{13}$ | $-C_{14}$ | $-C_{10}$ | $-C_{13}$ | $C_{14}$ | $-C_{10}$ | $-C_{13}$ | $-C_{14}$ | $t_8$ |
| 9 | 2 | $C_{10}$ | $-C_{13}$ | $C_{14}$ | $C_{10}$ | $-C_{13}$ | $-C_{14}$ | $-C_{10}$ | $C_{13}$ | $C_{14}$ | $-C_{10}$ | $C_{13}$ | $-C_{14}$ | $t_9$ |
| 10 | 2 | $jC_{10}$ | $jC_{13}$ | $C_{14}$ | $jC_{10}$ | $jC_{13}$ | $-C_{14}$ | $-jC_{10}$ | $-jC_{13}$ | $C_{14}$ | $-jC_{10}$ | $-jC_{13}$ | $-C_{14}$ | $t_{10}$ |
| 11 | 2 | $jC_{10}$ | $-jC_{13}$ | $C_{14}$ | $jC_{10}$ | $-jC_{13}$ | $-C_{14}$ | $-jC_{10}$ | $jC_{13}$ | $C_{14}$ | $-jC_{10}$ | $jC_{13}$ | $-C_{14}$ | $t_{11}$ |
| 12 | 2 | $jC_{10}$ | $jC_{14}$ | $C_{13}$ | $jC_{10}$ | $jC_{14}$ | $-C_{13}$ | $-jC_{10}$ | $-jC_{14}$ | $C_{13}$ | $-jC_{10}$ | $-jC_{14}$ | $-C_{13}$ | $t_{12}$ |
| 13 | 2 | $jC_{10}$ | $-jC_{14}$ | $C_{13}$ | $jC_{10}$ | $-jC_{14}$ | $-C_{13}$ | $-jC_{10}$ | $jC_{14}$ | $C_{13}$ | $-jC_{10}$ | $jC_{14}$ | $-C_{13}$ | $t_{13}$ |
| 14 | 2 | $jC_{13}$ | $jC_{14}$ | $C_{10}$ | $jC_{13}$ | $jC_{14}$ | $-C_{10}$ | $-jC_{13}$ | $-jC_{14}$ | $C_{10}$ | $-jC_{13}$ | $-jC_{14}$ | $-C_{10}$ | $t_{14}$ |
| 15 | 2 | $jC_{13}$ | $-jC_{14}$ | $C_{10}$ | $jC_{13}$ | $-jC_{14}$ | $-C_{10}$ | $-jC_{13}$ | $jC_{14}$ | $C_{10}$ | $-jC_{13}$ | $jC_{14}$ | $-C_{10}$ | $t_{15}$ |
| 16 | 3 | $C_0$ | $C_6$ | $C_{12}$ | $C_0$ | $C_6$ | $-C_{12}$ | $-C_0$ | $-C_6$ | $C_{12}$ | $-C_0$ | $-C_6$ | $-C_{12}$ | $t_{16}$ |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |
| 23 | 3 | $jC_6$ | $-jC_{12}$ | $C_0$ | $jC_6$ | $-jC_{12}$ | $-C_0$ | $-jC_6$ | $jC_{12}$ | $C_0$ | $-jC_6$ | $jC_{12}$ | $-C_0$ | $t_{20}$ |
| 24 | 4 | $C_4$ | $C_8$ | $C_{15}$ | $C_4$ | $C_8$ | $-C_{15}$ | $-C_4$ | $-C_8$ | $C_{15}$ | $-C_4$ | $-C_8$ | $-C_{15}$ | $t_{24}$ |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |
| 31 | 4 | $jC_8$ | $-jC_{15}$ | $C_4$ | $jC_8$ | $-jC_{15}$ | $-C_4$ | $-jC_8$ | $jC_{15}$ | $C_4$ | $-jC_8$ | $jC_{15}$ | $-C_4$ | $t_{31}$ |

NOTE: The code construction for code groups 0 to 15 using the SCH codes from code sets 1 and 2 is shown. The construction for code groups 16 to 31 using the SCH codes from code sets 3 and 4 is done in the same way.

## 78.3 Evaluation of synchronisation codes

The evaluation of information transmitted in SCH on code group and frame timing is shown in table 6, where the 32 code groups are listed. Each code group is containing 4 specific scrambling codes (cf. subclause 5A6.3), each scrambling code associated with a specific short and long basic midamble code.

Each code group is additionally linked to a specific $t_{Offset}$, thus to a specific frame timing. By using this scheme, the UE can derive the position of the frame border due to the position of the SCH sequence and the knowledge of $t_{Offset}$. The complete mapping of Code Group to Scrambling Code, Midamble Codes and $t_{Offset}$ is depicted in table 6.

**Table 6: Mapping scheme for Cell Parameters, Code Groups, Scrambling Codes, Midambles and $t_{Offset}$**

| CELL PARA-METER | Code Group | Associated Codes | | | Associated $t_{Offset}$ |
|---|---|---|---|---|---|
| | | Scrambling Code | Long Basic Midamble Code | Short Basic Midamble Code | |
| 0 | Group 0 | Code 0 | $m_{PL0}$ | $m_{SL0}$ | $t_0$ |
| 1 | | Code 1 | $m_{PL1}$ | $m_{SL1}$ | |
| 2 | | Code 2 | $m_{PL2}$ | $m_{SL2}$ | |
| 3 | | Code 3 | $m_{PL3}$ | $m_{SL3}$ | |
| 4 | Group 1 | Code 4 | $m_{PL4}$ | $m_{SL4}$ | $t_1$ |
| 5 | | Code 5 | $m_{PL5}$ | $m_{SL5}$ | |
| 6 | | Code 6 | $m_{PL6}$ | $m_{SL6}$ | |
| 7 | | Code 7 | $m_{PL7}$ | $m_{SL7}$ | |
| . . . . | | | | | |
| 124 | Group 31 | Code 124 | $m_{PL124}$ | $m_{SL124}$ | $t_{31}$ |
| 125 | | Code 125 | $m_{PL125}$ | $m_{SL125}$ | |
| 126 | | Code 126 | $m_{PL126}$ | $m_{SL126}$ | |
| 127 | | Code 127 | $m_{PL127}$ | $m_{SL127}$ | |

For basic midamble codes $m_P$ cf. [7], annex A 'Basic Midamble Codes'.

Each cell shall cycle through two sets of cell parameters in a code group with the cell parameters changing each frame. Table 7 shows how the cell parameters are cycled according to the SFN.

**Table 7: Alignment of cell parameter cycling and SFN**

| Initial Cell Parameter Assignment | Code Group | Cell Parameter used when SFN mod 2 = 0 | Cell Parameter used when SFN mod 2 = 1 |
|---|---|---|---|
| 0 | Group 0 | 0 | 1 |
| 1 | | 1 | 0 |
| 2 | | 2 | 3 |
| 3 | | 3 | 2 |
| 4 | Group 1 | 4 | 5 |
| 5 | | 5 | 4 |
| 6 | | 6 | 7 |
| 7 | | 7 | 6 |
| . . . . | | | |
| 124 | Group 31 | 124 | 125 |
| 125 | | 125 | 124 |
| 126 | | 126 | 127 |
| 127 | | 127 | 126 |

# 89 Synchronisation codes for the 1.28 Mcps option

## 89.1 The downlink pilot timeslot (DwPTS)

The contents of DwPTS is composed of 64 chips of a SYNC-DL sequence, cf.[AAB.1 Basic SYNC-DL sequence] and 32 chips of guard period (GP). The SYNC-DL code is not scrambled

There should be 32 different basic SYNC-DL codes for the whole system.

For the generation of the complex valued SYNC-DL codes of length 64 , the basic binary SYNC-DL codes

$= (s_1, s_2, \ldots, s_{64})$ of length 64 shown in Table AA.19 are used. The relation between the elements $\underline{\mathbf{s}}$ and $\mathbf{s}$ is given by:

$$\underline{s}_i = (\mathrm{j})^i \cdot s_i \qquad s_i \in \{1, -1\}\; \mathrm{i} = 1, \ldots, 64 \tag{1}$$

Hence, the elements $\underline{\mathbf{s}}_i$ of the complex SYNC-DL code $\underline{\mathbf{s}}$ are alternating real and imaginary.

The SYNC-DL is QPSK modulated and the phase of the SYNC-DL is used to signal the presence of the P-CCPCH in the multi-frame of the resource units of code $c_{Q=16}^{(k=1)}$ and $c_{Q=16}^{(k=2)}$ in time slot #0.

### 89.1.1 Modulation of the SYNC-DL

The SYNC-DL sequences are modulated with respect to the midamble ($m^{(1)}$) in time slot #0.

Four consecutive phases (phase quadruple) of the SYNC-DL are used to indicate the presence of the P-CCPCH in the following 4 sub-frames. In case the presence of a P-CCPCH is indicated, the next following sub-frame is the first sub-frame of the interleaving period. As QPSK is used for the modulation of the SYNC-DL, the phases 45, 135, 225, and 315° are used.

The total number of different phase quadruples is 2 (S1 and S2). A quadruple always starts with an even system frame number ((SFN mod 2) =0). Table 8 is showing the quadruples and their meaning.

**Table 8: Sequences for the phase modulation for the SYNC-DL**

| Name | Phase quadruple | Meaning |
|---|---|---|
| S1 | 135, 45, 225, 135 | There is a P-CCPCH in the next 4 sub-frames |
| S2 | 315, 225, 315, 45 | There is no P-CCPCH in the next 4 sub-frames |

## 89.2 The uplink pilot timeslot (UpPTS)

The contents in UpPTS is composed of 128chips of a SYNC-UL sequence, cf. [AAB.2 Basic SYNC-UL sequence] and 32chips of guard period (GP) .The SYNC-UL code is not scrambled.

There should be 256 different basic SYNC-UL codes (see Table AA.210) for the whole system.

For the generation of the complex valued SYNC-UL codes of length 128, the basic binary SYNC-UL codes

$= (s_1, s_2, \ldots, s_{128})$ of length 128 shown in Table AA.210 are used. The relation between the elements $\underline{\mathbf{s}}$ and $\mathbf{s}$ is given by:

$$\underline{s}_i = (\mathrm{j})^i \cdot s_i \qquad s_i \in \{1, -1\}\; \mathrm{i} = 1, \ldots, 128 \tag{2}$$

Hence, the elements $\underline{s}_i$ of the complex SYNC-UL code $\underline{s}$ are alternating real and imaginary.

## 89.3 Code Allocation

Relationship between the SYNC-DL and SYNC-UL sequences, the scrambling codes and the midamble codes

| Code Group | Associated Codes | | | |
|---|---|---|---|---|
| | SYNC-DL ID | SYNC-UL ID | Scrambling Code ID | Basic Midamble Code ID |
| Group 1 | 0 | 0...7 | 0 | 0 |
| | | | 1 | 1 |
| | | | 2 | 2 |
| | | | 3 | 3 |
| Group 2 | 1 | 8...15 | 4 | 4 |
| | | | 5 | 5 |
| | | | 6 | 6 |
| | | | 7 | 7 |
| . . . | | | | |
| Group 32 | 31 | 248...255 | 124 | 124 |
| | | | 125 | 125 |
| | | | 126 | 126 |
| | | | 127 | 127 |

# 910 Cell synchronisation codes

The cell synchronisation codes (CSCs) are constructed as so-called CEC sequences, i.e. concatenated and periodically extended complementary sequences. They are complex-valued sequences that are derived as cyclically offset versions from a set of possible constituent Golay complementary pairs.

The CSCs are chosen to have good aperiodic auto correlation properties. The aperiodic auto correlations of the applicable constituent Golay complementary pairs and every pair of their derived cyclically offset versions are complementary. Furthermore, orthogonality is preserved for all CSCs which are derived from the same constituent Golay complementary pair due to this complementary property.

The delay and weight matrices for the set of M = 8 possible constituent Golay complementary pairs are listed in the table below:

| Code ID *m* | Delay matrices $D_m$ and weight matrices $W_m$ of constituent Golay complementary pairs |
|---|---|
| 0 | $D_0$ = <512, 64, 128, 1, 16, 4, 256, 32, 8, 2>, $W_0$ = <1, 1, 1, 1, -1, -1, 1, 1, 1, 1> |
| 1 | $D_1$ = <2, 16, 32, 256, 1, 8, 128, 4, 512, 64>, $W_1$ = <1, -1, 1, -1, 1, -1, -1, 1, -1, -1> |
| 2 | $D_2$ = <16, 512, 32, 256, 4, 1, 64, 8, 2, 128>, $W_2$ = <-1, 1, 1, -1, -1, 1, -1, 1, -1, -1> |
| 3 | $D_3$ = <512, 16, 8, 4, 2, 256, 128, 64, 32, 1>, $W_3$ = <-1, -1, -1, -1, -1, 1, -1, 1, 1, 1> |
| 4 | $D_4$ = <512, 128, 256, 32, 2, 4, 64, 1, 16, 8>, $W_4$ = <1, -1, 1, -1, -1, -1, -1, -1, -1, 1> |
| 5 | $D_5$ = <1, 2, 4, 64, 512, 16, 32, 256, 128, 8>, $W_5$ = <-1, 1, 1, 1, 1, -1, -1, 1, -1, 1> |
| 6 | $D_6$ = <8, 16, 128, 2, 32, 1, 256, 512, 4, 64>, $W_6$ = <-1, -1, 1, 1, 1, 1, -1, -1, -1, 1> |
| 7 | $D_7$ = <1, 2, 128, 16, 256, 32, 8, 512, 64, 4>, $W_7$ = <1, 1, -1, -1, -1, -1, 1, -1, -1, -1> |

A constituent Golay complementary pair of length N = 1024, defined as:

$$s_m = \langle s_m(0), s_m(1), s_m(2), \ldots, s_m(1023)\rangle \text{ and } g_m = \langle g_m(0), g_m(1), g_m(2), \ldots, g_m(1023)\rangle$$

shall be derived from the selected delay and weight matrices:

$$D_m = \langle D_m(0), D_m(1), D_m(2), \ldots, D_m(9)\rangle \text{ and } W_m = \langle W_m(0), W_m(1), W_m(2), \ldots, W_m(9)\rangle$$

as follows.

Define:

$$a^{(0)} = \langle a^{(0)}(0), a^{(0)}(1), a^{(0)}(2), \ldots, a^{(0)}(1023)\rangle = \langle 1, 0, 0, \ldots, 0\rangle \text{ and}$$

$$b^{(0)} = \langle b^{(0)}(0), b^{(0)}(1), b^{(0)}(2), \ldots, b^{(0)}(1023)\rangle = \langle 1, 0, 0, \ldots, 0\rangle.$$

Then, the elements of the set of auxiliary sequences:

$$a^{(n)} = \langle a^{(n)}(0), a^{(n)}(1), a^{(n)}(2), \ldots, a^{(n)}(1023)\rangle \text{ and } b^{(n)} = \langle b^{(n)}(0), b^{(n)}(1), b^{(n)}(2), \ldots, b^{(n)}(1023)\rangle$$

are given by the recursive relations:

$$a^{(n+1)}(i) = a^{(n)}(i) + W_m(n) \times b^{(n)}(i - D_m(n)) \text{ and}$$

$$b^{(n+1)}(i) = a^{(n)}(i) - W_m(n) \times b^{(n)}(i - D_m(n))$$

with element index $i = 0, 1, 2, \ldots, 1023$ and iteration index $n = 0, 1, 2, \ldots, 9$. Operations on the element index shall be performed modulo 1024.

The elements of the constituent Golay complementary pairs $s_m$ and $g_m$ are then obtained from the output of the last iteration step using:

$$s_m(i) = a^{(10)}(i) \text{ and } g_m(i) = b^{(10)}(i) \text{ for } i = 0, 1, 2, ..., 1023$$

From each applicable constituent Golay complementary pair $s_m$ and $g_m$, up to K = 8 different cyclically offset pairs $s_m^{(k)}$ and $g_m^{(k)}$, with offset index $k = 0, 1, 2, \ldots, K-1$, of length 1152 chips can be derived. The complementary property of the respective aperiodic auto correlation is preserved for each particular pair of sequences $s_m^{(k)}$ and $g_m^{(k)}$. The generation of the K cyclically offset pairs from $s_m$ and $g_m$ is done in a similar way as the generation of the user midambles from a periodic basic midamble sequence as described in [7].

With N = 1024, K = 8, W = 128, the elements of a cyclically offset pair:

$$s_m^{(k)} = \langle s_m^{(k)}(0), s_m^{(k)}(1), s_m^{(k)}(2), \ldots, s_m^{(k)}(1151)\rangle \text{ and } g_m^{(k)} = \langle g_m^{(k)}(0), g_m^{(k)}(1), g_m^{(k)}(2), \ldots, g_m^{(k)}(1151)\rangle$$

for a particular offset $k$, with $k = 0, 1, 2, \ldots, K-1$, shall be derived from the elements of the constituent Golay complementary pairs $s_m$ and $g_m$ using:

$$s_m^{(k)}(i) = (j)^i \times s_m(i + k \times W) \text{ and } g_m^{(k)}(i) = (j)^i \times g_m(i + k \times W) \text{ for } i = 0, 1, 2, ..., N - k \times W - 1,$$

$$s_m^{(k)}(i) = (j)^i \times s_m(i - N + k \times W) \text{ and } g_m^{(k)}(i) = (j)^i \times g_m(i - N + k \times W) \text{ for } i = N - k \times W, N - k \times W + 1, ..., 1151.$$

Hence, the elements of $s_m^{(k)}$ and $g_m^{(k)}$ are alternating real and imaginary.

Note that both $s_m^{(0)}$ and $g_m^{(0)}$ simply correspond to $s_m$ and $g_m$ respectively, followed by its first W elements as post extension and that both $s_m^{(7)}$ and $g_m^{(7)}$ simply correspond to the last W elements of $s_m$ and $g_m$ in form of a pre extension, followed by $s_m$ and $g_m$ respectively.

Finally, the CSC $C_{CSC,m}^{(k)}$ derived from the $m$:th applicable constituent Golay complementary pair $s_m$ and $g_m$, and for the $k$:th offset is then defined as a concatenation of $s_m^{(k)}$ and $g_m^{(k)}$ by:

$$C_{CSC,m}^{(k)} = \langle s_m^{(k)}(0), s_m^{(k)}(1), s_m^{(k)}(2), \ldots, s_m^{(k)}(1151), g_m^{(k)}(0), g_m^{(k)}(1), g_m^{(k)}(2), \ldots, g_m^{(k)}(1151)\rangle$$

where the leftmost element $s_m^{(k)}(0)$ in the sequence corresponds to the chip to be first transmitted in time. An CSC has therefore length 2304 chips.

Note that due to this construction method, the auto correlations for all CSCs derived from one particular constituent Golay complementary pair $s_m$ and $g_m$ can be obtained simultaneously and in sequential order from the sum of partial correlations with $s_m$ and $g_m$, these CSCs remaining orthogonal.

CSCs derived according to above have complex values and shall not be subject to the channelisation or scrambling process, i.e. its elements represent complex chips for usage in the pulse shaping process at modulation.

# Annex A (normative): Scrambling Codes

The applicable scrambling codes are listed below. Code numbers are referring to table 6 'Mapping scheme for Cell Parameters, Code Groups, Scrambling Codes, Midambles and $t_{offset}$' in subclause 7.3 'Evaluation of synchronisation codes'.

| Scrambling Code | $v_1$ | $v_2$ | $v_3$ | $v_4$ | $v_5$ | $v_6$ | $v_7$ | $v_8$ | $v_9$ | $v_{10}$ | $v_{11}$ | $v_{12}$ | $v_{13}$ | $v_{14}$ | $v_{15}$ | $v_{16}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code 0 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 |
| Code 1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 |
| Code 2 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 |
| Code 3 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 |
| Code 4 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 |
| Code 5 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 |
| Code 6 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 |
| Code 7 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 |
| Code 8 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 |
| Code 9 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 |
| Code 10 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 |
| Code 11 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 |
| Code 12 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 |
| Code 13 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 |
| Code 14 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 |
| Code 15 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 |
| Code 16 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 |
| Code 17 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 |
| Code 18 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 |
| Code 19 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 |
| Code 20 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 |
| Code 21 | 1 | 1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 |
| Code 22 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 |
| Code 23 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 |
| Code 24 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 |
| Code 25 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 |
| Code 26 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 |
| Code 27 | -1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 |
| Code 28 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 |
| Code 29 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 |
| Code 30 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 |
| Code 31 | 1 | 1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 |
| Code 32 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 |
| Code 33 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 |
| Code 34 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 |
| Code 35 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 |
| Code 36 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 |
| Code 37 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 |
| Code 38 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 |
| Code 39 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 |
| Code 40 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 |
| Code 41 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 |
| Code 42 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 |
| Code 43 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 |
| Code 44 | -1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 |
| Code 45 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 |

| Scrambling Code | $v_1$ | $v_2$ | $v_3$ | $v_4$ | $v_5$ | $v_6$ | $v_7$ | $v_8$ | $v_9$ | $v_{10}$ | $v_{11}$ | $v_{12}$ | $v_{13}$ | $v_{14}$ | $v_{15}$ | $v_{16}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code 46 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 |
| Code 47 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 |
| Code 48 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 |
| Code 49 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 |
| Code 50 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 |
| Code 51 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 |
| Code 52 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 |
| Code 53 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 |
| Code 54 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 |
| Code 55 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 |
| Code 56 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 |
| Code 57 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 |
| Code 58 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 |
| Code 59 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 |
| Code 60 | -1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 |
| Code 61 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 |
| Code 62 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 |
| Code 63 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 |
| Code 64 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 |
| Code 65 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 |
| Code 66 | -1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 |
| Code 67 | -1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 |
| Code 68 | 1 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 |
| Code 69 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 |
| Code 70 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 |
| Code 71 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 |
| Code 72 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 |
| Code 73 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 |
| Code 74 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 |
| Code 75 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 |
| Code 76 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 |
| Code 77 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 |
| Code 78 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 |
| Code 79 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 |
| Code 80 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 |
| Code 81 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 |
| Code 82 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 |
| Code 83 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 |
| Code 84 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 |
| Code 85 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | -1 |
| Code 86 | -1 | -1 | -1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 |
| Code 87 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 |
| Code 88 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 |
| Code 89 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 | 1 | -1 | -1 |
| Code 90 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 |
| Code 91 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 |
| Code 92 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 |
| Code 93 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 |
| Code 94 | 1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 |
| Code 95 | 1 | 1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 |
| Code 96 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 |
| Code 97 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 |
| Code 98 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 |

| **Scrambling Code** | $v_1$ | $v_2$ | $v_3$ | $v_4$ | $v_5$ | $v_6$ | $v_7$ | $v_8$ | $v_9$ | $v_{10}$ | $v_{11}$ | $v_{12}$ | $v_{13}$ | $v_{14}$ | $v_{15}$ | $v_{16}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code 99 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 |
| Code 100 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 | 1 | -1 |
| Code 101 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 |
| Code 102 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 |
| Code 103 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | -1 |
| Code 104 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 |
| Code 105 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 |
| Code 106 | 1 | 1 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 |
| Code 107 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 |
| Code 108 | -1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | -1 |
| Code 109 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 |
| Code 110 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 |
| Code 111 | 1 | 1 | 1 | -1 | -1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 |
| Code 112 | -1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 |
| Code 113 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | -1 |
| Code 114 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 |
| Code 115 | 1 | -1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 |
| Code 116 | -1 | 1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 |
| Code 117 | 1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 |
| Code 118 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 |
| Code 119 | -1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 |
| Code 120 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 |
| Code 121 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 |
| Code 122 | -1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | -1 | -1 |
| Code 123 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 |
| Code 124 | -1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 |
| Code 125 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | -1 |
| Code 126 | 1 | 1 | 1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | -1 |
| Code 127 | 1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 |

# Annex AAB (normative): Synchronisation sequence

## AAB.1 Basic SYNC-DL sequence

**Table AA.19: Basic SYNC-DL Codes**

| Code ID | SYNC-DL Codes of length 64 |
|---|---|
| 0 | B3A7CC05A98688E4 |
| 1 | 9D559BD290606791 |
| 2 | 2CE7BA12A017C3A2 |
| 3 | 34511D20672F4712 |
| 4 | 9A772841474603F2 |
| 5 | 9109B1A5CE01F228 |
| 6 | 8FD429B3594501C0 |
| 7 | 25251354AA3F8C19 |
| 8 | C9A3B8E0C043EA56 |
| 9 | BA04B888E5BC1802 |
| 10 | A735354299370207 |
| 11 | 74C3C8DA4415AE51 |
| 12 | F4FD0458A0124663 |
| 13 | A011D4E16C3D6064 |
| 14 | BDA0661B0CAA8C68 |
| 15 | 8E31123F28928698 |
| 16 | F095C1632E2906AB |
| 17 | B60B4A8A664071CF |
| 18 | AA094DCCE91E041A |
| 19 | C0C31CDA8A256807 |
| 20 | D516964FB18C1890 |
| 21 | 30DE01834F4AACCE |
| 22 | 8F700323BA5CAD34 |
| 23 | 1B50F4DEE0C1380C |
| 24 | 443382164F56F2D1 |
| 25 | E1E4005D49B846B4 |
| 26 | 040A97165330BFAA |
| 27 | C48E26881693AD78 |
| 28 | D4354B2FE02361CC |
| 29 | 5383AB6C8A10CE84 |
| 30 | D417A730F2F12244 |
| 31 | ABF0A0D905A939C4 |

## AA~~B~~.2 Basic SYNC-UL Codes

**Table AA.2~~10~~: Basic SYNC-UL Codes**

| Code ID | SYNC-UL Codes of length 128 |
|---|---|
| 0 | C11C20F0D1807DB8859175B798EC094A |
| 1 | 91278068081EC8E74543DBC1C9AD4235 |
| 2 | 38F5AEE2E513DB12A663BA04160103E5 |
| 3 | 7AA8A0A210F12A1E4332F2EDD33011FC |
| 4 | C180EA3B9BA1774EB9611BD249C4A508 |
| 5 | B072A2C839489D496B98CE9D0132FBC9 |
| 6 | B2723EAC6EB01667F2B33961C8074234 |
| 7 | C4144AD060F0EC095E227B92CF7C8280 |
| 8 | 653036A10D3054146FCF815986C63A14 |
| 9 | F899CA61435D64DC07FDF04C4A0C053A |
| 10 | B56F2D6893A8051407F4C341D88DC7DC |
| 11 | DC0BE838242142EDE6413A72C88D74AA |
| 12 | 22A2FD86E4086C70A4860B13C76E579F |
| 13 | A3CBC21322C97D2A02728E7875F39588 |
| 14 | D4EC4F694A082CB38E3B1558A0FCC89F |
| 15 | CC891141C4E216D235C15CF5D3F9B002 |
| 16 | A1993114C50B77CB0C0725D1E22FD016 |
| 17 | 24F73A979DE52F82E8800CCB93842A59 |
| 18 | 8F878FA04659842E294D8DEAB20BA2FD |
| 19 | AC90B0442D70662B028CF76A6BECDF09 |
| 20 | D94A284DF64D7B0102F0E084C29C88C8 |
| 21 | 8603200C7596F24E865FD3815693358D |
| 22 | B466B12CF433642BD8B08F1F452E0550 |
| 23 | 86A3A1772C1C99FCA7DBBA0C312E34A0 |
| 24 | 622A1889F72A9A2C042D46F08EFEE1AC |
| 25 | BF220A362BC0D3B0D7CE400954C6CFAE |
| 26 | D28D73C52E89CF57905C502244F63616 |
| 27 | AD4E1C2103697D64D8B9D4C035D90548 |
| 28 | 8F081A9BA12B6C6BD024531AA984D21C |
| 29 | E4092429BE82988E1E3585BF6A6AE550 |
| 30 | 08BD36E0A9C061782CB38B35B335CA56 |
| 31 | 1CDFF3CC2685D1C44F4A1059AB03F40A |
| 32 | 506ED4E88FB1CECE3243F2A27A0221A4 |
| 33 | 846CF58A7AB613C83A24130B5778C0E2 |
| 34 | A2711A99E26A0C75AC026F4CFAECE893 |
| 35 | D846EEEBA2432AC05A01043C62579DCF |
| 36 | 6B16B4E851CAF2121FC4CF88820C89E7 |
| 37 | AA4889A78207674A74E10C6F2BE11D48 |
| 38 | 8534CF8145BC991052814ED5C72709EE |
| 39 | 01AEF15D2290A84A607425746D9963C7 |

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|---|---|
| 40 | 999188F758245D5164FE16D852942C71 |
| 41 | CF71C008599287E446E30745BD56E2D2 |
| 42 | 248414BA0DF8CDC4711FE7C8707ED0AD |
| 43 | EB2E263EC016191C81AB714BFE4D2B30 |
| 44 | 862082A7482FAC1C499793A0D8CED670 |
| 45 | DE2C22B2783AB75A7342608DE413840A |
| 46 | E31AA60B727F2CA2A78DAAC10665011D |
| 47 | CEF6CD06509870AC9E0177ACD550921D |
| 48 | E52C84D499FFCDC287581691471540F2 |
| 49 | B33BF6551A4322504BEE0930BCA1EC68 |
| 50 | 555BE6886D0FC43D72315E6C6D384148 |
| 51 | 8444F67451EE23CE1240C90F0B52A492 |
| 52 | 5C290D28E84060E69D09788A261B10FF |
| 53 | 337E0C35E83CD38CCC5D45804241F952 |
| 54 | A7879F0D31A8982A01EE6AC4952984DC |
| 55 | A37F506508928C70A83D69A2373781B9 |
| 56 | 42F55208EE12909803A7CBEB19B5419E |
| 57 | 57E5E268A328FCC9ED04B9E5420AC702 |
| 58 | EB033AD1222F84D8642C4E3FAAD28206 |
| 59 | 98EE1415F026AC0E862C520451697DD0 |
| 60 | 6A0528AEA4B7CD6702660D81F8821E19 |
| 61 | 763D626A87C603BCB09E1A4C800A378F |
| 62 | EEA61897879289340C23F669D6A03762 |
| 63 | A6571B3CC2D0E04F017ACC808B92DCE7 |
| 64 | DDF88B52EA1831D293A803CF23C8C471 |
| 65 | 6CA4D333A2684140475DAB491F61C17A |
| 66 | A7D2AD23043989A13289F7C3E135580A |
| 67 | B1C752FA66B41C81904EDE27EA000E2E |
| 68 | 8694BE3CC1CB36BE2A095F89CC619080 |
| 69 | 9C20334E1BBC596B25E151180BF99940 |
| 70 | 484256214F81070DD9C49A2B05A43DCE |
| 71 | 401A20BCBE29B7438A7AEE44635A9E23 |
| 72 | 8858585C3239CBF628033FA0DF189378 |
| 73 | EFA36404C1BA5118CC5F9052FD28D9C3 |
| 74 | 155609873D8A042D496E6477B747C4F8 |
| 75 | 8446077883A6D7D2549CC9742E3FD023 |
| 76 | E630142B189AA209371A6F0FFDBC30A7 |
| 77 | C46060535AC6DBB2095F1D7826D0CD5C |
| 78 | E00D19E48797148B28DEDA9D429362E2 |
| 79 | 645DE447E938485489416CAFCC1C571F |
| 80 | DA10AFBF2AE61C593A1D88584DE30598 |
| 81 | BB248AEA5FD3FE210CD48FC401E1A686 |
| 82 | A89F146BD9191F445301C081CB6F5625 |
| 83 | 15BBF04F247C59150208949EB6B9CC58 |

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|---|---|
| 84 | 08F48BFA7804B5B2CC2E96510232E062 |
| 85 | 9AA2BE74005A3679C626B209580B8D03 |
| 86 | 9D40664A2C808F2F293E255398B37E6A |
| 87 | 6869C98A8AAD81CAE41A23C83FF9EEA0 |
| 88 | 576E8948E61BD0927C4140C3C04C4CF3 |
| 89 | 0F942C67A1137B6EAA058C2A74872C73 |
| 90 | 9D058E27ED546C10632684BBC84E5BC1 |
| 91 | 79D4B840E20148B134F90B51164BCBD0 |
| 92 | 0E35E1D8D1214C05FAC790B69B239150 |
| 93 | FFA1BB0232CD71480BE5CA1C2A269F89 |
| 94 | B2956F5F4E270446F9211584792628DB |
| 95 | F56CCA23421C8EC8F8A41F7DA4A41EA2 |
| 96 | 0B5ECA04F1789A7148C80C39D57D05F6 |
| 97 | A10B538E8A8CFC8F8925C485F2A88660 |
| 98 | 9925C2C715001D9FC78ACCC51DA1AF34 |
| 99 | 0DAC9CFDEA40429A8B12C7D320D60F70 |
| 100 | 377FC9A097017958440914E83118E39D |
| 101 | 8421096FA8B47E4E943B6473671955CC |
| 102 | 574086183477C4F68540CB7E858263B1 |
| 103 | 895B6A8980C6703C779F49F40C5CFC19 |
| 104 | D0D253E157BC19262150CEA668679E71 |
| 105 | B8889C60EBA812BD7F0B6498823296D2 |
| 106 | A13FB9F3A08528E44B13C12CF0D461AA |
| 107 | 8D4DCFBE43D6E2024B1F8470224AA330 |
| 108 | 536D159E119E0893838657B12A074E64 |
| 109 | DCFD49C504AD3A2F049A0CB70238EC8A |
| 110 | D363DB4C46C11757FA8FB18139789102 |
| 111 | 424A1E8A1D4DA256E4CA3BC8C2201BE3 |
| 112 | 417B619ED30FEB0A847CC3A191A20398 |
| 113 | 843FBBC95453C61786D1332612B45B4D |
| 114 | F26CACC0732CF8ED0C5BC1462B1620B4 |
| 115 | 88E0FE440C70E9249A92A7AF94638880 |
| 116 | 99A52B7D8C950308057E0661D7459960 |
| 117 | A5C28218BF5D16E63E42698A0A6B0896 |
| 118 | B2763BEEC784A12E8C50778536921806 |
| 119 | 987B2B6A3A77A059B30A082457AB84E0 |
| 120 | 820DB500F1B206358D7A7F210AB85AA8 |
| 121 | 97760A5CFC5E03EB439C914590045938 |
| 122 | 896A720E8857C8708A59F8C94DE0841E |
| 123 | 2D101F0CF95263843412577340DEBB11 |
| 124 | E8E5214B4DCF5D11A245B0149D49C87C |
| 125 | 51224EAA10099ACDE384834A5ADF03D8 |
| 126 | 64E51253554A230C186FDE4E8781BC09 |
| 127 | A499E391E69ED08890AC1A82A6115BEC |

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|---|---|
| 128 | EE54C6E1834210D3EC1B07A456B92AA8 |
| 129 | 949DB5CA82420B54C1E0BCC111E704D9 |
| 130 | 9439EE9A9E4C447D1AA350926495047F |
| 131 | AD095CC0E7438AECE38D60980B3F2D00 |
| 132 | 83089C254C5EE9788072BC3D9282F798 |
| 133 | A27DC1A457BC5A56563D8A9B11203615 |
| 134 | 713053A9C0B1B08B14705FF5A7244DB4 |
| 135 | D36D4B9F4007354E0EC1B0CA8C8C7124 |
| 136 | 82E7C990612114F1CCE1BD9509FD4386 |
| 137 | C8D83FF0B48B14830D2015D53F8C0672 |
| 138 | 08AF223C869A36B169148FDDABB7D120 |
| 139 | B6C284C600AD0A99F86C449F8F4C53A6 |
| 140 | DC741B320C07682AF92AC4DBDE0C28C2 |
| 141 | 89B8D84FA902265850C0FA6FF0EB2C4F |
| 142 | A69445B3A52201DB984BC03D1956D7F3 |
| 143 | 0FE0F7224B7AD72E4D4530D0223F590C |
| 144 | 1B8C06F051434048EB925133AD3BD3F9 |
| 145 | E133D4C3C942726A351300C37E55D0DF |
| 146 | 9E09481D1881A66F562D8B453BC83AB2 |
| 147 | 2397B04B60A3C5700907BDBBA4E818C8 |
| 148 | 8F81F7A08CC6C8DA3D692AD34F50C012 |
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| | |
|---|---|
| 172 | EE21888101ABF06C1175828CB58B598D |
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| | |
|---|---|
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| 253 | ACD889634F79506F2582EA03240F2A07 |
| 254 | AA65407E1F4A33BF9A62860A3D6A4CC0 |
| 255 | B1B950AC76A608AA32D04B03C7FF24D3 |

# Annex B~~C~~ (informative): Generalised Hierarchical Golay Sequences

## B~~C~~.1 Alternative generation

The generalised hierarchical Golay sequences for the PSC described in 7.1 may be also viewed as generated (in real valued representation) by the following methods:

Method 1.

The sequence y is constructed from two constituent sequences $x_1$ and $x_2$ of length $n_1$ and $n_2$ respectively using the following formula:

- $y(i) = x_2(i \bmod n_2) * x_1(i \operatorname{div} n_2)$, $i = 0 \ldots (n_1 * n_2) - 1$.

The constituent sequences $x_1$ and $x_2$ are chosen to be the following length 16 (i.e. $n_1 = n_2 = 16$) sequences:

- $x_1$ is defined to be the length 16 ($N^{(1)}=4$) Golay complementary sequence obtained by the delay matrix $D^{(1)} = [8, 4, 1, 2]$ and weight matrix $W^{(1)} = [1, -1, 1, 1]$.
- $x_2$ is a generalised hierarchical sequence using the following formula, selecting s=2 and using the two Golay complementary sequences $x_3$ and $x_4$ as constituent sequences. The length of the sequence $x_3$ and $x_4$ is called $n_3$ respectively $n_4$.
- $x_2(i) = x_4(i \bmod s + s*(i \operatorname{div} sn_3)) * x_3((i \operatorname{div} s) \bmod n_3)$, $i = 0 \ldots (n_3 * n_4) - 1$.
- $x_3$ and $x_4$ are defined to be identical and the length 4 ($N^{(3)}= N^{(4)}=2$) Golay complementary sequence obtained by the delay matrix $D^{(3)} = D^{(4)} = [1, 2]$ and weight matrix $W^{(3)} = W^{(4)} = [1, 1]$.

The Golay complementary sequences $x_1$,$x_3$ and $x_4$ are defined using the following recursive relation:

$$a_0(k) = \delta(k) \text{ and } b_0(k) = \delta(k);$$

$$a_n(k) = a_{n-1}(k) + W^{(j)}_n \cdot b_{n-1}(k-D^{(j)}_n);$$

$$b_n(k) = a_{n-1}(k) - W^{(j)}_n \cdot b_{n-1}(k-D^{(j)}_n);$$

$$k = 0, 1, 2, \ldots, 2^{**}N^{(j)} -1;$$

$$n = 1, 2, \ldots, N^{(j)}.$$

The wanted Golay complementary sequence $x_j$ is defined by $a_n$ assuming $n=N^{(j)}$. The Kronecker delta function is described by $\delta$, k,j and n are integers.

Method 2

The sequence y can be viewed as a pruned Golay complementary sequence and generated using the following parameters which apply to the generator equations for a and b above:

(a) Let j = 0, $N^{(0)} = 8$.

(b) $[D_1^0,D_2^0,D_3^0,D_4^0,D_5^0,D_6^0,D_7^0,D_8^0] = [128, 64, 16, 32, 8, 1, 4, 2]$.

(c) $[W_1^0,W_2^0,W_3^0,W_4^0,W_5^0,W_6^0,W_7^0,W_8^0] = [1, -1, 1, 1, 1, 1, 1, 1]$.

(d) For n = 4, 6, set $b_4(k) = a_4(k)$, $b_6(k) = a_6(k)$.

# Annex ~~D~~C (informative): Change history

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date | TSG # | TSG Doc. | CR | Rev | Subject/Comment | Old | New |
| 14/01/00 | RAN_05 | RP-99593 | - | | Approved at TSG RAN #5 and placed under Change Control | - | 3.0.0 |
| 14/01/00 | RAN_06 | RP-99696 | 001 | 01 | Primary and Secondary CCPCH in TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99695 | 003 | 1 | Alignment of Terminology Regarding Spreading for TDD Mode | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99696 | 004 | - | Code allocation for Case 3 | 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-000069 | 002 | 3 | Cycling of cell parameters | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000069 | 005 | - | Removal of Synchronisation Case 3 in TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000069 | 006 | 1 | Signal Point Constellation | 3.1.1 | 3.2.0 |
| 03/05/00 | - | - | - | - | Revision marks accepted to create clean version | 3.2.0 | 3.2.1 |
| 26/06/00 | RAN_08 | RP-000273 | 008 | - | Editorial Modifications for 25.223 | 3.2.1 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000273 | 009 | - | Editorial modification of 25.223 | 3.2.1 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000273 | 010 | - | Editorial modification of 25.223 | 3.2.1 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000273 | 011 | 2 | Editorial modification of 25.223 | 3.2.1 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000273 | 012 | 2 | Modified code sets on SCH for cell search in UTRA TDD | 3.2.1 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000273 | 013 | 1 | Editorial update of TS25.223 | 3.2.1 | 3.3.0 |
| 23/09/00 | RAN_09 | RP-000346 | 007 | 1 | Gain Factors for TDD Mode | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000346 | 014 | - | Synchronisation codes | 3.3.0 | 3.4.0 |
| 16/03/01 | RAN_11 | - | - | - | Approved as Release 4 specification (v4.0.0) at TSG RAN #11 | 3.4.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010064 | 015 | 1 | Code specific phase offsets for TDD | 3.4.0 | 4.0..0 |
| 16/03/01 | RAN_11 | RP-010073 | 016 | - | Cell synchronisation codes for R'4 Node B sync over air interface in UTRA TDD | 3.4.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010071 | 017 | 1 | Inclusion of 1.28Mcps TDD in TS 25.223 | 3.4.0 | 4.0.0 |
| 15/06/01 | RAN_12 | RP-010337 | 019 | - | Addition to the abbreviation list and definition of a constant | 4.0.0 | 4.1.0 |
| 21/09/01 | RAN_13 | RP-010524 | 021 | 1 | Clarification of notations in TS25.221 and TS25.223 | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010530 | 022 | 1 | Clarification of notations in TS25.221 and TS25.223 | 4.1.0 | 4.2.0 |
| 14/12/01 | RAN_14 | RP-010748 | 023 | - | A correction of Figure 7 in subclause 7.7.2 of TS 25.223 | 4.2.0 | 4.3.0 |
| 08/03/03 | RAN_15 | RP-020051 | 025 | 1 | Removal of quantisation of bj gain factor when calculated from a reference TFC | 4.3.0 | 4.4.0 |
| 08/03/03 | RAN_15 | RP-020051 | 028 | - | Channelisation code-specific multiplier operation under autonomous SF change | 4.3.0 | 4.4.0 |
| 08/03/03 | RAN_15 | RP-020051 | 030 | - | Alignment of gamma(i) gains of 25.223 with SIR target of WG2 25.331 | 4.3.0 | 4.4.0 |
| 08/03/03 | RAN_15 | RP-020058 | 026 | 1 | CR to include HSDPA in TS25.223 | 4.4.0 | 5.0.0 |
| 07/06/02 | RAN_16 | RP-020317 | 031 | - | Correction of SPC for 16QAM in TDD | 5.0.0 | 5.1.0 |
| | | | | | | | |
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**3GPP TSG-RAN1 Meeting #29**
**Shanghai, China, 5 – 8 November 2002**

***R1-02-1392***

CR-Form-v7

# CHANGE REQUEST

| | | | | | | |
|---|---|---|---|---|---|---|
| ⌘ **25.224** | **CR** **104** | ⌘ **rev** | **-** | ⌘ | Current version: | **4.6.0** ⌘ |

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

***Proposed change affects:*** UICC apps⌘ [ ] ME [X] Radio Access Network [X] Core Network [ ]

| | | | | |
|---|---|---|---|---|
| ***Title:*** | ⌘ | Editorial modification to the section numberings | | |
| ***Source:*** | ⌘ | TSG RAN WG1 | | |
| ***Work item code:*** | ⌘ | TEI4 | ***Date:*** ⌘ | 01/11/2002 |
| ***Category:*** | ⌘ | **D** | ***Release:*** ⌘ | Rel-4 |
| | | *Use one of the following categories:*<br>***F*** *(correction)*<br>***A*** *(corresponds to a correction in an earlier release)*<br>***B*** *(addition of feature),*<br>***C*** *(functional modification of feature)*<br>***D*** *(editorial modification)*<br>Detailed explanations of the above categories can be found in 3GPP TR 21.900. | | *Use one of the following releases:*<br>*2 (GSM Phase 2)*<br>*R96 (Release 1996)*<br>*R97 (Release 1997)*<br>*R98 (Release 1998)*<br>*R99 (Release 1999)*<br>*Rel-4 (Release 4)*<br>*Rel-5 (Release 5)*<br>*Rel-6 (Release 6)* |

| | | |
|---|---|---|
| ***Reason for change:*** | ⌘ | The numbering used is not consistent with TS21.801. |
| ***Summary of change:*** | ⌘ | The sections, figures, and tables numberings are adjusted to follow the guidlines given in TS21.801. |
| ***Consequences if not approved:*** | ⌘ | Confusion and misunderstanding, not consistent with specification guidelines and the rest of the document. |

| | | | | | |
|---|---|---|---|---|---|
| ***Clauses affected:*** | ⌘ | All the document | | | |
| | | **Y** | **N** | | |
| ***Other specs affected:*** | ⌘ | | **X** | Other core specifications | ⌘ |
| | | | **X** | Test specifications | |
| | | | **X** | O&M Specifications | |
| ***Other comments:*** | ⌘ | | | | |

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1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

# Contents

# Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

# 1 Scope

The present document describes the Physical Layer Procedures in the TDD 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 25.201: "Physical layer - general description".

[2] 3GPP TS 25.102: "UE physical layer capabilities".

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

[4] 3GPP TS 25.212: "Multiplexing and channel coding (FDD)".

[5] 3GPP TS 25.213: "Spreading and modulation (FDD)".

[6] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[7] 3GPP TS 25.215: "Physical Layer - Measurements (FDD)".

[8] 3GPP TS 25.221: "Physical channels and mapping of transport channels onto physical channels (TDD)".

[9] 3GPP TS 25.222: "Multiplexing and channel coding (TDD)".

[10] 3GPP TS 25.223: "Spreading and modulation (TDD)".

[11] 3GPP TS 25.225: "Physical Layer - Measurements (TDD)".

[12] 3GPP TS 25.301: "Radio Interface Protocol Architecture".

[13] 3GPP TS 25.302: "Services Provided by the Physical Layer".

[14] 3GPP TS 25.401: "UTRAN Overall Description".

[15] 3GPP TS 25.331: "RRC Protocol Specification"

[16] 3GPP TS 25.433: "UTRAN Iub Interface NBAP Signalling"

[17] 3GPP TS 25.105: "UTRA (BS) TDD; Radio transmission and Reception"

[18] 3GPP TS 25.321: "MAC protocol specification"

[19] 3GPP TS 25.303: "Interlayer Procedures in Connected Mode"

[20] 3GPP TS 25.402: "Synchronisation in UTRAN Stage 2"

# 3 Abbreviations

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

| | |
|---|---|
| ASC | Access Service Class |
| BCCH | Broadcast Control Channel |
| BCH | Broadcast Channel |
| CCTrCH | Coded Composite Transport Channel |
| CDMA | Code Division Multiple Access |
| CRC | Cyclic Redundancy Check |
| DCA | Dynamic Channel Allocation |
| DL | Downlink |
| DPCH | Dedicated Physical Channel |
| DTX | Discontinuous Transmission |
| FACH | Forward Access Channel |
| FDD | Frequency Division Duplex |
| ISCP | Interference Signal Code Power |
| MAC | Medium Access Control |
| NRT | Non-Real Time |
| P-CCPCH | Primary Common Control Physical Channel |
| PC | Power Control |
| PDSCH | Physical Downlink Shared Channel |
| PRACH | Physical Random Access Channel |
| PUSCH | Physical Uplink Shared Channel |
| RACH | Random Access Channel |
| RL | Radio Link |
| RRC | Radio Resource Control |
| RSCP | Received Signal Code Power |
| RT | Real Time |
| RU | Resource Unit |
| SBGP | Special Burst Generation Gap |
| SBP | Special Burst Period |
| SBSP | Special Burst Scheduling Period |
| S-CCPCH | Secondary Common Control Physical Channel |
| SCH | Synchronisation Channel |
| SCTD | Space Code Transmit Diversity |
| SFN | System Frame Number |
| SIR | Signal–to-Interference Ratio |
| SSCH | Secondary Synchronisation Channel |
| STD | Selective Transmit Diversity |
| TA | Timing Advance |
| TDD | Time Division Duplex |
| TF | Transport Format |
| TFC | Transport Format Combination |
| TFCI | Transport Format Combination Indicator |
| TFCS | Transport Format Combination Set |
| TPC | Transmit Power Control |
| TSTD | Time Switched Transmit Diversity |
| TTI | Transmission Time Interval |
| TxAA | Transmit Adaptive Antennas |
| UE | User Equipment |
| UL | Uplink |
| UMTS | Universal Mobile Telecommunications System |
| UTRAN | UMTS Radio Access Network |
| VBR | Variable Bit Rate |

# 4 Physical layer procedures for the 3,84 Mcps option

## 4.1 General

## 4.2 Transmitter Power Control

### 4.2.1 General Parameters

Power control is applied for the TDD mode to limit the interference level within the system thus reducing the intercell interference level and to reduce the power consumption in the UE.

All codes within one timeslot allocated to the same CCTrCH use the same transmission power, in case they have the same spreading factor.

**Table 1: Transmit Power Control characteristics**

| | Uplink | Downlink |
|---|---|---|
| **Power control rate** | Variable<br>1-7 slots delay (2 slot SCH)<br>1-14 slots delay (1 slot SCH) | Variable, with rate depending on the slot allocation. |
| **TPC Step size** | -- | 1dB or 2 dB or 3 dB |
| **Remarks** | All figures are without processing and measurement times | |

### 4.2.2 Uplink Control

#### 4.2.2.1 General Limits

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 total UE transmit power is below the maximum allowed output power. In some cases the total UE transmit power in a timeslot after uplink power control calculation might exceed the maximum allowed output power. In these cases the calculated transmit power of all uplink physical channels in this timeslot shall be scaled by the same amount in dB before transmission. The total UE transmission power used shall be the maximum allowed output power.

The UTRAN may not expect the UE to be capable of reducing its total transmit power below the minimum level specified in [2].

#### 4.2.2.2 PRACH

The transmit power for the PRACH is set by higher layers based on open loop power control as described in [15].

#### 4.2.2.3 DPCH, PUSCH

The transmit power for DPCH and PUSCH is set by higher layers based on open loop power control as described in [15].

##### 4.2.2.3.1 Gain Factors

Two or more transport channels may be multiplexed onto a CCTrCH as described in [9]. These transport channels undergo rate matching which involves repetition or puncturing. This rate matching affects the transmit power required to obtain a particular $E_b/N_0$. Thus, the transmission power of the CCTrCH shall be weighted by a gain factor $\beta$.

There are two ways of controlling the gain factors for different TFC's within a CCTrCH transmitted in a radio frame:

- $\beta$ is signalled for the TFC, or
- $\beta$ is computed for the TFC, based upon the signalled settings for a reference TFC.

Combinations of the two above methods may be used to associate $\beta$ values to all TFC's in the TFCS for a CCTrCH. The two methods are described in sections 4.2.2.3.1.1 and 4.2.2.3.1.2 respectively. Several reference TFC's for several different CCTrCH's may be signalled from higher layers.

The weight and gain factors may vary on a radio frame basis depending upon the current SF and TFC used. The setting of weight and gain factors is independent of any other form of power control. That means that the transmit power $P_{UL}$ is calculated according to the formula given in [15] and then the weight and gain factors are applied on top of that, cf. [10].

##### 4.2.2.3.1.1 Signalled Gain Factors

When the gain factor $\beta_j$ is signalled by higher layers for a certain TFC, the signalled values are used directly for weighting DPCH or PUSCH within a CCTrCH. Exact values are given in [10].

##### 4.2.2.3.1.2 Computed Gain Factors

The gain factor $\beta_j$ may also be computed for certain TFCs, based on the signalled settings for a reference TFC:

Let $\beta_{ref}$ denote the signalled gain factor for the reference TFC. Further, let $\beta_j$ denote the gain factor 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*, $N_i$ is the number of bits output from the radio frame segmentation block for transport channel *i* 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.

Moreover, define the variable $L_{ref} = \sum_i \frac{1}{SF_i}$

where $SF_i$ is the spreading factor of DPCH or PUSCH *i* and the sum is taken over all DPCH or PUSCH *i* used in the reference TFC.

Similarly, define the variable $L_j = \sum_i \frac{1}{SF_i}$

where the sum is taken over all DPCH or PUSCH *i* used in the *j*-th TFC.

The gain factors $\beta_j$ for the *j*-th TFC are then computed as follows:

$$\beta_j = \sqrt{\frac{L_{ref}}{L_j}} \times \sqrt{\frac{K_j}{K_{ref}}}$$

No quantisation of $\beta_j$ is performed and as such, values other than the quantised $\beta_j$ given in [10] may be used.

#### 4.2.2.3.2 Out of synchronisation handling

As stated in 4.2.3.3, the association between TPC commands sent on uplink DPCH and PUSCH, with the power controlled downlink DPCH and PDSCH is signaled by higher layers. In the case of multiple DL CCTrCHs it is possible that an UL CCTrCH will provide TPC commands to more than one DL CCTrCH.

In the second phase of synchronisation evaluation, as defined in 4.4.2.1.2, the UE shall shut off the transmission of an UL CCTrCH if the following criteria are fulfilled for any one of the DL CCTrCHs commanded by its TPC:

- The UE estimates the received dedicated channel burst quality over the last 160 ms period to be worse than a threshold $Q_{out}$, and in addition, no special burst, as defined in 4.5, is detected with quality above a threshold, $Q_{sbout}$. $Q_{out}$ and $Q_{sbout}$ are defined implicitly by the relevant tests in [2]. If the UE detects the beacon channel reception level [10 dB] above the handover triggering level, then the UE shall use a 320 ms estimation period for the burst quality evaluation and for the Special Burst detection window.

UE shall subsequently resume the uplink transmission of the CCTrCH if the following criteria are fulfilled:

- The UE estimates the received dedicated CCTrCH burst reception quality over the last 160 ms period to be better than a threshold $Q_{in}$ or the UE detects a burst with quality above threshold $Q_{sbin}$ and TFCI decoded to be that of the Special Burst. $Q_{in}$ and $Q_{sbin}$ are defined implicitly by the relevant tests in [2]. If the UE detects the beacon channel reception level [10 dB] above the handover triggering level, then the UE shall use a 320 ms estimation period for the burst quality evaluation and for the Special Burst detection window.

## 4.2.3 Downlink Control

### 4.2.3.1 P-CCPCH

The Primary CCPCH transmit power is set by higher layer signalling and can be changed based on network conditions on a slow basis. The reference transmit power of the P-CCPCH is broadcast on BCH or individually signalled to each UE.

### 4.2.3.2 S-CCPCH, PICH

The relative transmit power of the Secondary CCPCH and the PICH compared to the P-CCPCH transmit power are set by higher layer signalling. The PICH power offset relative to the P-CCPCH reference power is signalled on the BCH.

### 4.2.3.3 SCH

The SCH transmit power is set by higher layer signalling [16]. The value is given relative to the power of the P-CCPCH.

### ~~4.2.3.4~~4.2.3.3A PNBSCH

The PNBSCH transmit power is set by higher layer signalling [16]. The value given is relative to the power of the P-CCPCH

### ~~4.2.3.5~~4.2.3.4 DPCH, PDSCH

The initial transmission power of the downlink DPCH and the PDSCH shall be set by the network. If associated uplink CCTrCHs for TPC commands are signalled to the UE by higher layers (mandatory for a DPCH), the network shall transit into inner loop power control after the initial transmission. The UE shall then generate TPC commands to control the network transmit power and send them in the TPC field of the associated uplink CCTrCHs. An example on how to derive the TPC commands and the definition of the inner loop power control are given in Annex A.1. A TPC command sent in an uplink CCTrCH controls all downlink DPCHs or PDSCHs to which the associated downlink CCTrCH is mapped to.

In the case that no associated downlink data is scheduled within 15 timeslots before the transmission of a TPC command then this is regarded as a transmission pause. The TPC commands in this case shall be derived from measurements on the P-CCPCH. An example solution for the generation of the TPC command for this case is given in Annex A 1.

Each TPC command shall always be based on all associated downlink transmissions received since the previous related TPC command. Related TPC commands are defined as TPC commands associated with the same downlink CCTrCHs. If there are no associated downlink transmissions between two or more uplink transmissions carrying related TPC commands, then these TPC commands shall be identical and they shall be regarded by the UTRAN as a single TPC command. This rule applies both to the case where the TPC commands are based on measurements on the associated CCTrCH or, in the case of a transmission pause, on the P-CCPCH.

As a response to the received TPC command, UTRAN may adjust the transmit power. When the TPC command is judged as "down", the transmission power may be reduced by the TPC step size, whereas if judged as "up", the transmission power may be raised by the TPC step size.

The UTRAN may apply an individual offset to the transmission power in each timeslot according to the downlink interference level at the UE.

The transmission power of one DPCH or PDSCH shall not exceed the limits set by higher layer signalling by means of Maximum_DL_Power (dB) and Minimum_DL_Power (dB). The transmission power is defined as the average power over one timeslot of the complex QPSK symbols of a single DPCH or PDSCH before spreading relative to the power of the P-CCPCH.

During a downlink transmission pause, both UE and Node B shall use the same TPC step size which is signalled by higher layers. The UTRAN may accumulate the TPC commands received during the pause. TPC commands that shall be regarded as identical may only be counted once. The initial UTRAN transmission power for the first data transmission after the pause may then be set to the sum of transmission power before the pause and a power offset according to the accumulated TPC commands. Additionally this sum may include a constant set by the operator and a correction term due to uncertainties in the reception of the TPC bits. The total downlink transmission power at the Node B within one timeslot shall not exceed Maximum Transmission Power set by higher layer signalling. If the total transmit power of all channels in a timeslot exceeds this limit, then the transmission power of all downlink DPCHs and PDSCHs shall be reduced by the same amount in dB. The value for this power reduction is determined, so that the total transmit power of all channels in this timeslot is equal to the maximum transmission power.

#### ~~4.2.3.5.1~~4.2.3.4.1 Out of synchronisation handling

When the dedicated physical channel out of sync criteria based on the received burst quality is as given in the subclause 4.4.2 then the UE shall set the uplink TPC command = "up". The CRC based criteria shall not be taken into account in TPC bit value setting.

## 4.3 Timing Advance

UTRAN may adjust the UE transmission timing with timing advance. The initial value for timing advance ($TA_{phys}$) will be determined in the UTRAN by measurement of the timing of the PRACH. The required timing advance will be represented as an 6 bit number (0-63) 'UL Timing Advance' $TA_{ul}$, being the multiplier of 4 chips which is nearest to the required timing advance (i.e. $TA_{phys} = TA_{ul} \times 4$ chips).

When Timing Advance is used the UTRAN will continuously measure the timing of a transmission from the UE and send the necessary timing advance value. On receipt of this value the UE shall adjust the timing of its transmissions accordingly in steps of ±4chips. The transmission of TA values is done by means of higher layer messages. Upon receiving the TA command the UE shall adjust its transmission timing according to the timing advance command at the frame number specified by higher layer signaling. The UE is signaled the TA value in advance of the specified frame activation time to allow for local processing of the command and application of the TA adjustment on the specified frame. Node-B is also signaled the TA value and radio frame number that the TA adjustment is expected.to take place.

If TA is enabled by higher layers, after handover the UE shall transmit in the new cell with timing advance TA adjusted by the relative timing difference Δt between the new and the old cell:

$TA_{new} = TA_{old} + 2\Delta t$.

## 4.4 Synchronisation procedures

### 4.4.1 Cell Search

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

### 4.4.2 Dedicated channel synchronisation

#### 4.4.2.1 Synchronisation primitives

##### 4.4.2.1.1 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.

##### 4.4.2.1.2 Downlink synchronisation primitives

Layer 1 in the UE shall check the synchronization status of each DL CCTrCH individually in every radio frame All bursts and transport channels of a CCTrCH shall be taken into account. Synchronisation status is indicated to higher layers, using the CPHY-Sync-IND or CPHY-Out-of-Sync-IND primitives. For dedicated physical channels configured with Repetition Periods [15 ] only the configured active periods shall be taken into account in the estimation. The status check shall also include detection of the Special Bursts defined in 4.5 for DTX.

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

The first phase lasts until 160 ms after the downlink CCTrCH is considered to be established by higher layers. During this time, Out-of-sync shall not be reported. In-sync shall be reported using the CPHY-Sync-IND primitive if any one of the following three criteria is fulfilled.

a) The UE estimates the burst reception quality 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 burst reception quality measurement have been collected.

b) At least one transport block with a CRC attached is received in a TTI ending in the current frame with correct CRC.

c) The UE detects at least one Special Burst. Special Burst detection shall be successful if the burst is detected with quality above a threshold, $Q_{sbin}$, and the TFCI is decoded to be that of the Special Burst.

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 all three of the following criteria are fulfilled:

- the UE estimates the received dedicated channel burst quality over the last 160 ms period to be worse than a threshold $Q_{out}$. The value, $Q_{out}$ is defined implicitly by the relevant tests in [2];

- no Special Burst is detected with quality above a threshold $Q_{sbout}$ within the last 160 ms period. The value $Q_{sbout}$ is defined implicitly by the relevant tests in [2];

- over the previous 160 ms, no transport block has been received with a correct CRC

If the UE detects the beacon channel reception level [10 dB] above the handover triggering level, the UE shall use 320 ms estimation period for the burst quality evaluation and for the Special Burst and CRC detection window.

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

- the UE estimates the received burst reception quality over the last 160 ms period to be better than a threshold $Q_{in}$. The value, $Q_{in}$ is defined implicitly by the relevant tests in [2].

- the UE detects at least one Special Burst with quality above a threshold $Q_{sbin}$ within the last 160 ms period. The value, $Q_{sbin}$, is defined implicitly by the relevent tests in [2].

- at least one transport block with a CRC attached is received in a TTI ending in the current frame with correct CRC.

If the UE detects the beacon channel reception level [10 dB] above the handover triggering level, the UE uses 320 ms estimation period for the burst quality evaluation and for the Special Burst detection window.

If no data are provided by higher layers for transmission during the second phase on the downlink dedicated channel then DTX shall be applied as defined in section 4.5.

How the primitives are used by higher layers is described in [15]. The above definitions may lead to radio frames where neither the In-Sync or Out-of-Sync primatives are reported.

##### 4.4.2.1.3 Uplink synchronisation primitives

Layer 1 in the Node B shall every radio frame check synchronisation status, individually for each UL CCTrCH of the radio link. Synchronisation status is indicated to the RL Failure/Restored triggering function using either the CPHY-Sync-IND or CPHY-Out-of-Sync-IND primitive.

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

#### 4.4.2.2 Radio link monitoring

##### 4.4.2.2.1 Downlink radio link failure

The downlink CCTrCHs are monitored by the UE, to trigger radio link failure procedures. The downlink CCTrCH failure status is specified in [15], 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. These primitives shall provide status for each DL CCTrCH separately.

##### 4.4.2.2.2 Uplink radio link failure/restore

The uplink CCTrCHs are monitored by the Node B in order to trigger CCTrCH failure/restore procedures. The uplink CCTrCH failure/restore status is reported using the synchronisation status primitives CPHY-Sync-IND and CPHY-Out-of-Sync-IND, indicating in-sync and out-of-sync respectively.

When the CCTrCH 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 indicate to higher layers which CCTrCHs are out-of-sync using the synchronization status primitives. Furthermore, the CCTrCH state shall be changed to the out-of-sync state.

When a CCTrCH is in the out-of-sync state, after receiving N_INSYNC_IND successive in-sync indications Node B shall indicate that the CCTrCH has re-established synchronisation and the CCTrCH's state shall be changed to the in-sync-state. The specific parameter settings (values of T_RLFAILURE, N_OUTSYNC_IND, and N_INSYNC_IND) are configurable, see [16].

## 4.5 Discontinuous transmission (DTX) of Radio Frames

DTX is applied to CCTrCHs mapped to dedicated and shared physical channels (PUSCH, PDSCH, UL DPCH and DL DPCH), if the total bit rate of the CCTrCH differs from the total channel bit rate of the physical channels allocated to this CCTrCH.

Rate matching is used in order to fill resource units completely, that are only partially filled with data. In the case that after rate matching and multiplexing no data at all is to be transmitted in a resource unit the complete resource unit is discarded from transmission. This applies also to the case where only one resource unit is allocated and no data has to be transmitted.

### 4.5.1 Use of Special Bursts for DTX

In case there are no transport blocks provided for transmission by higher layers for any given CCTrCH after link establishment, then a Special Burst shall be transmitted in the first allocated frame of the transmission pause. If, including the first frame, there is a consecutive period of Special Burst Period (SBP) frames without transport blocks provided by higher layers, then another special burst shall be generated and transmitted at the next possible frame. This pattern shall be continued until transport blocks are provided for the CCTrCH by the higher layers. SBP shall be provided by higher layers. The value of SBP shall be independently specified for uplink and for downlink and shall be designated as

SBGP (special burst generation period) for uplink transmissions

SBSP (special burst scheduling parameter) for downlink transmissions

The default value for both SBGP and SBSP shall be 8.

This special burst shall have the same slot format as the burst used for data provided by higher layers. The special burst is filled with an arbitrary bit pattern, contains a TFCI and TPC bits if inner loop PC is applied and is transmitted for each CCTrCH individually on the physical channel which is defined to carry the TFCI. The TFCI of the special burst is filled with "0" bits. The transmission power of the special burst shall be the same as that of the substituted physical channel of the CCTrCH carrying the TFCI.

### 4.5.2 Use of Special Bursts for Initial Establishment / Reconfiguration

Upon initial establishment or reconfiguration for either 160 ms following detection of in-sync, or until the first transport block is received from higher layers, both the UE and the Node B shall transmit the special burst for each CCTrCH for each assigned resource which was scheduled to include a TFCI.

## 4.6 Downlink Transmit Diversity

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

### 4.6.1 Transmit Diversity for PDSCH and DPCH

The transmitter structure to support transmit diversity for PDSCH and DPCH transmission is shown in figure 1. 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. Examples of transmit diversity schemes are given in annex B.

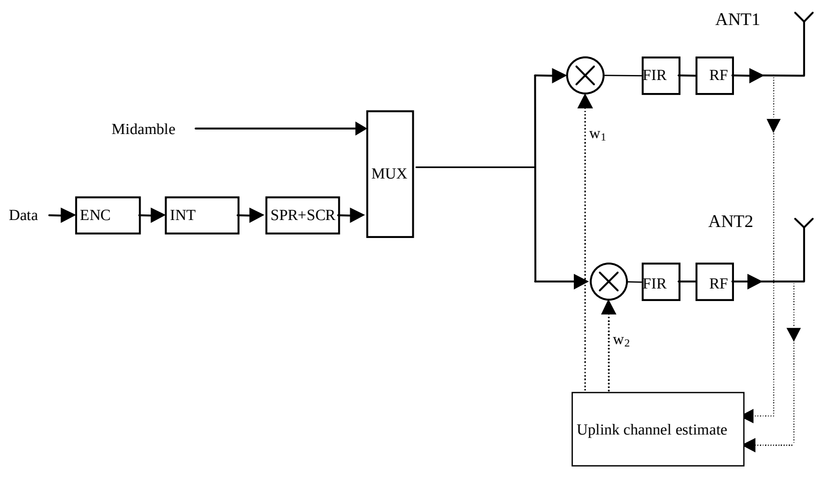


**Figure 1: Downlink transmitter structure to support Transmit Diversity for PDSCH and DPCH transmission (UTRAN Access Point)**

## 4.6.2 Transmit Diversity for SCH

Time Switched Transmit Diversity (TSTD) can be employed as transmit diversity scheme for the synchronisation channel.

### 4.6.2.1 SCH Transmission Scheme

The transmitter structure to support transmit diversity for SCH transmission is shown in figure 2. P-SCH and S-SCH are transmitted from antenna 1 and antenna 2 alternatively. An example for the antenna switching pattern is shown in figure 3.

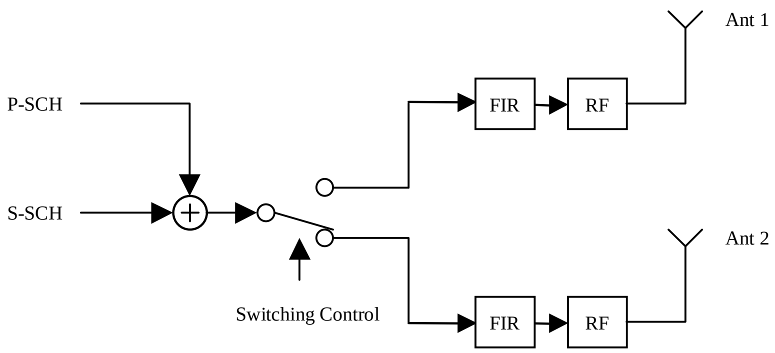


**Figure 2: Downlink transmitter structure to support Transmit Diversity for SCH transmission (UTRAN Access Point)**

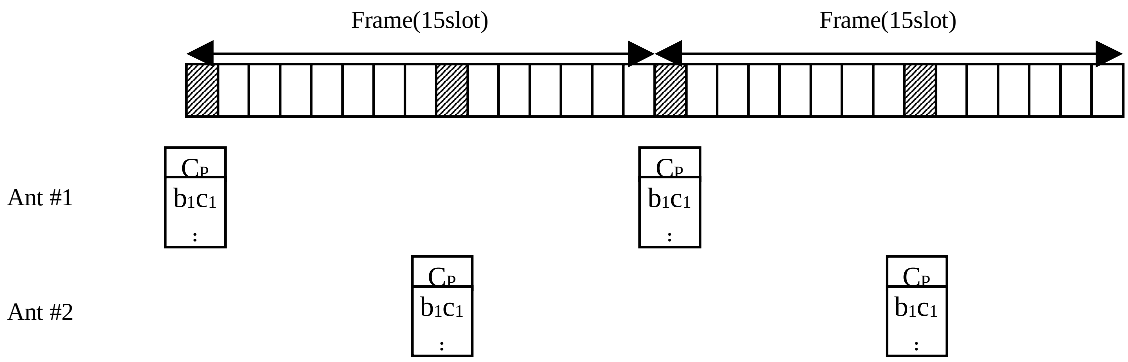


**Figure 3: Antenna Switching Pattern (Case 2)**

## 4.6.3 Transmit Diversity for Beacon Channels

Space Code Transmit Diversity (SCTD) for beacon channels may be employed optionally in the UTRAN. The support is mandatory in the UE. The use of SCTD will be indicated by higher layers. If SCTD is active within a cell :-

- SCTD shall be applied to any beacon channel, and
- the maximum number $K_{Cell}$ of midambles for burst type 1 that are supported in this cell may be 8 or 16, see [8]. The case of $K_{Cell}$ = 4 midambles is not allowed for this burst type.

### 4.6.3.1 SCTD Transmission Scheme

The open loop downlink transmit diversity scheme for beacon channels is shown in figure 4. Channel coding, rate matching, interleaving and bit-to-symbol mapping are performed as in the non-diversity mode. In Space Code Transmit

Diversity mode the data sequence is spread with the channelisation codes $c_{16}^{(k=1)}$ and $c_{16}^{(k=2)}$ and scrambled with the cell specific scrambling code. The spread sequence on code $c_{16}^{(k=2)}$ is then transmitted on the diversity antenna. The power applied to each antenna shall be equal.

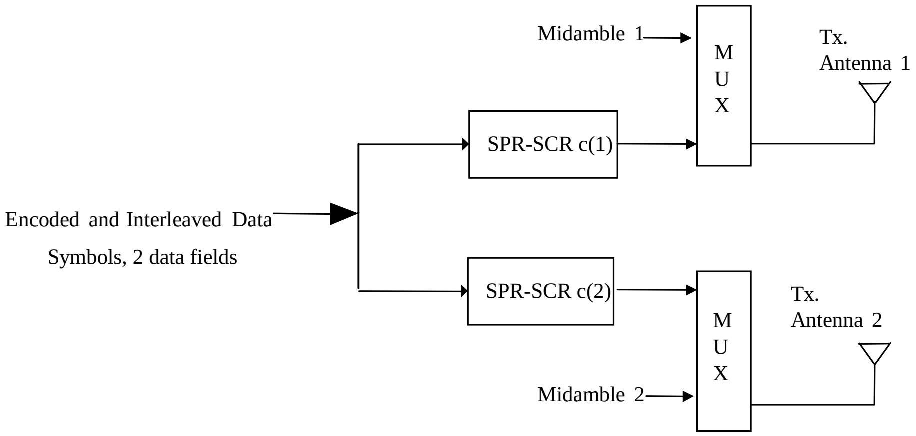


**Figure 4: Block Diagram of the transmitter SCTD**

# 4.7 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. Retransmission on the RACH in case of failed transmission (e.g. due to a collision) is controlled by higher layers. Thus, the backoff algorithm and associated handling of timers is not described here. The definition of the RACH in terms of PRACH Access Service Classes is broadcast on the BCH in each cell. Parameters for common physical channel uplink outer loop power control are also broadcast on the BCH in each cell. The UE needs to decode this information prior to transmission on the RACH. Higher layer signalling may indicate, that in some frames a timeslot shall be blocked for RACH uplink transmission.

## 4.7.1 Physical random access procedure

The physical random access procedure described in this subclause is initiated upon request from the MAC sublayer (see [18] and [19]).

Note: The selection of a PRACH is done by the RRC Layer.

Before the physical random-access procedure can be initiated, Layer 1 shall receive the following information from the RRC layer using the primitives CPHY-TrCH-Config-REQ and CPHY-RL-Setup/Modify-REQ.

- the available PRACH channelization codes (There is a 1-1 mapping between the channelization code and the midamble shift as defined by RRC) for each Access Service Class (ASC) of the selected PRACH (the selection of a PRACH is done by the RRC ). CPHY-RL-Setup/Modify-REQ);
- the timeslot, spreading factor, and midamble type(direct or inverted) for the selected PRACH (CPHY-RL-Setup/Modify-REQ);
- the RACH Transport Format (CPHY-TrCH-Config-REQ);
- the RACH transport channel identity (CPHY-TrCH-Config-REQ)
- the set of parameters for common physical channel uplink outer loop power control(CPHY-RL-Setup/Modify-REQ).

NOTE: 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 MAC:

- the ASC of the PRACH transmission;
- the data to be transmitted (Transport Block Set).

  the selected ASC sub-channel. The ASC subchannel is defined in reference [18]. The value is passed in the PHY-Data-REQ is the $CFN_{CELL.}$

In addition, Layer 1 may receive information from higher layers, that a timeslot in certain frames shall be blocked for PRACH uplink transmission.

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

1 Randomly select one channelization code from the set of available codes for the selected ASC. The random function shall be such that each code is chosen with equal probability.

2 Determine the midamble shift to use, based on the selected channelization code.

3 Set the PRACH message transmission power level according to the specification for common physical channels in uplink (see subclause 4.2.2.2).

4 Transmit the RACH Transport Block Set (the random access message) with no timing advance in the selected sub-channel using the selected channelization code.

# 4.8 DSCH procedure

The physical downlink shared channel procedure described below shall be applied by the UE when the physical layer signalling either with the midamble based signalling or TFCI based signalling is used to indicate for the UE the need for PDSCH detection. There is also a third alternative to indicate to the UE the need for the PDSCH detection and this is done by means of higher layer signalling, already described in [8].

## 4.8.1 DSCH procedure with TFCI indication

When the UE has been allocated by higher layers to receive data on DSCH using the TFCI, the UE shall decode the PDSCH in the following cases:

- In case of a standalone PDSCH the TFCI is located on the PDSCH itself, then the UE shall decode the TFCI and based on which data rate was indicated by the TFCI, the decoding shall be performed. The UE shall decode PDSCH only if the TFCI word decode corresponds to the TFC part of the TFCS given to the UE by higher layers.
- In case that the TFCI is located on the DCH, the UE shall decode the PDSCH frame or frames if the TFCI on the DCH indicates the need for PDSCH reception. Upon reception of the DCH time slot or time slots, the PDSCH slot (or first PDSCH slot) shall start *SFN n+2* after the DCH frame containing the TFCI, where n indicates the SFN on which the DCH is received. In the case that the TFCI is repeated over several frames, the PDSCH slot shall start *SFN n+2* after the frame having the DCH slot which contains the last part of the repeated TFCI.

## 4.8.2 DSCH procedure with midamble indication

When the UE has been allocated by higher layers to receive PDSCH based on the midamble used on the PDSCH (midamble based signalling described in [8]), the UE shall operate as follows:

- The UE shall test the midamble it received and if the midamble received was the same as indicated by higher layers to correspond to PDSCH reception, the UE shall detect the PDSCH data according to the TF given by the higher layers for the UE.
- In case of multiple time slot allocation for the DSCH indicated to be part of the TF for the UE, the UE shall receive all timeslots if the midamble of the first timeslot of PDSCH was the midamble indicated to the UE by higher layers.
- In case the standalone PDSCH (no associated DCH) contains the TFCI the UE shall detect the TF indicated by the TFCI on PDSCH.

## 4.9 Node B Synchronisation Procedure over the Air

An option exists to use cell sync bursts to achieve and maintain Node B synchronisation [20]. This optional procedure is based on transmissions of cell synchronisation bursts [10] in predetermined timeslots normally assigned to contain PRACH, according to an RNC schedule. Such soundings between neighbouring cells facilitate timing offset measurements by the cells. The timing offset measurements are reported back to the RNC for processing. The RNC generates cell timing updates that are transmitted to the Node Bs and cells for implementation.

When Cell Sync Bursts are used to achieve and maintain intercell Synchronisation there are three distinct phases, with a potential additional sub-phase involving late entrant cells.

### 4.9.1 Frequency Acquisition Phase

The frequency acquisition phase is used to bring cells of an RNS area to within frequency limits prior to initial synchronisation. No traffic is supported during this phase. In this phase cell(s) identified as master time reference shall transmit cell sync bursts [10] specified by higher layers continuously, i. e. one in every timeslot. All other cells shall listen for transmissions and shall perform frequency locking to the transmissions received.  They shall signal completion of frequency acquisition to the RNC and begin continuous transmission of cell sync bursts specified by higher layers.

### 4.9.2 Initial Synchronisation

For Initial Phase, where no traffic is supported, the following procedure for initial synchronisation may be used to bring cells of an RNS area into synchronisation at network start up. In this phase each cell shall transmit cell sync bursts [10] according to the higher layer command.  All cells use the same cell sync burst code and code offset. Each cell shall listen for transmissions from other cells. Each cell shall report the timing and received SIR of successfully detected cell sync bursts to the RNC. The RNC uses these measurements to adjust the timing of each cell to achieve the required synchronisation accuracy.

### 4.9.3 Steady-State Phase

The steady-state phase is used to maintain the required synchronisation accuracy. With the start of the steady-state phase, traffic is supported in a cell. A procedure that may be used for the steady-state phase involves cell synch bursts [10] that are transmitted and received without effect on existing traffic. Higher layers signal the transmit parameters, i. e. when to transmit which code and code offset, and which transmit power to use. The higher layers also signal to appropriate cells the receive parameters i. e. which codes and code offsets to measure in a certain timeslot. Upon determination of errors in timing, the RNC may adjust the timing of a cell or cells.

### 4.9.4 Late entrant cells

A procedure that may be used for introducing new cells into an already synchronised RNS involves the one time transmission of a single cell sync burst [10] (scheduled by higher layers) by all neighbour cells of the late entrant cell. and received by the late entrant cell. The RNC may use this information to adjust the late entrant cell sufficiently to allow the cell to enter steady state phase.

## 4.10 Idle periods for IPDL location method

### 4.10.1 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 ceased, except for the SCH transmission. During these idle periods the visibility of neighbour cells from the UE is improved.

The idle periods are arranged in a determined pattern according to higher layer parameters. An idle period has a duration of one time slot. During idle periods only the SCH is transmitted. 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.

The time difference measurements can be performed on any channel. If the P-CCPCH falls in an idle slot, UTRAN may decide not to transmit the P-CCPCH in two consecutive frames, the first of these two frames containing the idle slot. This option is signalled by higher layers.

### 4.10.2 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 the next idle period. Note that there is at most one idle period in a radio frame.

**IP_Start:** The number of the first frame with idle periods. In case of continuous mode IP_Start is the SFN of the first frame with idle periods and in case of burst mode IP_Start defines the number of frames after Burst_Start with the first frame with idle periods.

**IP_Slot:** The number of the slot that has to be idle [0..14].

**IP_PCCPCH:** This logic value indicates, if the P-CCPCH is switched off in two consecutive frames. The first of these two frames contains the idle period.

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 between the start of a burst and the start of the next burst.

### 4.10.3 Calculation of idle period position

In burst mode, burst #0 starts in the radio frame with SFN = 256×Burst_Start. Burst #n starts in the radio frame with SFN = 256×Burst_Start + $n$×256×Burst_Freq ( $n$ = 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 starts in the radio frame with SFN = 0. In case of continuous mode the parameter IP_Start defines the first frame with idle periods.

The position of an idle period is defined by two values: IP_Frame($x$) and IP_Slot. IP_Frame($x$) defines the $x^{th}$ frame within a burst that contains the idle period. IP_Slot defines the slot in that frame during which no transmission takes place except for the SCH.

The actual frame with idle periods within a burst is calculated as follows:

IP_Frame($x$) = IP_Start + ($x$-1) × IP_Spacing with $x$ = 1, 2, 3, ....

If the parameter IP_PCCPCH is set to 1, then the P-CCPCH will not be transmitted in the frame IP_Frame($x$) +1 within a burst.

Figure 5 below illustrates the idle periods for the burst mode case, if the IP_P-CCPCH parameter is set to 0.

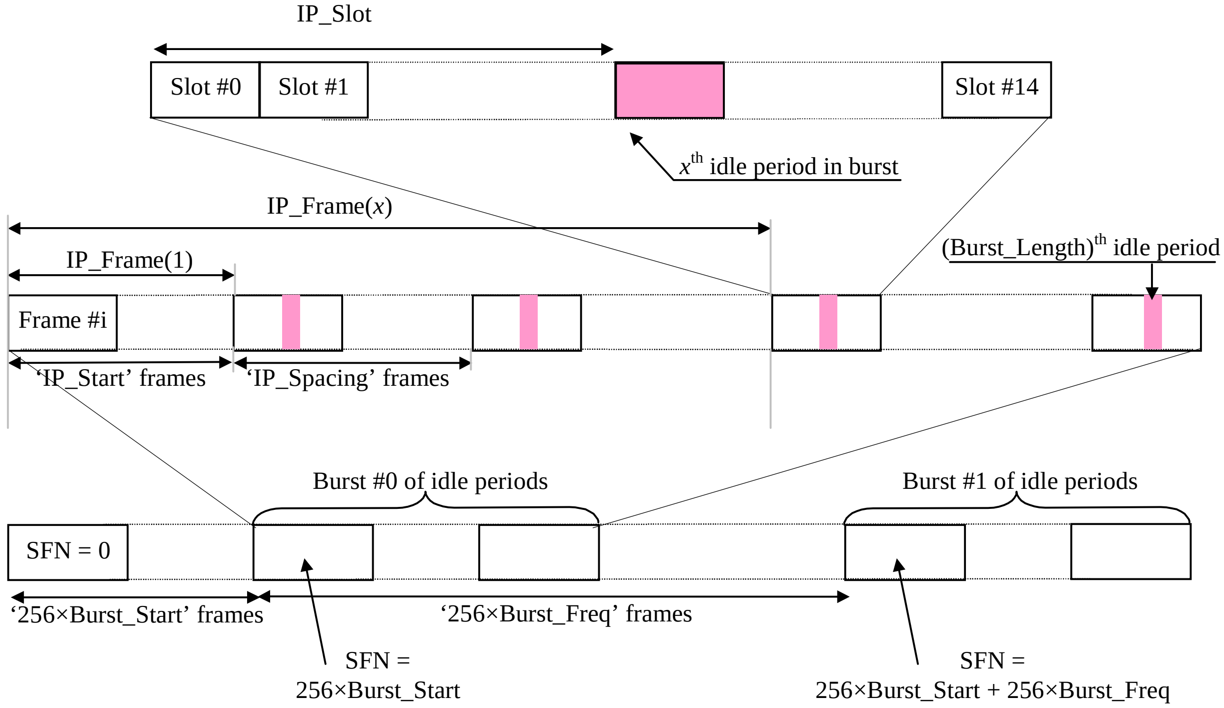


**Figure 5: Idle Period placement in the case of burst mode operation with IP_P-CCPCH parameter set to 0**

# 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**

| | Uplink | Downlink |
|---|---|---|
| Power control rate | Variable<br>Closed loop: 0-200 cycles/sec.<br>Open loop: (about 200us – 3575us delay ) | Variable<br>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 | |

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 UpPCH

The transmit power for the UpPCH is set by higher layers based on open loop power control as described in [15].

#### 5.1.1.3 PRACH

The transmit power for the PRACH is set by higher layers based on open loop power control as described in [15].

#### 5.1.1.4 DPCH and PUSCH

The closed loop power control makes use of layer 1 symbols in the DPCH and PUSCH. The power control step can take the values 1,2,3 dB within the overall dynamic range 80dB. The initial transmission power for uplink DPCH and PUSCH is signalled by higher layers.

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 or PUSCH, respectively. 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 and PUSCH 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 Gain Factors

Same as that of 3.84 Mcps TDD, cf. [4.2.2.3.1 Gain Factors].

##### 5.1.1.4.2 Out of synchronization handling

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

#### 5.1.2.2 The power of the FPACH

The transmit power for the FPACH is set by the higher layer signalling [16].

#### 5.1.2.3 S-CCPCH, PICH

Same as that of 3.84 Mcps 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 or PUSCH 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 or PDSCH, respectively. 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 may 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.3.

The transmission power of one DPCH or PDSCH shall not exceed the limits set by higher layer signalling by means of Maximum_DL_Power (dB) and Minimum_DL_Power (dB). The transmission power is defined as the average power over one timeslot of the complex QPSK (or 8PSK respectively) symbols of a single DPCH or PDSCH before spreading relative to the power of the P-CCPCH.

During a downlink transmission pause, both UE and Node B shall use the same TPC step size, which is signalled by higher layers. The UTRAN may accumulate the TPC commands received during the pause. TPC commands that shall be regarded as identical may only be counted once. The initial UTRAN transmission power for the first data transmission after the pause may then be set to the sum of transmission power before the pause and a power offset according to the accumulated TPC commands. Additionally this sum may include a constant set by the operator and a correction term due to uncertainties in the reception of the TPC bits. The total downlink transmission power at the Node B within one timeslot shall not exceed Maximum Transmission Power set by higher layer signalling. If the total transmit power of all channels in a timeslot exceeds this limit, then the transmission power of all downlink DPCHs and PDSCHs shall be reduced by the same amount in dB. The value for this power reduction is determined, so that the total transmit power of all channels in this timeslot is equal to the maximum transmission power.

##### 5.1.2.4.1 Out of synchronisation handling

Same as that of 3.84 Mcps TDD, cf.[~~4.2.3.5.1~~ 4.2.3.4.1 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 1,28 Mcps 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 $\Delta t_p$ 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:

$T_{TX-UpPCH} = T_{RX-DwPCH} - 2\Delta t_p + 12*16\ T_C$

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,

$2\Delta t_p$ 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:

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

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. The UE shall derive a single SS command separately for each controlled uplink timeslot by combining all received SS commands that are related to the controlled time slot (cf. [8]) and that are received within the last up to M sub-frames. The value of the “Uplink synchronisation frequency” M (1..8) is configured by higher layers.

When the combined SS command is judged as 'down', the UE transmit timing for the controlled UL timeslot shall be delayed by one timing adjustment step of k/8 chips. When the command is judged as 'up', the UE transmit timing for the controlled UL timeslot shall be advanced by one timing adjustment step of k/8 chips. When the command is judged as 'do nothing', the timing shall not be changed. The value of the "Uplink synchronisation step size" k (1..8) is configured by higher layers.

The timing adjustment shall take place in each sub-frame satisfying the following equation:

$$SFN' \bmod M = 0$$

where

SFN' is the system frame number counting the sub-frames. The system frame number of the radio frames (SFN) can be derived from SFN' by

SFN=SFN' div 2, where div is the remainder free division operation.

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 Δt between the new and the old cell if indicated by higher layers:

$TA_{new} = TA_{old} + 2\Delta t$.

#### 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.]

## 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 CAD.

### 5.3.2 DCH synchronization

The DPCH synchronisation is the same as that of 3,84 Mcps 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 PDSCH, DPCH, P-CCPCH, S-CCPCH, PICH and DwPCH is optional in UTRAN. Its support is mandatory at the UE.

### 5.5.1 Transmit Diversity for PDSCH and DPCH

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

#### 5.5.1.1 TSTD for PDSCH and DPCH

TSTD can be employed as transmit diversity scheme for PDSCH and 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 and/or PDSCH is transmitted from antenna 1 and antenna 2 alternately every sub-frame. Not all DPCHs and/or PDSCHs in the sub-frame need to be transmitted on the same antenna and not all DPCHs and/or PDSCHs within a sub-frame have to use TSTD. Figure 7 shows an example for the antenna switching pattern for the transmission of DPCH/PDSCH for the case that all physical channels are transmitted with TSTD and are using the same antenna in the sub-frame.

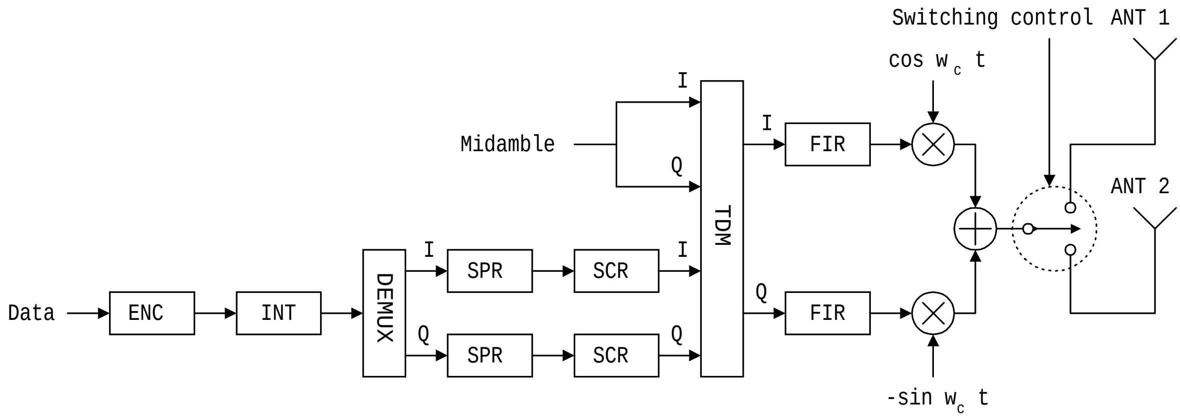


**Figure 6: Example for TSTD Transmitter structure for DPCH/PDSCH and P-CCPCH.**

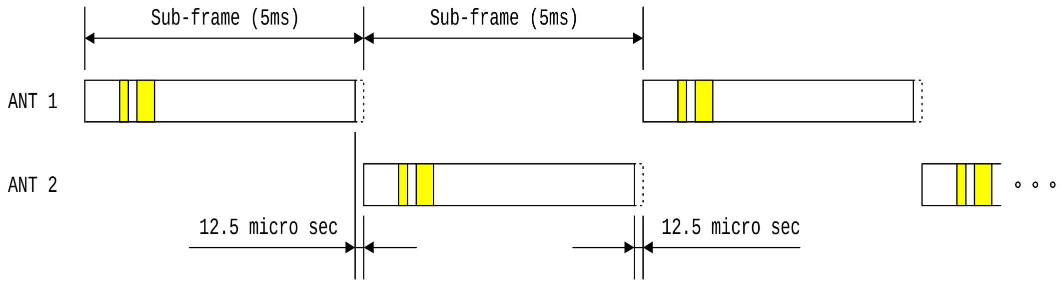


**Figure 7: Example for the antenna swithing pattern for TSTD transmission of DPCH/PDSCH and P-CCPCH: all physical channels are transmitted with TSTD and are using the same antenna in the sub-frame.**

#### 5.5.1.2 Closed Loop Tx Diversity for PDSCH and DPCH

The transmitter structure to support transmit diversity for DPCH and/or PDSCH 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.

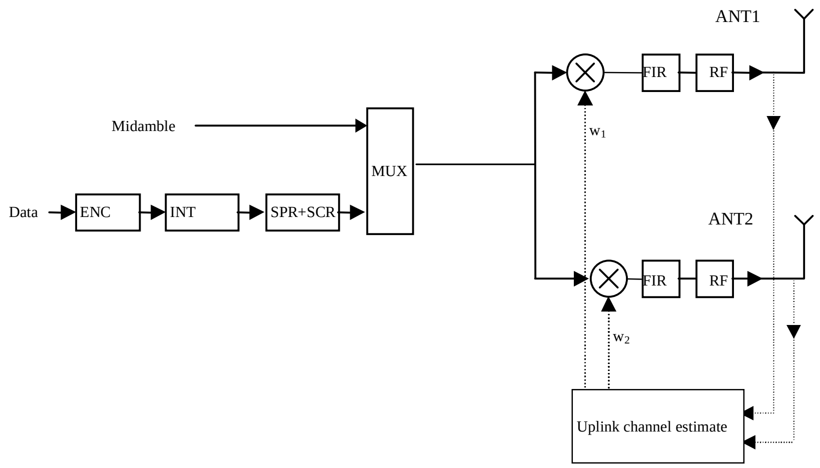


**Figure 8: Downlink transmitter structure to support Transmit Diversity for DPCH and/or PDSCH transmission (UTRAN Access Point) in 1.28 Mcps TDD**

## 5.5.2 Transmit Diversity for DwPCH

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.

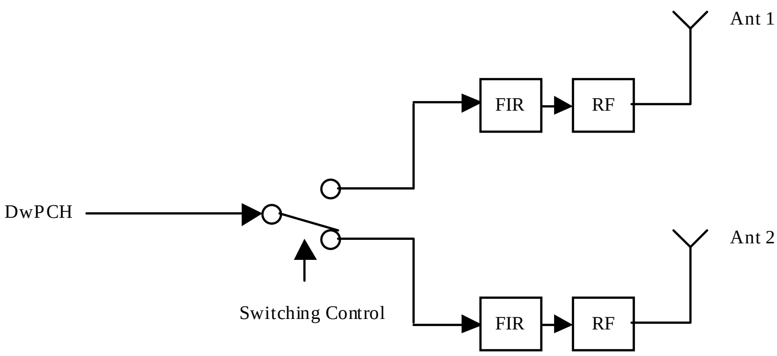


**Figure 9: Downlink transmitter structure to support Transmit Diversity for DwPCH transmission (UTRAN Access Point) in 1.28 Mcps TDD**

## 5.5.3 Transmit Diversity for P-CCPCH

TSTD or Space Code Transmit Diversity (SCTD) 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.

## 5.5.4 SCTD Transmission Scheme for Beacon Channels

The use of SCTD will be indicated by higher layers. If SCTD is active within a cell, SCTD shall be applied to any beacon channel.

The open loop downlink transmit diversity scheme for beacon channels is shown in figure 10, exemplary for the P-CCPCH. Channel coding, rate matching, interleaving and bit-to-symbol mapping are performed as in the non-diversity mode. In TxDiversity mode the beacon channel that is allocated to code $c_{16}^{(k=1)}$ is spread with the channelisation codes $c_{16}^{(k=1)}$ and $c_{16}^{(k=3)}$ and scrambled with the cell specific scrambling code. The beacon channel that is allocated to code $c_{16}^{(k=2)}$ is spread with the channelisation codes $c_{16}^{(k=2)}$ and $c_{16}^{(k=4)}$ and scrambled with the cell specific scrambling code. The spread sequences on code $c_{16}^{(k=3)}$ and code $c_{16}^{(k=4)}$ are then transmitted on the diversity antenna. The power applied to each antenna shall be equal.

The use of SCTD will be indicated by higher layers.

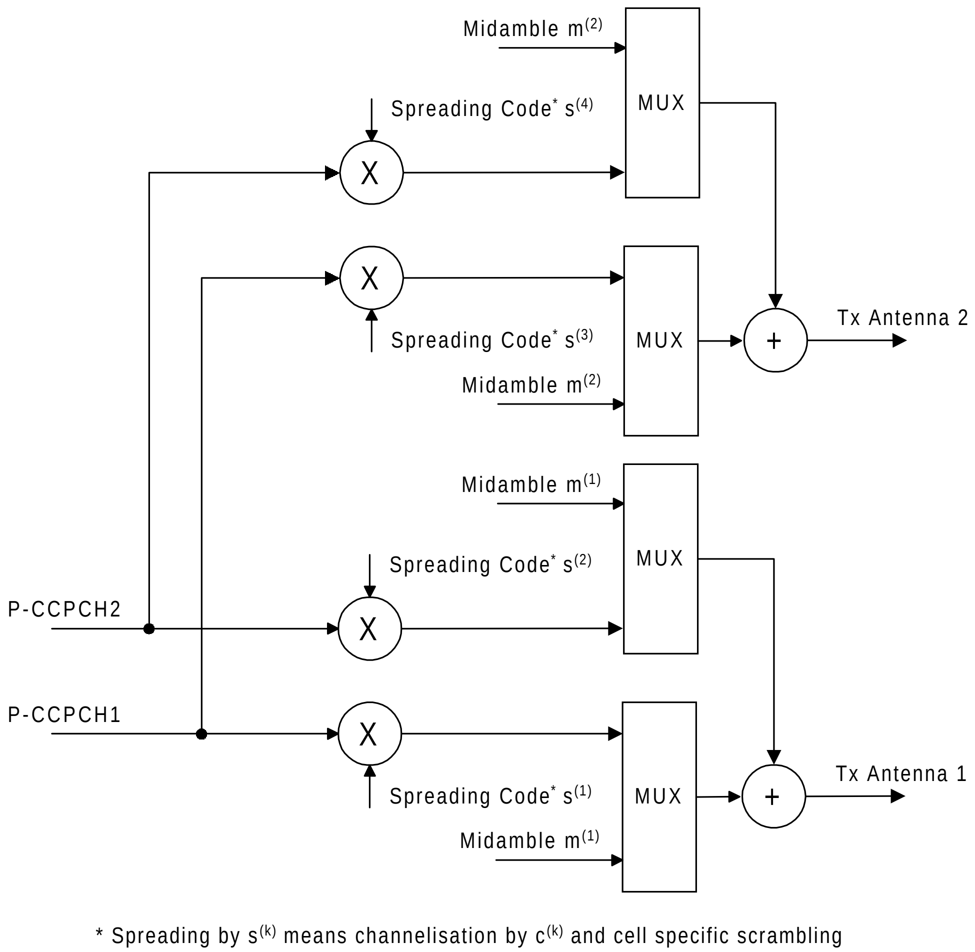


**Figure 10: Block Diagram of the transmitter (SCTD) in 1.28 Mcps TDD, exemplary for the P-CCPCH**

## 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

$FPACH_{i}$ : : FPACH number i

$L_i$ : Length of RACH transport blocks associated to $FPACH_i$ in sub-frames

$N_{RACHi}$ : The number of PRACHs associated to the i[th] FPACH

$n_{RACHi}$ : The number of a PRACH associated to the i[th] FPACH ranging from 0 to $N_{RACHi}$-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 system 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 transport 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 physical random access procedure described in this sub-clause is initiated upon request 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 $L_i$ of a RACH message associated to $FPACH_i$ 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: $N_{RACHi}$ PRACHs can be associated with to $FPACH_i$. The maximum allowed

$N_{RACHi}$ is $L_i$.

- 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";
- The power-ramping factor Power Ramp Step [Integer];

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. In the case that the Commanded Signature transmission Power exceeds the maximum allowed value, set the Signature transmission Power to the maximum allowed 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 $FPACH_i$ associated to the transmitted UpPCH only in the sub-frames fulfilling the following relation:

$(SFN' \bmod L_i)=n_{RACHi}$ ; $n_{RACHi}=0,\ldots, N_{RACHi}-1$,

6 In case no valid answer is detected in the due time: Increase the Signature transmission power by $\Delta P_0$ = Power Ramp Step [dB], 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 $FPACH_i$

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 $L_i$ 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 $n_{RACHi}$ th PRACH associated to the $FPACH_i$ if the following equation ifs fulfilled:

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

Here SFN' if 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 $FPACH_i$ associated the transmitted UpPCH only in the sub-frames fulfilling the following relation:

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

- 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 $T_{ref}$ 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 CB~~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:

*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.

### 5.6.4 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 resources allocated to PRACH are virtually collision free. This two-step approach will guarantee that the RACH resources can be handled with conventional traffic on the same UL time slots.

# Annex A (informative): Power Control

## A.1 Example Implementation of Downlink Power Control in the UE

The power control may be realized by two cascaded control loops. The outer loop controls the transmission quality, whose reference value is set by higher layers [15], by providing the reference value for the inner loop. This reference value should be the SIR at the UE [15]. The inner loop controls the physical quantity for which the outer loop produces the reference value (e. g. the SIR) by generating TPC commands. This may be done by comparing the measured SIR to its reference value. 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:

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

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

| | |
|---|---|
| RSCP: | Received signal code power in dBm |
| ISCP: | Interference signal code power in the DPCH / PDSCH timeslot in dBm |
| 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, $1 \le i \le$ number of frames in the pause |
| $L_0$: | weighted pathloss in the last frame before the transmission pause in dB |
| $RSCP_0$: | RSCP of the data that was used in the SIR calculation of the last frame before the pause in dBm |
| TPC (k): | ± power control stepsize in dB according to the TPC bit generated and transmitted in frame k, TPC bit "up" = +stepsize, TPC bit "down" = −stepsize |

## A.2 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.3 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.1 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.4 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 B (informative): Determination of Weight Information

Selective Transmit Diversity (STD) and Transmit Adaptive Antennas (TxAA) are examples of transmit diversity schemes for dedicated physical channels.

## B.1 STD Weights

The weight vector will take only two values depending on the signal strength received by each antenna in the uplink slot. For each user, the antenna receiving the highest power will be selected (i.e. the corresponding weight will be set to 1).

**Table B.13: STD weights for two TX antennas**

| | $W_1$ | $W_2$ |
|---|---|---|
| Antenna 1 receiving highest power | 1 | 0 |
| Antenna 2 receiving highest power | 0 | 1 |

## B.2 TxAA Weights

In a generic sense, the weight vector to be applied at the transmitter is the $\underline{w}$ that maximises:

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

where

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

and where the column vector $\underline{h}_i$ represents the estimated uplink channel impulse response for the i'th transmission antenna, of length equal to the length of the channel impulse response.

# Annex C (informative): Cell search procedure for 3,84 Mcps TDD

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

**Step 1: Primary synchronisation code acquisition**

During the first step of the cell search procedure, the UE uses the SCH's primary synchronisation code to find 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. A cell can be found by detecting peaks in the matched filter output.

Note that for a cell of SCH slot configuration case 1, the SCH can be received periodically every 15 slots. In case of a cell of SCH slot configuration case 2, the following SCH slot can be received at offsets of either 7 or 8 slots from the previous SCH slot.

**Step 2: Code group identification and slot synchronisation**

During the second step of the cell search procedure, the UE uses the SCH's secondary synchronisation codes to identify 1 out of 32 code groups for the cell found in the first step. This is typically done by correlating the received signal with the secondary synchronisation codes at the detected peak positions of the first step. The primary synchronisation code provides the phase reference for coherent detection of the secondary synchronisation codes. The code group can then uniquely be identified by detection of the maximum correlation values.

Each code group indicates a different $t_{offset}$ parameter and 4 specific cell parameters. Each of the cell parameters is associated with one particular downlink scrambling code and one particular long and short basic midamble code. When the UE has determined the code group, it can unambiguously derive the slot timing of the found cell from the detected peak position in the first step and the $t_{offset}$ parameter of the found code group in the second step.

Note that the modulation of the secondary synchronisation codes also indicates the position of the SCH slot within a 2 frames period, e.g. a frame with even or odd SFN. Additionally, in the case of SCH slot configuration following case 2, the SCH slot position within one frame, e.g. first or last SCH slot, can be derived from the modulation of the secondary synchronisation codes.

**Step 3: Downlink scrambling code, basic midamble code identification and frame synchronisation**

During the third and last step of the cell search procedure, the UE determines the exact downlink scrambling code, basic midamble code and frame timing used by the found cell. The long basic midamble code can be identified by correlation over the P-CCPCH (or any other beacon channel) with the 4 possible long basic midamble codes of the code group found in the second step. A P-CCPCH (or any other beacon channel) always uses the midamble $m^{(1)}$ (and in case of SCTD also midamble $m^{(2)}$) derived from the long basic midamble code and always uses a fixed and pre-assigned channelisation code.

When the long basic midamble code has been identified, downlink scrambling code and cell parameter are also known. The UE can read system and cell specific BCH information and acquire frame synchronisation.

Note that even for an initial cell parameter assignment, a cell cycles through a set composed of 2 different cell parameters according to the SFN of a frame, e.g. the downlink scrambling code and the basic midamble code of a cell alternate for frames with even and odd SFN. Cell parameter cycling leaves the code group of a cell unchanged.

If the UE has received information about which cell parameters or SCH configurations to search for, cell search can be simplified.

# Annex CA~~D~~ (informative): Cell search procedure for 1,28 Mcps 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 1,28 Mcps 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.

# Annex CB~~E~~ (informative): Examples random access procedure for 1,28 Mcps TDD

**Table ~~E~~CB.1~~-1~~: One PRACH, TTI=5ms, 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<br>2 | 3<br>4 | 5<br>6 | 7<br>8 | | | | | | | |
| Acknowledged user on FPACH | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | |
| User sending on PRACH 0 | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |

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

**Table ~~E~~CB.2~~-2~~: Two PRACHs, TTI=10ms, WT=4, L =2, SF8 PRACH**

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

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

**Table ~~E~~CB.3~~-3~~: Four PRACHs, TTI=20ms, WT=4, L =4, SF16 PRACH**

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

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

**Table ~~E~~CB.4~~-4~~: Two PRACHs, TTI=20ms, WT=4, L =4, SF16 PRACH**

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

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 sub-frames would have passed since the UpPCH.

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

| Change history | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 14/01/00 | RAN_05 | RP-99594 | - | | Approved at TSG RAN #5 and placed under Change Control | - | 3.0.0 |
| 14/01/00 | RAN_06 | RP-99698 | 001 | 01 | Primary and Secondary CCPCH in TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99698 | 002 | - | Measurement procedure of received reference power for OL-TPC in TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99699 | 004 | 1 | STTD capability for P-CCPCH, TDD component | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99697 | 005 | 1 | Alignment of Terminology Regarding Spreading for TDD Mode | 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-000070 | 003 | 2 | Cycling of cell parameters | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 007 | 2 | Clarifications on the UL synchronisation and Timing advance | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 008 | - | Modification of SIR threshold on setting TPC | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 009 | 1 | New section describing the random access procedure | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 011 | - | Removal of Synchronisation Case 3 in TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 012 | 1 | Clarifications on power control procedures | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 013 | - | Signal Point Constellation | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 014 | 2 | Out-of-sync handling for UTRA TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 015 | - | Removal of ODMA from the TDD specifications | 3.1.1 | 3.2.0 |
| 26/06/00 | RAN_08 | RP-000274 | 016 | - | Editorial correction for the power control section in 25.224 | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000274 | 017 | - | Power control for TDD during DTX | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000274 | 018 | 1 | Power Control for PDSCH | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000274 | 020 | 1 | Editorial modification of 25.224 | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000274 | 021 | - | Clarifications on TxDiversity for UTRA TDD | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000274 | 022 | 1 | Introduction of the TDD DSCH detection procedure in TS 25.224 | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000274 | 023 | - | Downlink power control on timeslot basis | 3.2.0 | 3.3.0 |
| 23/09/00 | RAN_09 | RP-000347 | 019 | 1 | Gain Factors for TDD Mode | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000347 | 025 | - | Terminology regarding the beacon function | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000347 | 026 | 1 | Synchronisation of timing advance adjustment and timing deviation measurement | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000347 | 027 | 1 | CCTrCH UL/DL pairing for DL inner loop power control | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000347 | 028 | 1 | RACH timing in TDD mode | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000347 | 030 | 1 | TDD Access Bursts for HOV | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000347 | 032 | - | Removal of ODMA related abbreviations and correction of references | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000347 | 033 | - | Clarifications on the Out-of-sync handling for UTRA TDD | 3.3.0 | 3.4.0 |
| 15/12/00 | RAN_10 | RP-000544 | 035 | 1 | Radio Link establishment and sync status reporting | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000544 | 040 | - | Clarification on PICH power setting | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000544 | 042 | - | Correction to TDD timing advance description | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000544 | 043 | - | Limit on maximum value of alpha used for open loop power control | 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-010065 | 036 | - | DTX and Special Burst Scheduling | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010065 | 037 | 1 | RACH random access procedure | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010065 | 045 | - | Introduction of closed-loop Tx diversity for the PDSCH and DTX for the PUSCH/PDSCH | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010065 | 046 | 2 | Corrections of TDD power control sections | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010065 | 050 | - | Use of a special burst in reconfiguration | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010065 | 053 | - | Known TFCI for the TDD special burst | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010073 | 044 | 2 | Layer 1 procedure for Node B synchronisation | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010071 | 047 | 1 | Inclusion of 1,28 Mcps TDD in TS 25.224 | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010072 | 048 | 1 | Idle periods for IPDL location method | 3.5.0 | 4.0.0 |
| 15/06/01 | RAN_12 | RP-010338 | 057 | - | Correction of Timing Advance section for 3.84 Mcps TDD | 4.0.0 | 4.1.0 |
| 15/06/01 | RAN_12 | RP-010338 | 059 | - | Addition to the abbreviation list | 4.0.0 | 4.1.0 |
| 15/06/01 | RAN_12 | RP-010343 | 049 | - | Clarification of IP_Frame(x) definition | 4.0.0 | 4.1.0 |
| 15/06/01 | RAN_12 | RP-010343 | 055 | 1 | Correction of IPDL burst parameters | 4.0.0 | 4.1.0 |
| 21/09/01 | RAN_13 | RP-010525 | 064 | 1 | Correction of criteria for OOS indication | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010531 | 060 | - | Corrections for TS 25.224 | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010531 | 062 | 1 | Corrections of Annex E in 25.224 | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010531 | 061 | - | Corrections and Clarifications for calculation of idle period position in subclause 4.10.3 in 25.224 | 4.1.0 | 4.2.0 |
| 14/12/01 | RAN_14 | RP-010742 | 066 | - | Removal of the remark on power control | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010742 | 068 | 1 | Transmit Diversity for P-CCPCH and PICH | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010742 | 070 | 1 | Correction to random access procedure (Primitive from MAC) | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010749 | 073 | 1 | Random access procedure for 1.28Mcps TDD | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010749 | 074 | - | Transmit diversity for P-CCPCH and PICH | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010749 | 075 | - | Correction of Annex A.3 in 25.224 | 4.2.0 | 4.3.0 |

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 14/12/01 | RAN_14 | RP-010749 | 076 | - | Removal of the remark on power control | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010749 | 077 | - | Corrections to DL-PC sections for 1.28 Mcps TDD | 4.2.0 | 4.3.0 |
| 08/03/02 | RAN_15 | RP-020052 | 079 | 1 | Removal of quantisation of bj gain factor when calculated from a reference TFC | 4.3.0 | 4.4.0 |
| 08/03/02 | RAN_15 | RP-020052 | 084 | 1 | TDD MAC layer subchannel assignment | 4.3.0 | 4.4.0 |
| 08/03/02 | RAN_15 | RP-020052 | 086 | - | Transmit diversity on PICH | 4.3.0 | 4.4.0 |
| 07/06/02 | RAN_16 | RP-020315 | 087 | - | Clarification on power control and TxDiversity procedure for 1.28 Mcps TDD | 4.4.0 | 4.5.0 |
| 19/09/02 | RAN_17 | RP-020572 | 093 | 2 | Corrections to transmit diversity mode for TDD beacon-function physical channels | 4.5.0 | 4.6.0 |
| 19/09/02 | RAN_17 | RP-020577 | 096 | 1 | Corrections to uplink synchronisation procedure | 4.5.0 | 4.6.0 |
| 19/09/02 | RAN_17 | RP-020577 | 098 | - | Correction to the PRACH open loop power control procedure for 1.28 Mcps TDD | 4.5.0 | 4.6.0 |
| 19/09/02 | RAN_17 | RP-020579 | 100 | 1 | Corrections to transmit diversity mode for TDD beacon-function physical channels | 4.5.0 | 4.6.0 |
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**Shanghai, China, 5 – 8 November 2002**

***R1-02-1392***

*CR-Form-v7*

# CHANGE REQUEST

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ⌘ | **25.224** | **CR** | **105** | ⌘ **rev** | **-** | ⌘ Current version: | **5.2.1** ⌘ |

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

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Proposed change affects:*** | UICC apps⌘ | | ME | X | Radio Access Network | X | Core Network |

| | | | | |
|---|---|---|---|---|
| ***Title:*** | ⌘ | Editorial modification to the section numberings | | |
| ***Source:*** | ⌘ | TSG RAN WG1 | | |
| ***Work item code:*** | ⌘ | TEI5 | ***Date:*** ⌘ | 01/11/2002 |
| ***Category:*** | ⌘ | **D** | ***Release:*** ⌘ | Rel-5 |
| | | *Use one of the following categories:*<br>***F*** *(correction)*<br>***A*** *(corresponds to a correction in an earlier release)*<br>***B*** *(addition of feature),*<br>***C*** *(functional modification of feature)*<br>***D*** *(editorial modification)*<br>Detailed explanations of the above categories can be found in 3GPP TR 21.900. | | *Use one of the following releases:*<br>*2 (GSM Phase 2)*<br>*R96 (Release 1996)*<br>*R97 (Release 1997)*<br>*R98 (Release 1998)*<br>*R99 (Release 1999)*<br>*Rel-4 (Release 4)*<br>*Rel-5 (Release 5)*<br>*Rel-6 (Release 6)* |

| | | |
|---|---|---|
| ***Reason for change:*** | ⌘ | The numbering used is not consistent with TS21.801. |
| ***Summary of change:*** | ⌘ | The sections, figures, and tables numberings are adjusted to follow the guidlines given in TS21.801. |
| ***Consequences if not approved:*** | ⌘ | Confusion and misunderstanding, not consistent with specification guidelines, and the rest of the document. |

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|---|---|---|---|---|---|---|
| ***Clauses affected:*** | ⌘ | All the document | | | | |
| | | **Y** | **N** | | | |
| ***Other specs affected:*** | ⌘ | | X | Other core specifications | ⌘ | |
| | | | X | Test specifications | | |
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# Contents

# Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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- x the first digit:
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# 1 Scope

The present document describes the Physical Layer Procedures in the TDD 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 25.201: "Physical layer - general description".

[2] 3GPP TS 25.102: "UE physical layer capabilities".

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

[4] 3GPP TS 25.212: "Multiplexing and channel coding (FDD)".

[5] 3GPP TS 25.213: "Spreading and modulation (FDD)".

[6] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[7] 3GPP TS 25.215: "Physical Layer - Measurements (FDD)".

[8] 3GPP TS 25.221: "Physical channels and mapping of transport channels onto physical channels (TDD)".

[9] 3GPP TS 25.222: "Multiplexing and channel coding (TDD)".

[10] 3GPP TS 25.223: "Spreading and modulation (TDD)".

[11] 3GPP TS 25.225: "Physical Layer - Measurements (TDD)".

[12] 3GPP TS 25.301: "Radio Interface Protocol Architecture".

[13] 3GPP TS 25.302: "Services Provided by the Physical Layer".

[14] 3GPP TS 25.401: "UTRAN Overall Description".

[15] 3GPP TS 25.331: "RRC Protocol Specification"

[16] 3GPP TS 25.433: "UTRAN Iub Interface NBAP Signalling"

[17] 3GPP TS 25.105: "UTRA (BS) TDD; Radio transmission and Reception"

[18] 3GPP TS 25.321: "MAC protocol specification"

[19] 3GPP TS 25.303: "Interlayer Procedures in Connected Mode"

[20] 3GPP TS 25.402: "Synchronisation in UTRAN Stage 2"

# 3 Abbreviations

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

| | |
|---|---|
| ACK | Acknowledgement |
| ASC | Access Service Class |
| BCCH | Broadcast Control Channel |
| BCH | Broadcast Channel |
| CCTrCH | Coded Composite Transport Channel |
| CDMA | Code Division Multiple Access |
| CQI | Channel Quality Information |
| CRC | Cyclic Redundancy Check |
| DCA | Dynamic Channel Allocation |
| DL | Downlink |
| DPCH | Dedicated Physical Channel |
| DTX | Discontinuous Transmission |
| FACH | Forward Access Channel |
| FDD | Frequency Division Duplex |
| HS-DSCH | High Speed Downlink Shared Channel |
| HS-PDSCH | High Speed Physical Downlink Shared Channel |
| HS-SCCH | Shared Control Channel for HS-DSCH |
| HS-SICH | Shared Information Channel for HS-DSCH |
| ISCP | Interference Signal Code Power |
| MAC | Medium Access Control |
| NACK | Negative Acknowledgement |
| NRT | Non-Real Time |
| P-CCPCH | Primary Common Control Physical Channel |
| PC | Power Control |
| PDSCH | Physical Downlink Shared Channel |
| PRACH | Physical Random Access Channel |
| PUSCH | Physical Uplink Shared Channel |
| RACH | Random Access Channel |
| RL | Radio Link |
| RRC | Radio Resource Control |
| RSCP | Received Signal Code Power |
| RT | Real Time |
| RU | Resource Unit |
| SBGP | Special Burst Generation Gap |
| SBP | Special Burst Period |
| SBSP | Special Burst Scheduling Period |
| S-CCPCH | Secondary Common Control Physical Channel |
| SCH | Synchronisation Channel |
| SCTD | Space Code Transmit Diversity |
| SFN | System Frame Number |
| SIR | Signal–to-Interference Ratio |
| SSCH | Secondary Synchronisation Channel |
| STD | Selective Transmit Diversity |
| TA | Timing Advance |
| TDD | Time Division Duplex |
| TF | Transport Format |
| TFC | Transport Format Combination |
| TFCI | Transport Format Combination Indicator |
| TFCS | Transport Format Combination Set |
| TFRC | Transport Format Resource Combination |
| TFRI | Transport Format Resource Indicator |
| TPC | Transmit Power Control |
| TSTD | Time Switched Transmit Diversity |
| TTI | Transmission Time Interval |
| TxAA | Transmit Adaptive Antennas |
| UE | User Equipment |
| UL | Uplink |

| | |
|---|---|
| UMTS | Universal Mobile Telecommunications System |
| UTRAN | UMTS Radio Access Network |
| VBR | Variable Bit Rate |

# 4 Physical layer procedures for the 3,84 Mcps option

## 4.1 General

## 4.2 Transmitter Power Control

### 4.2.1 General Parameters

Power control is applied for the TDD mode to limit the interference level within the system thus reducing the intercell interference level and to reduce the power consumption in the UE.

All codes within one timeslot allocated to the same CCTrCH use the same transmission power, in case they have the same spreading factor.

**Table 1: Transmit Power Control characteristics**

| | Uplink | Downlink |
|---|---|---|
| **Power control rate** | Variable<br>1-7 slots delay (2 slot SCH)<br>1-14 slots delay (1 slot SCH) | Variable, with rate depending on the slot allocation. |
| **TPC Step size** | -- | 1dB or 2 dB or 3 dB |
| **Remarks** | All figures are without processing and measurement times | |

### 4.2.2 Uplink Control

#### 4.2.2.1 General Limits

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 total UE transmit power is below the maximum allowed output power. In some cases the total UE transmit power in a timeslot after uplink power control calculation might exceed the maximum allowed output power. In these cases the calculated transmit power of all uplink physical channels in this timeslot shall be scaled by the same amount in dB before transmission. The total UE transmission power used shall be the maximum allowed output power.

The UTRAN may not expect the UE to be capable of reducing its total transmit power below the minimum level specified in [2].

#### 4.2.2.2 PRACH

The transmit power for the PRACH is set by higher layers based on open loop power control as described in [15].

#### 4.2.2.3 DPCH, PUSCH and HS-SICH

The transmit power for DPCH, PUSCH and HS-SICH is set by higher layers based on open loop power control as described in [15].

In the case that an ACK is being transmitted on the HS-SICH, the UE shall apply a power offset to the transmit power of the entire HS-SICH. This power offset shall be signalled by higher layers.

#### 4.2.2.3.1 Gain Factors

Two or more transport channels may be multiplexed onto a CCTrCH as described in [9]. These transport channels undergo rate matching which involves repetition or puncturing. This rate matching affects the transmit power required to obtain a particular $E_b/N_0$. Thus, the transmission power of the CCTrCH shall be weighted by a gain factor β.

There are two ways of controlling the gain factors for different TFC's within a CCTrCH transmitted in a radio frame:

- β is signalled for the TFC, or
- β is computed for the TFC, based upon the signalled settings for a reference TFC.

Combinations of the two above methods may be used to associate β values to all TFC's in the TFCS for a CCTrCH. The two methods are described in sections 4.2.2.3.1.1 and 4.2.2.3.1.2 respectively. Several reference TFC's for several different CCTrCH's may be signalled from higher layers.

The weight and gain factors may vary on a radio frame basis depending upon the current SF and TFC used. The setting of weight and gain factors is independent of any other form of power control. That means that the transmit power $P_{UL}$ is calculated according to the formula given in [15] and then the weight and gain factors are applied on top of that, cf. [10].

##### 4.2.2.3.1.1 Signalled Gain Factors

When the gain factor $\beta_j$ is signalled by higher layers for a certain TFC, the signalled values are used directly for weighting DPCH or PUSCH within a CCTrCH. Exact values are given in [10].

##### 4.2.2.3.1.2 Computed Gain Factors

The gain factor $\beta_j$ may also be computed for certain TFCs, based on the signalled settings for a reference TFC:

Let $\beta_{ref}$ denote the signalled gain factor for the reference TFC. Further, let $\beta_j$ denote the gain factor 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*, $N_i$ is the number of bits output from the radio frame segmentation block for transport channel *i* 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.

Moreover, define the variable $L_{ref} = \sum_i \frac{1}{SF_i}$

where $SF_i$ is the spreading factor of DPCH or PUSCH *i* and the sum is taken over all DPCH or PUSCH *i* used in the reference TFC.

Similarly, define the variable $L_j = \sum_i \frac{1}{SF_i}$

where the sum is taken over all DPCH or PUSCH *i* used in the *j*-th TFC.

The gain factors $\beta_j$ for the *j*-th TFC are then computed as follows:

$$\beta_j = \sqrt{\frac{L_{ref}}{L_j}} \times \sqrt{\frac{K_j}{K_{ref}}}$$

No quantisation of $\beta_j$ is performed and as such, values other than the quantised $\beta_j$ given in [10] may be used.

#### 4.2.2.3.2 Out of synchronisation handling

As stated in 4.2.3.3, the association between TPC commands sent on uplink DPCH and PUSCH, with the power controlled downlink DPCH and PDSCH is signaled by higher layers. In the case of multiple DL CCTrCHs it is possible that an UL CCTrCH will provide TPC commands to more than one DL CCTrCH.

In the second phase of synchronisation evaluation, as defined in 4.4.2.1.2, the UE shall shut off the transmission of an UL CCTrCH if the following criteria are fulfilled for any one of the DL CCTrCHs commanded by its TPC:

- The UE estimates the received dedicated channel burst quality over the last 160 ms period to be worse than a threshold $Q_{out}$, and in addition, no special burst, as defined in 4.5, is detected with quality above a threshold, $Q_{sbout}$. $Q_{out}$ and $Q_{sbout}$ are defined implicitly by the relevant tests in [2]. If the UE detects the beacon channel reception level [10 dB] above the handover triggering level, then the UE shall use a 320 ms estimation period for the burst quality evaluation and for the Special Burst detection window.

UE shall subsequently resume the uplink transmission of the CCTrCH if the following criteria are fulfilled:

- The UE estimates the received dedicated CCTrCH burst reception quality over the last 160 ms period to be better than a threshold $Q_{in}$ or the UE detects a burst with quality above threshold $Q_{sbin}$ and TFCI decoded to be that of the Special Burst. $Q_{in}$ and $Q_{sbin}$ are defined implicitly by the relevant tests in [2]. If the UE detects the beacon channel reception level [10 dB] above the handover triggering level, then the UE shall use a 320 ms estimation period for the burst quality evaluation and for the Special Burst detection window.

## 4.2.3 Downlink Control

### 4.2.3.1 P-CCPCH

The Primary CCPCH transmit power is set by higher layer signalling and can be changed based on network conditions on a slow basis. The reference transmit power of the P-CCPCH is broadcast on BCH or individually signalled to each UE.

### 4.2.3.2 S-CCPCH, PICH

The relative transmit power of the Secondary CCPCH and the PICH compared to the P-CCPCH transmit power are set by higher layer signalling. The PICH power offset relative to the P-CCPCH reference power is signalled on the BCH.

### 4.2.3.3 SCH

The SCH transmit power is set by higher layer signalling [16]. The value is given relative to the power of the P-CCPCH.

### 4.2.3.3A~~4.2.3.4~~ PNBSCH

The PNBSCH transmit power is set by higher layer signalling [16]. The value given is relative to the power of the P-CCPCH

### 4.2.3.4~~4.2.3.5~~ DPCH, PDSCH

The initial transmission power of the downlink DPCH and the PDSCH shall be set by the network. If associated uplink CCTrCHs for TPC commands are signalled to the UE by higher layers (mandatory for a DPCH), the network shall transit into inner loop power control after the initial transmission. The UE shall then generate TPC commands to control the network transmit power and send them in the TPC field of the associated uplink CCTrCHs. An example on how to derive the TPC commands and the definition of the inner loop power control are given in Annex A.1. A TPC command sent in an uplink CCTrCH controls all downlink DPCHs or PDSCHs to which the associated downlink CCTrCH is mapped to.

In the case that no associated downlink data is scheduled within 15 timeslots before the transmission of a TPC command then this is regarded as a transmission pause. The TPC commands in this case shall be derived from measurements on the P-CCPCH. An example solution for the generation of the TPC command for this case is given in Annex A 1.

Each TPC command shall always be based on all associated downlink transmissions received since the previous related TPC command. Related TPC commands are defined as TPC commands associated with the same downlink CCTrCHs. If there are no associated downlink transmissions between two or more uplink transmissions carrying related TPC commands, then these TPC commands shall be identical and they shall be regarded by the UTRAN as a single TPC command. This rule applies both to the case where the TPC commands are based on measurements on the associated CCTrCH or, in the case of a transmission pause, on the P-CCPCH.

As a response to the received TPC command, UTRAN may adjust the transmit power. When the TPC command is judged as "down", the transmission power may be reduced by the TPC step size, whereas if judged as "up", the transmission power may be raised by the TPC step size.

The UTRAN may apply an individual offset to the transmission power in each timeslot according to the downlink interference level at the UE.

The transmission power of one DPCH or PDSCH shall not exceed the limits set by higher layer signalling by means of Maximum_DL_Power (dB) and Minimum_DL_Power (dB). The transmission power is defined as the average power over one timeslot of the complex QPSK symbols of a single DPCH or PDSCH before spreading relative to the power of the P-CCPCH.

During a downlink transmission pause, both UE and Node B shall use the same TPC step size which is signalled by higher layers. The UTRAN may accumulate the TPC commands received during the pause. TPC commands that shall be regarded as identical may only be counted once. The initial UTRAN transmission power for the first data transmission after the pause may then be set to the sum of transmission power before the pause and a power offset according to the accumulated TPC commands. Additionally this sum may include a constant set by the operator and a correction term due to uncertainties in the reception of the TPC bits. The total downlink transmission power at the Node B within one timeslot shall not exceed Maximum Transmission Power set by higher layer signalling. If the total transmit power of all channels in a timeslot exceeds this limit, then the transmission power of all downlink DPCHs and PDSCHs shall be reduced by the same amount in dB. The value for this power reduction is determined, so that the total transmit power of all channels in this timeslot is equal to the maximum transmission power.

##### 4.2.3.4~~5~~.1 Out of synchronisation handling

When the dedicated physical channel out of sync criteria based on the received burst quality is as given in the subclause 4.4.2 then the UE shall set the uplink TPC command = "up". The CRC based criteria shall not be taken into account in TPC bit value setting.

#### 4.2.3.5~~6~~ HS-PDSCH

The HS-PDSCH power control is under the control of the NodeB.

#### ~~4.2.3.7~~4.2.3.6 HS-SCCH

Higher layers shall indicate the initial transmit power of the HS-SCCH. How exactly this information is taken into account in the power setting is at the discretion of the NodeB.

Following the initial transmission, the NodeB may optionally power control the HS-SCCH. This may be done using TPC commands sent by the UE in the HS-SICH.

The UE shall set the TPC commands in the HS-SICH in order to control the transmit power of the HS-SCCH. The TPC commands shall be set in order to meet the HS-SCCH target BLER.

The accuracy of the received HS-SCCH BLER estimate made by the UE may be enhanced by a suitable use of the HCSN field received within the HS-SCCH itself [9]. This field shall initially be set to zero and shall be incremented by the NodeB each time an HS-SCCH is transmitted to the UE.

## 4.3 Timing Advance

UTRAN may adjust the UE transmission timing with timing advance. The initial value for timing advance ($TA_{phys}$) will be determined in the UTRAN by measurement of the timing of the PRACH. The required timing advance will be represented as an 6 bit number (0-63) 'UL Timing Advance' $TA_{ul}$, being the multiplier of 4 chips which is nearest to the required timing advance (i.e. $TA_{phys} = TA_{ul} \times 4$ chips).

When Timing Advance is used the UTRAN will continuously measure the timing of a transmission from the UE and send the necessary timing advance value. On receipt of this value the UE shall adjust the timing of its transmissions accordingly in steps of ±4chips. The transmission of TA values is done by means of higher layer messages. Upon receiving the TA command the UE shall adjust its transmission timing according to the timing advance command at the frame number specified by higher layer signaling. The UE is signaled the TA value in advance of the specified frame activation time to allow for local processing of the command and application of the TA adjustment on the specified frame. Node-B is also signaled the TA value and radio frame number that the TA adjustment is expected.to take place.

If TA is enabled by higher layers, after handover the UE shall transmit in the new cell with timing advance TA adjusted by the relative timing difference Δt between the new and the old cell:

$TA_{new} = TA_{old} + 2\Delta t$.

## 4.4 Synchronisation procedures

### 4.4.1 Cell Search

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

### 4.4.2 Dedicated channel synchronisation

#### 4.4.2.1 Synchronisation primitives

##### 4.4.2.1.1 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.

##### 4.4.2.1.2 Downlink synchronisation primitives

Layer 1 in the UE shall check the synchronization status of each DL CCTrCH individually in every radio frame All bursts and transport channels of a CCTrCH shall be taken into account. Synchronisation status is indicated to higher layers, using the CPHY-Sync-IND or CPHY-Out-of-Sync-IND primitives. For dedicated physical channels configured with Repetition Periods [15 ] only the configured active periods shall be taken into account in the estimation. The status check shall also include detection of the Special Bursts defined in 4.5 for DTX.

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

The first phase lasts until 160 ms after the downlink CCTrCH is considered to be established by higher layers. During this time, Out-of-sync shall not be reported. In-sync shall be reported using the CPHY-Sync-IND primitive if any one of the following three criteria is fulfilled.

a) The UE estimates the burst reception quality 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 burst reception quality measurement have been collected.

b) At least one transport block with a CRC attached is received in a TTI ending in the current frame with correct CRC.

c) The UE detects at least one Special Burst. Special Burst detection shall be successful if the burst is detected with quality above a threshold, $Q_{sbin}$, and the TFCI is decoded to be that of the Special Burst.

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 all three of the following criteria are fulfilled:

- the UE estimates the received dedicated channel burst quality over the last 160 ms period to be worse than a threshold $Q_{out}$. The value, $Q_{out}$ is defined implicitly by the relevant tests in [2];
- no Special Burst is detected with quality above a threshold $Q_{sbout}$ within the last 160 ms period. The value $Q_{sbout}$ is defined implicitly by the relevant tests in [2];
- over the previous 160 ms, no transport block has been received with a correct CRC

If the UE detects the beacon channel reception level [10 dB] above the handover triggering level, the UE shall use 320 ms estimation period for the burst quality evaluation and for the Special Burst and CRC detection window.

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

- the UE estimates the received burst reception quality over the last 160 ms period to be better than a threshold $Q_{in}$. The value, $Q_{in}$ is defined implicitly by the relevant tests in [2].
- the UE detects at least one Special Burst with quality above a threshold $Q_{sbin}$ within the last 160 ms period. The value, $Q_{sbin}$, is defined implicitly by the relevent tests in [2].
- at least one transport block with a CRC attached is received in a TTI ending in the current frame with correct CRC.

If the UE detects the beacon channel reception level [10 dB] above the handover triggering level, the UE uses 320 ms estimation period for the burst quality evaluation and for the Special Burst detection window.

If no data are provided by higher layers for transmission during the second phase on the downlink dedicated channel then DTX shall be applied as defined in section 4.5.

How the primitives are used by higher layers is described in [15]. The above definitions may lead to radio frames where neither the In-Sync or Out-of-Sync primatives are reported.

#### 4.4.2.1.3 Uplink synchronisation primitives

Layer 1 in the Node B shall every radio frame check synchronisation status, individually for each UL CCTrCH of the radio link. Synchronisation status is indicated to the RL Failure/Restored triggering function using either the CPHY-Sync-IND or CPHY-Out-of-Sync-IND primitive.

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

### 4.4.2.2 Radio link monitoring

#### 4.4.2.2.1 Downlink radio link failure

The downlink CCTrCHs are monitored by the UE, to trigger radio link failure procedures. The downlink CCTrCH failure status is specified in [15], 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. These primitives shall provide status for each DL CCTrCH separately.

#### 4.4.2.2.2 Uplink radio link failure/restore

The uplink CCTrCHs are monitored by the Node B in order to trigger CCTrCH failure/restore procedures. The uplink CCTrCH failure/restore status is reported using the synchronisation status primitives CPHY-Sync-IND and CPHY-Out-of-Sync-IND, indicating in-sync and out-of-sync respectively.

When the CCTrCH 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 indicate to higher layers which CCTrCHs are out-of-sync using the synchronization status primitives. Furthermore, the CCTrCH state shall be changed to the out-of-sync state.

When a CCTrCH is in the out-of-sync state, after receiving N_INSYNC_IND successive in-sync indications Node B shall indicate that the CCTrCH has re-established synchronisation and the CCTrCH's state shall be changed to the in-sync-state. The specific parameter settings (values of T_RLFAILURE, N_OUTSYNC_IND, and N_INSYNC_IND) are configurable, see [16].

## 4.5 Discontinuous transmission (DTX) of Radio Frames

DTX is applied to CCTrCHs mapped to dedicated and shared physical channels (PUSCH, PDSCH, UL DPCH and DL DPCH), if the total bit rate of the CCTrCH differs from the total channel bit rate of the physical channels allocated to this CCTrCH.

Rate matching is used in order to fill resource units completely, that are only partially filled with data. In the case that after rate matching and multiplexing no data at all is to be transmitted in a resource unit the complete resource unit is discarded from transmission. This applies also to the case where only one resource unit is allocated and no data has to be transmitted.

### 4.5.1 Use of Special Bursts for DTX

In case there are no transport blocks provided for transmission by higher layers for any given CCTrCH after link establishment, then a Special Burst shall be transmitted in the first allocated frame of the transmission pause. If, including the first frame, there is a consecutive period of Special Burst Period (SBP) frames without transport blocks provided by higher layers, then another special burst shall be generated and transmitted at the next possible frame. This pattern shall be continued until transport blocks are provided for the CCTrCH by the higher layers. SBP shall be provided by higher layers. The value of SBP shall be independently specified for uplink and for downlink and shall be designated as

SBGP (special burst generation period) for uplink transmissions

SBSP (special burst scheduling parameter) for downlink transmissions

The default value for both SBGP and SBSP shall be 8.

This special burst shall have the same slot format as the burst used for data provided by higher layers. The special burst is filled with an arbitrary bit pattern, contains a TFCI and TPC bits if inner loop PC is applied and is transmitted for each CCTrCH individually on the physical channel which is defined to carry the TFCI. The TFCI of the special burst is filled with "0" bits. The transmission power of the special burst shall be the same as that of the substituted physical channel of the CCTrCH carrying the TFCI.

### 4.5.2 Use of Special Bursts for Initial Establishment / Reconfiguration

Upon initial establishment or reconfiguration for either 160 ms following detection of in-sync, or until the first transport block is received from higher layers, both the UE and the Node B shall transmit the special burst for each CCTrCH for each assigned resource which was scheduled to include a TFCI.

## 4.6 Downlink Transmit Diversity

Downlink transmit diversity for PDSCH, DPCH, P-CCPCH, S-CCPCH, PICH, HS-SCCH, HS-PDSCH, and SCH is optional in UTRAN. Its support is mandatory at the UE.

### 4.6.1 Transmit Diversity for PDSCH, DPCH, HS-SCCH and HS-PDSCH

The transmitter structure to support transmit diversity for PDSCH, DPCH, HS-SCCH, and HS-PDSCH transmission is shown in figure 1. 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. Examples of transmit diversity schemes are given in annex B.

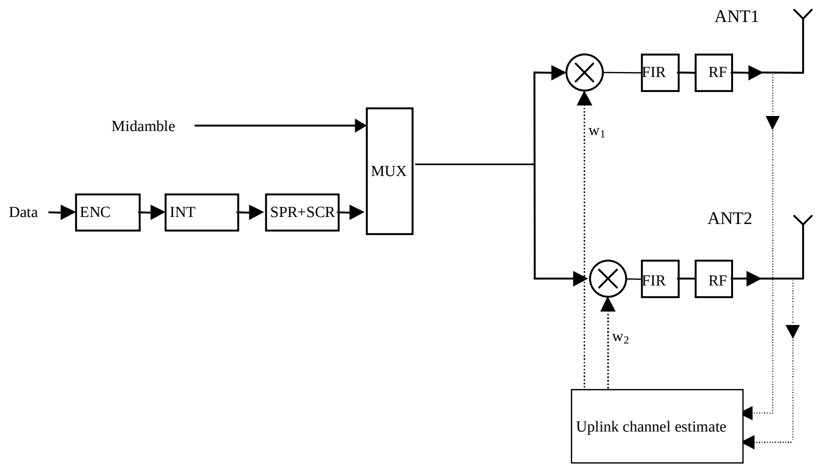


**Figure 1: Downlink transmitter structure to support Transmit Diversity for PDSCH, DPCH, HS-SCCH, and HS-PDSCH transmission (UTRAN Access Point)**

## 4.6.2 Transmit Diversity for SCH

Time Switched Transmit Diversity (TSTD) can be employed as transmit diversity scheme for the synchronisation channel.

### 4.6.2.1 SCH Transmission Scheme

The transmitter structure to support transmit diversity for SCH transmission is shown in figure 2. P-SCH and S-SCH are transmitted from antenna 1 and antenna 2 alternatively. An example for the antenna switching pattern is shown in figure 3.

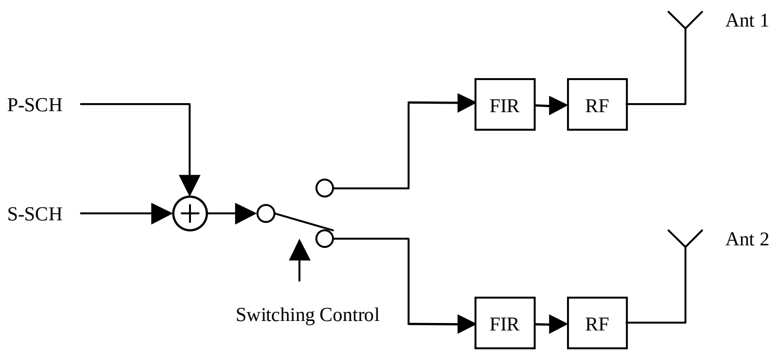


**Figure 2: Downlink transmitter structure to support Transmit Diversity for SCH transmission (UTRAN Access Point)**

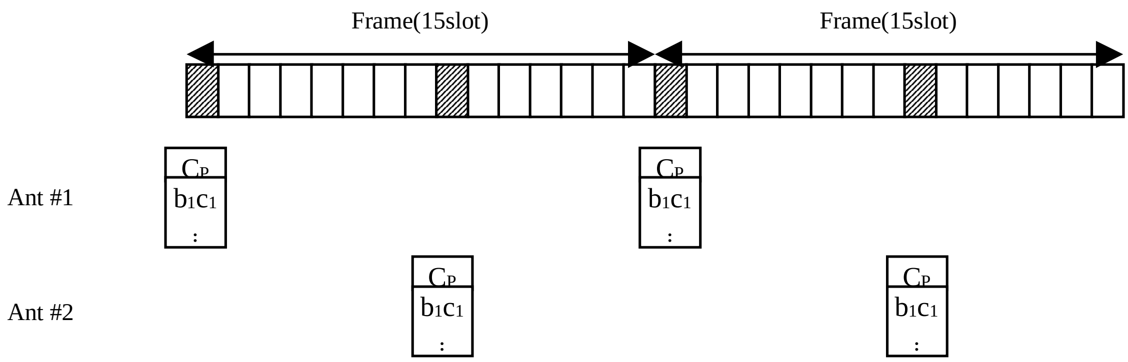


**Figure 3: Antenna Switching Pattern (Case 2)**

## 4.6.3 Transmit Diversity for Beacon Channels

Space Code Transmit Diversity (SCTD) for beacon channels may be employed optionally in the UTRAN. The support is mandatory in the UE. The use of SCTD will be indicated by higher layers. If SCTD is active within a cell :-

- SCTD shall be applied to any beacon channel, and
- the maximum number $K_{Cell}$ of midambles for burst type 1 that are supported in this cell may be 8 or 16, see [8]. The case of $K_{Cell}$ = 4 midambles is not allowed for this burst type.

### 4.6.3.1 SCTD Transmission Scheme

The open loop downlink transmit diversity scheme for beacon channels is shown in figure 4. Channel coding, rate matching, interleaving and bit-to-symbol mapping are performed as in the non-diversity mode. In Space Code Transmit Diversity mode the data sequence is spread with the channelisation codes $c_{16}^{(k=1)}$ and $c_{16}^{(k=2)}$ and scrambled with the cell specific scrambling code. The spread sequence on code $c_{16}^{(k=2)}$ is then transmitted on the diversity antenna. The power applied to each antenna shall be equal.

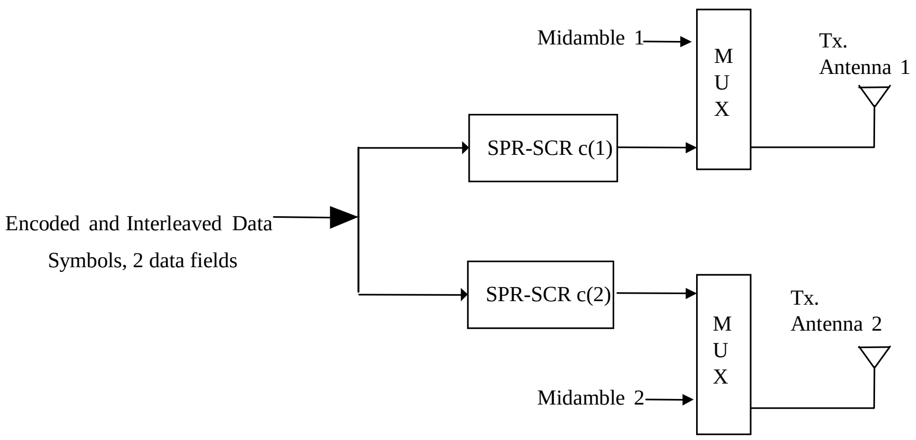


**Figure 4: Block Diagram of the transmitter SCTD**

## 4.7 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. Retransmission on the RACH in case of failed transmission (e.g. due to a collision) is controlled by higher layers. Thus, the backoff algorithm and associated handling of timers is not described here. The definition of the RACH in terms of PRACH Access Service Classes is broadcast on the BCH in each cell. Parameters for common physical channel uplink outer loop power control are also broadcast on the BCH in each cell. The UE needs to decode this information prior to transmission on the RACH. Higher layer signalling may indicate, that in some frames a timeslot shall be blocked for RACH uplink transmission.

### 4.7.1 Physical random access procedure

The physical random access procedure described in this subclause is initiated upon request from the MAC sublayer (see [18] and [19]).

Note: The selection of a PRACH is done by the RRC Layer.

Before the physical random-access procedure can be initiated, Layer 1 shall receive the following information from the RRC layer using the primitives CPHY-TrCH-Config-REQ and CPHY-RL-Setup/Modify-REQ.

- the available PRACH channelization codes (There is a 1-1 mapping between the channelization code and the midamble shift as defined by RRC) for each Access Service Class (ASC) of the selected PRACH (the selection of a PRACH is done by the RRC ). CPHY-RL-Setup/Modify-REQ);
- the timeslot, spreading factor, and midamble type(direct or inverted) for the selected PRACH (CPHY-RL-Setup/Modify-REQ);
- the RACH Transport Format (CPHY-TrCH-Config-REQ);
- the RACH transport channel identity (CPHY-TrCH-Config-REQ)
- the set of parameters for common physical channel uplink outer loop power control(CPHY-RL-Setup/Modify-REQ).

NOTE: 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 MAC:

- the ASC of the PRACH transmission;
- the data to be transmitted (Transport Block Set).

  the selected ASC sub-channel. The ASC subchannel is defined in reference [18]. The value is passed in the PHY-Data-REQ is the $CFN_{CELL.}$

In addition, Layer 1 may receive information from higher layers, that a timeslot in certain frames shall be blocked for PRACH uplink transmission.

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

1 Randomly select one channelization code from the set of available codes for the selected ASC. The random function shall be such that each code is chosen with equal probability.

2 Determine the midamble shift to use, based on the selected channelization code.

3 Set the PRACH message transmission power level according to the specification for common physical channels in uplink (see subclause 4.2.2.2).

4 Transmit the RACH Transport Block Set (the random access message) with no timing advance in the selected sub-channel using the selected channelization code.

## 4.8 DSCH procedure

The physical downlink shared channel procedure described below shall be applied by the UE when the physical layer signalling either with the midamble based signalling or TFCI based signalling is used to indicate for the UE the need for

PDSCH detection. There is also a third alternative to indicate to the UE the need for the PDSCH detection and this is done by means of higher layer signalling, already described in [8].

### 4.8.1 DSCH procedure with TFCI indication

When the UE has been allocated by higher layers to receive data on DSCH using the TFCI, the UE shall decode the PDSCH in the following cases:

- In case of a standalone PDSCH the TFCI is located on the PDSCH itself, then the UE shall decode the TFCI and based on which data rate was indicated by the TFCI, the decoding shall be performed. The UE shall decode PDSCH only if the TFCI word decode corresponds to the TFC part of the TFCS given to the UE by higher layers.

- In case that the TFCI is located on the DCH, the UE shall decode the PDSCH frame or frames if the TFCI on the DCH indicates the need for PDSCH reception. Upon reception of the DCH time slot or time slots, the PDSCH slot (or first PDSCH slot) shall start *SFN n+2* after the DCH frame containing the TFCI, where n indicates the SFN on which the DCH is received. In the case that the TFCI is repeated over several frames, the PDSCH slot shall start *SFN n+2* after the frame having the DCH slot which contains the last part of the repeated TFCI.

### 4.8.2 DSCH procedure with midamble indication

When the UE has been allocated by higher layers to receive PDSCH based on the midamble used on the PDSCH (midamble based signalling described in [8]), the UE shall operate as follows:

- The UE shall test the midamble it received and if the midamble received was the same as indicated by higher layers to correspond to PDSCH reception, the UE shall detect the PDSCH data according to the TF given by the higher layers for the UE.

- In case of multiple time slot allocation for the DSCH indicated to be part of the TF for the UE, the UE shall receive all timeslots if the midamble of the first timeslot of PDSCH was the midamble indicated to the UE by higher layers.

- In case the standalone PDSCH (no associated DCH) contains the TFCI the UE shall detect the TF indicated by the TFCI on PDSCH.

## 4.9 Node B Synchronisation Procedure over the Air

An option exists to use cell sync bursts to achieve and maintain Node B synchronisation [20]. This optional procedure is based on transmissions of cell synchronisation bursts [10] in predetermined timeslots normally assigned to contain PRACH, according to an RNC schedule. Such soundings between neighbouring cells facilitate timing offset measurements by the cells. The timing offset measurements are reported back to the RNC for processing. The RNC generates cell timing updates that are transmitted to the Node Bs and cells for implementation.

When Cell Sync Bursts are used to achieve and maintain intercell Synchronisation there are three distinct phases, with a potential additional sub-phase involving late entrant cells.

### 4.9.1 Frequency Acquisition Phase

The frequency acquisition phase is used to bring cells of an RNS area to within frequency limits prior to initial synchronisation. No traffic is supported during this phase. In this phase cell(s) identified as master time reference shall transmit cell sync bursts [10] specified by higher layers continuously, i. e. one in every timeslot. All other cells shall listen for transmissions and shall perform frequency locking to the transmissions received. They shall signal completion of frequency acquisition to the RNC and begin continuous transmission of cell sync bursts specified by higher layers.

### 4.9.2 Initial Synchronisation

For Initial Phase, where no traffic is supported, the following procedure for initial synchronisation may be used to bring cells of an RNS area into synchronisation at network start up. In this phase each cell shall transmit cell sync bursts [10] according to the higher layer command. All cells use the same cell sync burst code and code offset. Each cell shall listen for transmissions from other cells. Each cell shall report the timing and received SIR of successfully detected cell sync bursts to the RNC. The RNC uses these measurements to adjust the timing of each cell to achieve the required synchronisation accuracy.

### 4.9.3 Steady-State Phase

The steady-state phase is used to maintain the required synchronisation accuracy. With the start of the steady-state phase, traffic is supported in a cell. A procedure that may be used for the steady-state phase involves cell synch bursts [10] that are transmitted and received without effect on existing traffic. Higher layers signal the transmit parameters, i. e. when to transmit which code and code offset, and which transmit power to use. The higher layers also signal to appropriate cells the receive parameters i. e. which codes and code offsets to measure in a certain timeslot. Upon determination of errors in timing, the RNC may adjust the timing of a cell or cells.

### 4.9.4 Late entrant cells

A procedure that may be used for introducing new cells into an already synchronised RNS involves the one time transmission of a single cell sync burst [10] (scheduled by higher layers) by all neighbour cells of the late entrant cell. and received by the late entrant cell. The RNC may use this information to adjust the late entrant cell sufficiently to allow the cell to enter steady state phase.

## 4.10 Idle periods for IPDL location method

### 4.10.1 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 ceased, except for the SCH transmission. During these idle periods the visibility of neighbour cells from the UE is improved.

The idle periods are arranged in a determined pattern according to higher layer parameters. An idle period has a duration of one time slot. During idle periods only the SCH is transmitted. 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.

The time difference measurements can be performed on any channel. If the P-CCPCH falls in an idle slot, UTRAN may decide not to transmit the P-CCPCH in two consecutive frames, the first of these two frames containing the idle slot. This option is signalled by higher layers.

### 4.10.2 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 the next idle period. Note that there is at most one idle period in a radio frame.

**IP_Start:** The number of the first frame with idle periods. In case of continuous mode IP_Start is the SFN of the first frame with idle periods and in case of burst mode IP_Start defines the number of frames after Burst_Start with the first frame with idle periods.

**IP_Slot:** The number of the slot that has to be idle [0..14].

**IP_PCCPCH:** This logic value indicates, if the P-CCPCH is switched off in two consecutive frames. The first of these two frames contains the idle period.

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 between the start of a burst and the start of the next burst.

## 4.10.3 Calculation of idle period position

In burst mode, burst #0 starts in the radio frame with SFN = 256×Burst_Start. Burst #n starts in the radio frame with SFN = 256×Burst_Start + $n$×256×Burst_Freq ( $n$ = 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 starts in the radio frame with SFN = 0. In case of continuous mode the parameter IP_Start defines the first frame with idle periods.

The position of an idle period is defined by two values: IP_Frame($x$) and IP_Slot. IP_Frame($x$) defines the $x^{th}$ frame within a burst that contains the idle period. IP_Slot defines the slot in that frame during which no transmission takes place except for the SCH.

The actual frame with idle periods within a burst is calculated as follows:

IP_Frame($x$) = IP_Start + ($x$-1) × IP_Spacing with $x$ = 1, 2, 3, ....

If the parameter IP_PCCPCH is set to 1, then the P-CCPCH will not be transmitted in the frame IP_Frame($x$) +1 within a burst.

Figure 5 below illustrates the idle periods for the burst mode case, if the IP_P-CCPCH parameter is set to 0.

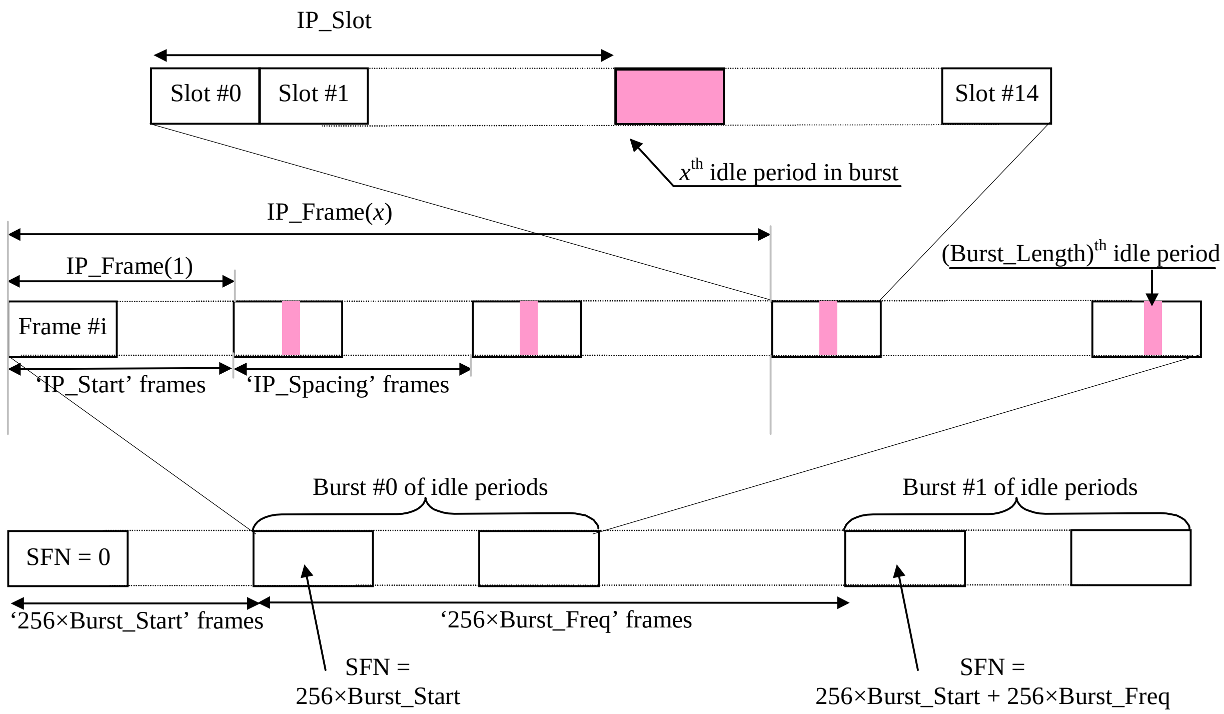


**Figure 5: Idle Period placement in the case of burst mode operation with IP_P-CCPCH parameter set to 0**

# 4.11 HS-DSCH Procedure

## 4.11.1 Link Adaptation Procedure

For HS-DSCH, the modulation scheme and effective code rate shall be selected by higher layers located within the NodeB. This shall be achieved by appropriate selection of an HS-DSCH transport block size, modulation format and resources by higher layers. Selection of these parameters may be based on CQI reports from the UE.

The overall HS-DSCH link adaptation procedure consists of *two parts:*

*Node B procedure:*

1) The NodeB shall transmit HS-SCCH carrying a UE identity identifying the UE for which HS-DSCH TTI allocation has been given. In the case of HS-DSCH transmissions in consecutive TTIs to the same UE, the same HS-SCCH shall be used for associated signalling.

2) The NodeB transmits HS-DSCH to the UE using the resources indicated in the HS-SCCH.

3) Upon receiving the HS-SICH from the respective UE, the status report (ACK/NACK and CQI) shall be passed to higher layers.

*UE procedure:*

1) When indicated by higher layers, the UE shall start monitoring all HS-SCCHs that are in its HS-SCCH set as signalled to it by higher layers. The information carried on the HS-SCCH is described in [8].

2) In the case that a HS-SCCH is identified to be correct by its CRC, the UE shall read the HS-PDSCHs indicated by the HS-SCCH. In the case that a HS-SCCH is identified to be incorrect, the UE shall discard the data on the HS-SCCH and return to monitoring.

3) After reading the HS-PDSCHs, the UE shall generate an ACK/NACK message and transmit this to the NodeB in the associated HS-SICH, along with the most recently derived CQI.

### 4.11.2 HS-DSCH Channel Quality Indication Procedure

The quality indicator sent by the UE on the HS-SICH is a recommended Transport Format Resource Combination, TFRC. The recommended TFRC shall be based on the HS-PDSCH resources most recently received by the UE and refers to the possible transport block sizes and modulation schemes available for these resources. Hence the channel quality indicator (CQI) consists only of the Transport Block Size and Modulation Format fields of the TFRI. The UE adopts the same mapping table for these fields as is used by the NodeB.

The reporting procedure is as follows:

1. The UE receives a message on an HS-SCCH telling it which resources have been allocated to it for the next associated HS-DSCH transmission.
2. The UE reads the HS-DSCH transmission, and makes the necessary measurements to derive a CQI that it estimates would give it the highest throughput for the allocated resources whilst still meeting a specified threshold BLER of 10%.
3. The UE reports the most recently derived CQI to the NodeB in the next available HS-SICH.

# 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**

| | Uplink | Downlink |
|---|---|---|
| Power control rate | Variable<br>Closed loop: 0-200 cycles/sec.<br>Open loop: (about 200us – 3575us delay ) | Variable<br>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 | |

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 UpPCH

The transmit power for the UpPCH is set by higher layers based on open loop power control as described in [15]

#### 5.1.1.3 PRACH

The transmit power for the UpPCH is set by higher layers based on open loop power control as described in [15].

#### 5.1.1.4 DPCH and PUSCH

The closed loop power control makes use of layer 1 symbols in the DPCH and PUSCH. The power control step can take the values 1,2,3 dB within the overall dynamic range 80dB. The initial transmission power for uplink DPCH and PUSCH is signalled by higher layers.

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 or PUSCH, respectively. 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 and PUSCH 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 Gain Factors

Same as that of 3.84 Mcps TDD, cf. [4.2.2.3.1 Gain Factors].

##### 5.1.1.4.2 Out of synchronization handling

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

#### 5.1.1.5 HS-SICH

The transmit power of the HS-SICH shall be set by the UE according to the procedures described below. In the case that an ACK is being transmitted on the HS-SICH, the UE shall apply a power offset to the transmit power of the entire HS-SICH. This power offset shall be signalled by higher layers.

On receipt of a TPC command in the HS-SCCH, the UE shall adjust the HS-SICH transmit power according to the power control step size specified by higher layers. However, for the first HS-SICH transmission following the first detected HS-SCCH transmission, or the first HS-SICH transmission following a gap of one or more detected HS-SCCH transmissions to the UE, the UE shall use open loop power control to set the HS-SICH transmit power for that transmission. In this case, the transmit power of the HS-SICH, $P_{HS\text{-}SICH}$, shall be calculated using the following equation:

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

where $L_{P\text{-}CCPCH}$ is the measured pathloss from the NodeB (based on the P-CCPCH received power level) and $PRX_{HS\text{-}SICH,des}$ is the desired receive power level on the HS-SICH when a NAK is being transmitted, which shall be signalled to the UE by higher layers.

### 5.1.2 Downlink Control

#### 5.1.2.1 P-CCPCH

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

#### 5.1.2.2 The power of the FPACH

The transmit power for the FPACH is set by the higher layer signalling [16].

#### 5.1.2.3 S-CCPCH, PICH

Same as that of 3.84 Mcps 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 or PUSCH 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 or PDSCH, respectively. 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 may 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.3.

The transmission power of one DPCH or PDSCH shall not exceed the limits set by higher layer signalling by means of Maximum_DL_Power (dB) and Minimum_DL_Power (dB). The transmission power is defined as the average power over one timeslot of the complex QPSK (or 8PSK respectively) symbols of a single DPCH or PDSCH before spreading relative to the power of the P-CCPCH.

During a downlink transmission pause, both UE and Node B shall use the same TPC step size, which is signalled by higher layers. The UTRAN may accumulate the TPC commands received during the pause. TPC commands that shall be regarded as identical may only be counted once. The initial UTRAN transmission power for the first data transmission after the pause may then be set to the sum of transmission power before the pause and a power offset according to the accumulated TPC commands. Additionally this sum may include a constant set by the operator and a correction term due to uncertainties in the reception of the TPC bits. The total downlink transmission power at the Node B within one timeslot shall not exceed Maximum Transmission Power set by higher layer signalling. If the total transmit power of all channels in a timeslot exceeds this limit, then the transmission power of all downlink DPCHs and PDSCHs shall be reduced by the same amount in dB. The value for this power reduction is determined, so that the total transmit power of all channels in this timeslot is equal to the maximum transmission power.

##### 5.1.2.4.1 Out of synchronisation handling

Same as that of 3.84 Mcps TDD, cf.[4.2.3.4.1 ~~4.2.3.5.1~~ Out of synchronisation handling].

#### 5.1.2.5 HS-PDSCH

The power control for HS-PDSCH for 1.28 Mcps TDD is the same as for 3.84 Mcps, see section 4.2.3.5~~6~~

#### 5.1.2.6 HS-SCCH

The power control for HS-SCCH for 1.28 Mcps TDD is the same as for 3.84 Mcps, see section ~~4.2.3.7~~4.2.3.6

## 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 1,28 Mcps 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 $\Delta t_p$ 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 $T_{TX\text{-}UpPCH}$ is given by:

$T_{TX\text{-}UpPCH} = T_{RX\text{-}DwPCH} - 2\Delta t_p + 12*16\ T_C$

in multiple of 1/8 chips, where

$T_{TX\text{-}UpPCH}$ is the beginning time of UpPCH transmission with the UE's timing,

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

$2\Delta t_p$ 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 $T_{TX\text{-}PRACH}$ is given by:

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

in multiple of 1/8 chips, where

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

$T_{RX\text{-}PRACH}$ 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. The UE shall derive a single SS command separately for each controlled uplink timeslot by combining all received SS commands that are related to the controlled time slot (cf. [8]) and that are received within the last up to M sub-frames. The value of the "Uplink synchronisation frequency" M (1..8) is configured by higher layers.

When the combined SS command is judged as 'down', the UE transmit timing for the controlled UL timeslot shall be delayed by one timing adjustment step of k/8 chips. When the command is judged as 'up', the UE transmit timing for the controlled UL timeslot shall be advanced by one timing adjustment step of k/8 chips. When the command is judged as 'do nothing', the timing shall not be changed. The value of the "Uplink synchronisation step size" k (1..8) is configured by higher layers.

The timing adjustment shall take place in each sub-frame satisfying the following equation:

$$SFN' \bmod M = 0$$

where

SFN' is the system frame number counting the sub-frames. The system frame number of the radio frames (SFN) can be derived from SFN' by

SFN=SFN' div 2, where div is the remainder free division operation.

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 if indicated by higher layers:

$TA_{new} = TA_{old} + 2\Delta t$.

#### 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.]

### 5.2.5 HS-SICH

The initial transmit timing for the HS-SICH shall be taken from that of the associated uplink DPCH. The UE shall then adjust the timing of the HS-SICH according to SS commands transmitted to it on the HS-SCCH. The step size for these commands shall be signalled to the UE by higher layers. In the case that there is a gap of one or more subframes during which no HS-SCCH transmissions, and thus no SS commands, are received by the UE, the UE shall adjust the timing of the HS-SICH according to SS commands received on the associated downlink DPCH until such time as another HS-SCCH transmission is received.

## 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 CA~~D~~.

### 5.3.2 DCH synchronization

The DPCH synchronisation is the same as that of 3,84 Mcps 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 PDSCH, DPCH, P-CCPCH, S-CCPCH, PICH, HS-SCCH, HS-PDSCH, and DwPCH is optional in UTRAN. Its support is mandatory at the UE.

### 5.5.1 Transmit Diversity for PDSCH, DPCH, HS-SCCH, and HS-PDSCH

Time Switched Transmit Diversity (TSTD) may be employed as transmit diversity scheme for downlink DPCH and PDSCH. Closed loop Transmit Diversity may be employed as transmit diversity scheme for downlink DPCH, HS-SCCH, and HS-PDSCH.

#### 5.5.1.1 TSTD for PDSCH and DPCH

TSTD can be employed as transmit diversity scheme for PDSCH and 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 and/or PDSCH is transmitted from antenna 1 and antenna 2 alternately every sub-frame. Not all DPCHs and/or PDSCHs in the sub-frame need to be transmitted on the same antenna and not all DPCHs and/or PDSCHs within a sub-frame have to use TSTD. Figure 7 shows an example for the antenna switching pattern for the transmission of DPCH/PDSCH for the case that all physical channels are transmitted with TSTD and are using the same antenna in the sub-frame.

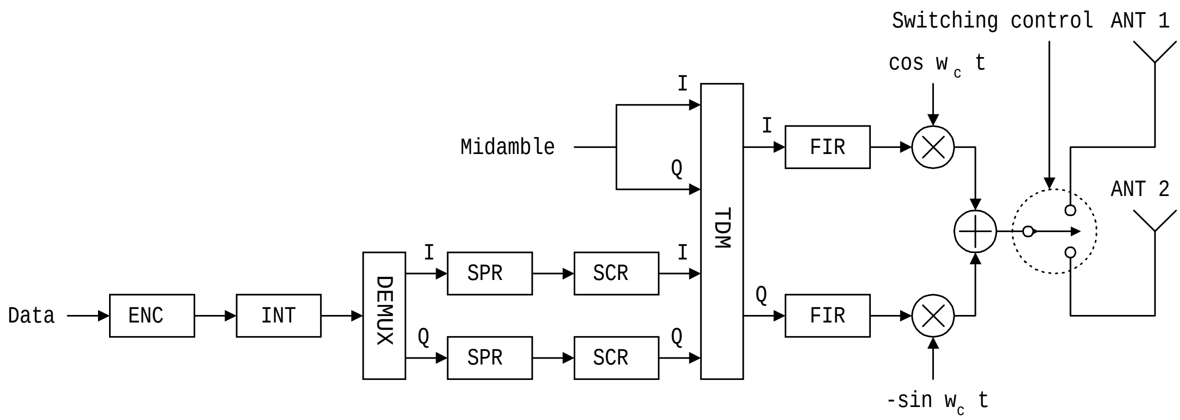


**Figure 6: Example for TSTD Transmitter structure for DPCH/PDSCH and P-CCPCH.**

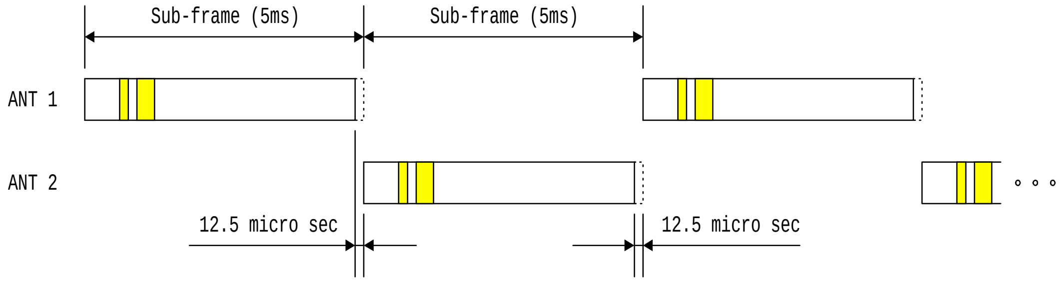


**Figure 7: Example for the antenna swithing pattern for TSTD transmission of DPCH/PDSCH and P-CCPCH: all physical channels are transmitted with TSTD and are using the same antenna in the sub-frame.**

#### 5.5.1.2 Closed Loop Tx Diversity for PDSCH, DPCH, HS-SCCH, and HS-PDSCH

The transmitter structure to support transmit diversity for DPCH, PDSCH, HS-SCCH, and HS-PDSCH 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.

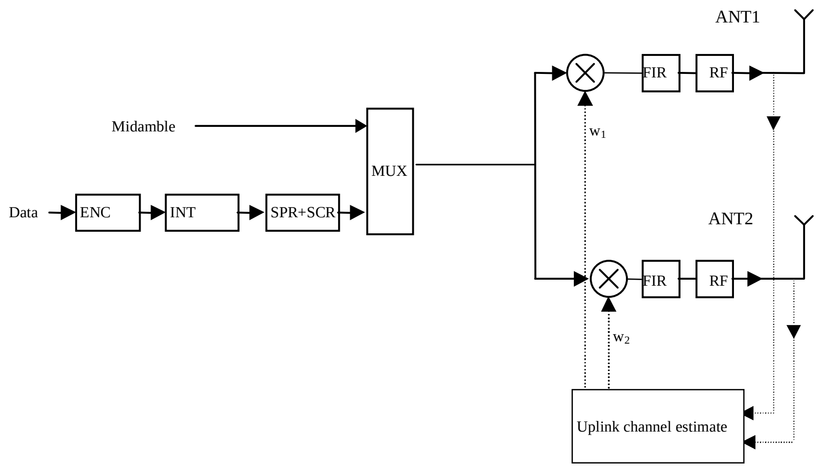


**Figure 8: Downlink transmitter structure to support Transmit Diversity for DPCH, PDSCH, HS-SCCH, and HS-PDSCH transmission (UTRAN Access Point) in 1.28 Mcps TDD**

### 5.5.2 Transmit Diversity for DwPCH

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.

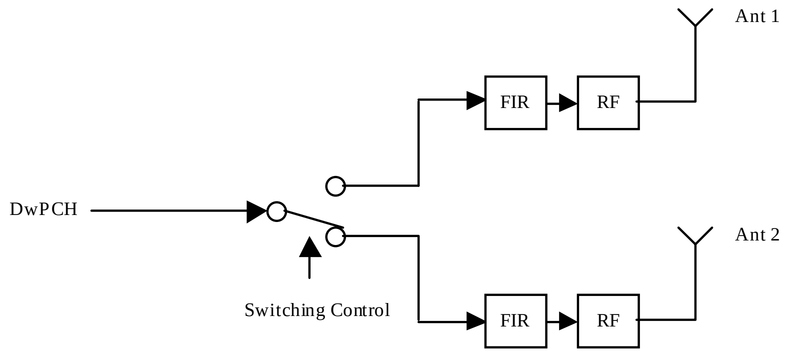


**Figure 9: Downlink transmitter structure to support Transmit Diversity for DwPCH transmission (UTRAN Access Point) in 1.28 Mcps TDD**

## 5.5.3 Transmit Diversity for P-CCPCH

TSTD or Space Code Transmit Diversity (SCTD) 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. 4 SCTD Transmission Scheme for Beacon Channels

The use of SCTD will be indicated by higher layers. If SCTD is active within a cell, SCTD shall be applied to any beacon channel.

The open loop downlink transmit diversity scheme for beacon channels is shown in figure 10, exemplary for the P-CCPCH. Channel coding, rate matching, interleaving and bit-to-symbol mapping are performed as in the non-diversity mode. In TxDiversity mode the beacon channel that is allocated to code $c_{16}^{(k=1)}$ is spread with the channelisation codes $c_{16}^{(k=1)}$ and $c_{16}^{(k=3)}$ and scrambled with the cell specific scrambling code. The beacon channel that is allocated to code $c_{16}^{(k=2)}$ is spread with the channelisation codes $c_{16}^{(k=2)}$ and $c_{16}^{(k=4)}$ and scrambled with the cell specific scrambling code. The spread sequences on code $c_{16}^{(k=3)}$ and code $c_{16}^{(k=4)}$ are then transmitted on the diversity antenna. The power applied to each antenna shall be equal.

The use of SCTD will be indicated by higher layers.

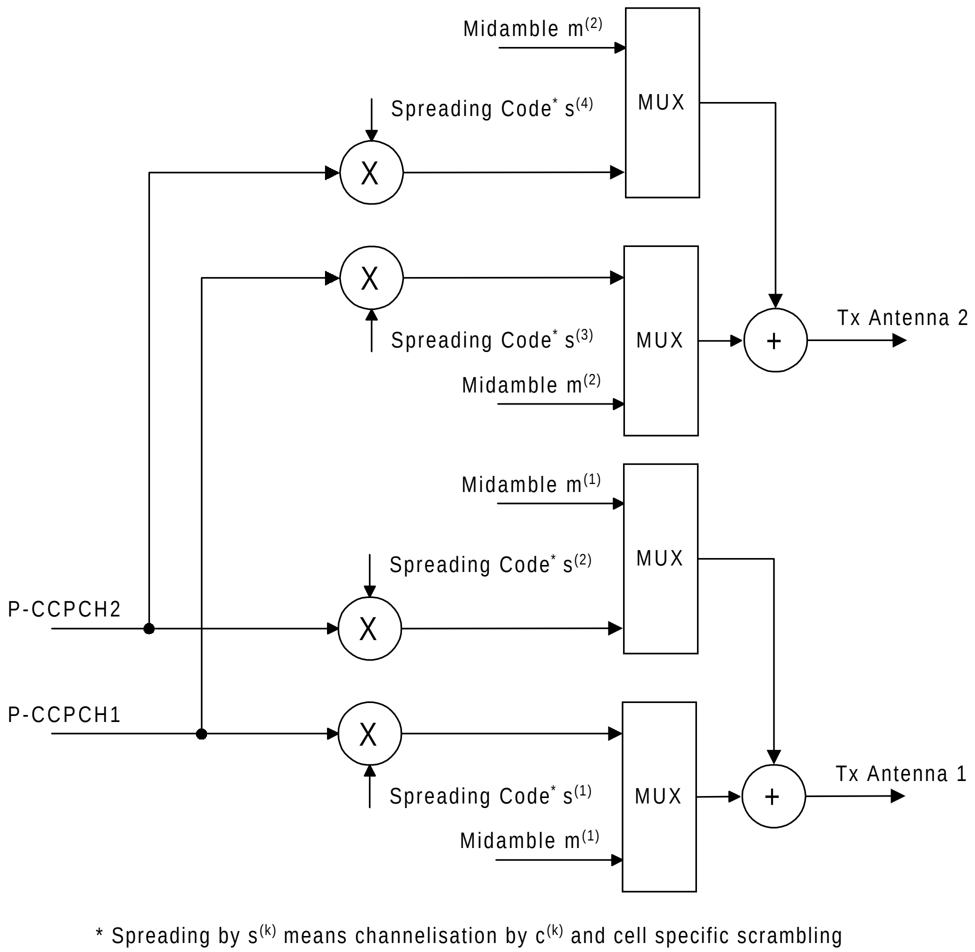


**Figure 10: Block Diagram of the transmitter (SCTD) in 1.28 Mcps TDD, exemplary for the P-CCPCH**

# 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

$FPACH_{i\,:}$ : FPACH number i

$L_i$ : Length of RACH transport blocks associated to $FPACH_i$ in sub-frames

$N_{RACHi}$ : The number of PRACHs associated to the $i^{th}$ FPACH

$n_{RACHi}$ : The number of a PRACH associated to the $i^{th}$ FPACH ranging from 0 to $N_{RACHi}$-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 system 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 transport 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 physical random access procedure described in this sub-clause is initiated upon request 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 $L_i$ of a RACH message associated to $FPACH_i$ 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: $N_{RACHi}$ PRACHs can be associated with to $FPACH_i$. The maximum allowed

$N_{RACHi}$ is $L_i$.

- 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";
- The power-ramping factor Power Ramp Step [Integer];

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. In the case that the Commanded Signature transmission Power exceeds the maximum allowed value, set the Signature transmission Power to the maximum allowed 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 $FPACH_i$ associated to the transmitted UpPCH only in the sub-frames fulfilling the following relation:

$(SFN' \bmod L_i)=n_{RACHi}$ ; $n_{RACHi}=0,\ldots, N_{RACHi}-1$,

6 In case no valid answer is detected in the due time: Increase the Signature transmission power by $\Delta P_0$ = Power Ramp Step [dB], 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 $FPACH_i$

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 $L_i$ 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 $n_{RACHi}$ $^{th}$ PRACH associated to the $FPACH_i$ if the following equation ifs fulfilled:

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

Here SFN' if 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 $FPACH_i$ associated the transmitted UpPCH only in the sub-frames fulfilling the following relation:

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

- 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 $T_{ref}$ 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 CBE.

### 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:

*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.

### 5.6.4 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 resources allocated to PRACH are virtually collision free. This two-step approach will guarantee that the RACH resources can be handled with conventional traffic on the same UL time slots.

## 5.7 Node B Synchronisation Procedure over the Air

An option exists to use the regular DwPCH transmissions to achieve and maintain Node B synchronisation [20]. This optional procedure is based on measurements of DwPCHs from neighbouring cells according to an RNC schedule. The timing offset measurements are reported back to the RNC for processing. The RNC generates cell timing updates that are transmitted to the Node Bs and cells for implementation (common with the 3.84 Mcps TDD option). Alternatively the RNC may indicate that the NodeB shall autonomously adjust the cell timings. Two distinct phases can be distinguished for Node B synchronisation over the air, with a potential additional sub-phase involving late entrant cells.

### 5.7.1 Initial Synchronisation

Common with 3.84 Mcps TDD, see [4.9.2 Initial Synchronisation], however, the regular DwPCHs are used as cell sync bursts.

### 5.7.2 Steady-State Phase

Common with 3.84 Mcps TDD, see [4.9.3 Steady-State Phase], however, the regular DwPCHs are used as cell sync bursts. If the NodeB adjusts the cell timings autonomously, it shall take into account the propagation delay, signaled by the RNC.

### 5.7.3 Late entrant cells

A procedure that may be used for introducing new cells into an already synchronised RNS involves the continuous measurement of the DwPCHs of the neighbouring cells by the late entrant cell. The RNC may use this information to adjust the late entrant cell sufficiently to allow the cell to enter steady state phase.

## 5.8 Idle periods for IPDL location method

### 5.8.1 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 the DwPCH from a Node B is temporarily ceased. During these idle periods the visibility of neighbour cells from the UE is improved.

The idle periods are arranged in a determined pattern according to higher layer parameters. An idle period has a duration of one DwPTS.

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. The time difference measurements can be performed on any channel.

### 5.8.2 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 the next idle period.

**IP_Start:** The number of the first frame with idle periods. In case of continuous mode IP_Start is the SFN of the first frame with idle periods and in case of burst mode IP_Start defines the number of frames after Burst_Start with the first frame with idle periods.

**IP_Sub:** Indicates whether the idle period is to occur in the odd, the even or both the odd and even 5 ms sub-frames of the 10 ms idle frame.

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 between the start of a burst and the start of the next burst.

### 5.8.3 Calculation of idle period position

In burst mode, burst #0 starts in the radio frame with SFN = 256×Burst_Start. Burst #n starts in the radio frame with SFN = 256×Burst_Start + $n$×256×Burst_Freq ( $n$ = 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 starts in the radio frame with SFN = 0. In case of continuous mode the parameter IP_Start defines the first frame with idle periods.

The DwPCH, that has to be idle, is defined by two values: IP_Frame(*x*) and IP_Sub. IP_Frame(*x*) defines the $x^{th}$ frame within a burst in which subframe with the number IP_Sub has to be switched off.

The actual frame with idle periods within a burst is calculated as follows:

$$IP\_Frame(x) = IP\_Start + (x-1) \times IP\_Spacing \text{ with } x = 1, 2, 3, ....$$

Figure 11 below illustrates the idle periods for the burst mode which shows the case that both subframes within each frame have DwPTS as an idle period.

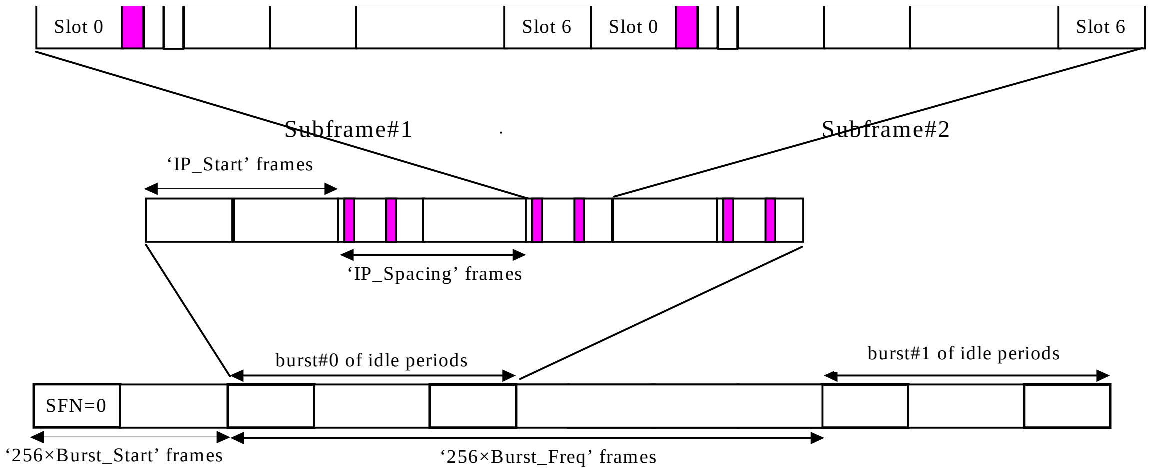


**Figure 11: Idle periods of burst mode for 1.28Mcps TDD**

## 5.9 HS-DSCH Procedure

The HS-DSCH procedure is the same as that of 3,84 Mcps TDD, cf. 4.11 HS-DSCH Procedure.

# Annex A (informative): Power Control

## A.1 Example Implementation of Downlink Power Control in the UE

The power control may be realized by two cascaded control loops. The outer loop controls the transmission quality, whose reference value is set by higher layers [15], by providing the reference value for the inner loop. This reference value should be the SIR at the UE [15]. The inner loop controls the physical quantity for which the outer loop produces the reference value (e. g. the SIR) by generating TPC commands. This may be done by comparing the measured SIR to its reference value. 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:

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

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

| | |
|---|---|
| RSCP: | Received signal code power in dBm |
| ISCP: | Interference signal code power in the DPCH / PDSCH timeslot in dBm |
| 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, $1 \le i \le$ number of frames in the pause |
| $L_0$: | weighted pathloss in the last frame before the transmission pause in dB |
| $RSCP_0$: | RSCP of the data that was used in the SIR calculation of the last frame before the pause in dBm |
| TPC (k): | ± power control stepsize in dB according to the TPC bit generated and transmitted in frame k, TPC bit "up" = +stepsize, TPC bit "down" = −stepsize |

## A.2 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.3 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.1 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.4 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 B (informative): Determination of Weight Information

Selective Transmit Diversity (STD) and Transmit Adaptive Antennas (TxAA) are examples of transmit diversity schemes for dedicated physical channels.

# B.1 STD Weights

The weight vector will take only two values depending on the signal strength received by each antenna in the uplink slot. For each user, the antenna receiving the highest power will be selected (i.e. the corresponding weight will be set to 1).

**Table B.13: STD weights for two TX antennas**

| | $W_1$ | $W_2$ |
|---|---|---|
| Antenna 1 receiving highest power | 1 | 0 |
| Antenna 2 receiving highest power | 0 | 1 |

# B.2 TxAA Weights

In a generic sense, the weight vector to be applied at the transmitter is the $\underline{w}$ that maximises:

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

where

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

and where the column vector $\underline{h}_i$ represents the estimated uplink channel impulse response for the i'th transmission antenna, of length equal to the length of the channel impulse response.

# Annex C (informative):<br>Cell search procedure for 3,84 Mcps TDD

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

**Step 1: Primary synchronisation code acquisition**

During the first step of the cell search procedure, the UE uses the SCH's primary synchronisation code to find 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. A cell can be found by detecting peaks in the matched filter output.

Note that for a cell of SCH slot configuration case 1, the SCH can be received periodically every 15 slots. In case of a cell of SCH slot configuration case 2, the following SCH slot can be received at offsets of either 7 or 8 slots from the previous SCH slot.

**Step 2: Code group identification and slot synchronisation**

During the second step of the cell search procedure, the UE uses the SCH's secondary synchronisation codes to identify 1 out of 32 code groups for the cell found in the first step. This is typically done by correlating the received signal with the secondary synchronisation codes at the detected peak positions of the first step. The primary synchronisation code provides the phase reference for coherent detection of the secondary synchronisation codes. The code group can then uniquely be identified by detection of the maximum correlation values.

Each code group indicates a different $t_{offset}$ parameter and 4 specific cell parameters. Each of the cell parameters is associated with one particular downlink scrambling code and one particular long and short basic midamble code. When the UE has determined the code group, it can unambiguously derive the slot timing of the found cell from the detected peak position in the first step and the $t_{offset}$ parameter of the found code group in the second step.

Note that the modulation of the secondary synchronisation codes also indicates the position of the SCH slot within a 2 frames period, e.g. a frame with even or odd SFN. Additionally, in the case of SCH slot configuration following case 2, the SCH slot position within one frame, e.g. first or last SCH slot, can be derived from the modulation of the secondary synchronisation codes.

**Step 3: Downlink scrambling code, basic midamble code identification and frame synchronisation**

During the third and last step of the cell search procedure, the UE determines the exact downlink scrambling code, basic midamble code and frame timing used by the found cell. The long basic midamble code can be identified by correlation over the P-CCPCH (or any other beacon channel) with the 4 possible long basic midamble codes of the code group found in the second step. A P-CCPCH (or any other beacon channel) always uses the midamble $m^{(1)}$ (and in case of SCTD also midamble $m^{(2)}$) derived from the long basic midamble code and always uses a fixed and pre-assigned channelisation code.

When the long basic midamble code has been identified, downlink scrambling code and cell parameter are also known. The UE can read system and cell specific BCH information and acquire frame synchronisation.

Note that even for an initial cell parameter assignment, a cell cycles through a set composed of 2 different cell parameters according to the SFN of a frame, e.g. the downlink scrambling code and the basic midamble code of a cell alternate for frames with even and odd SFN. Cell parameter cycling leaves the code group of a cell unchanged.

If the UE has received information about which cell parameters or SCH configurations to search for, cell search can be simplified.

# Annex CAD (informative): Cell search procedure for 1,28 Mcps 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 1,28 Mcps 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.

# Annex CB~~E~~ (informative): Examples random access procedure for 1,28 Mcps TDD

**Table CB.1~~E-1~~: One PRACH, TTI=5ms, 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<br>2 | 3<br>4 | 5<br>6 | 7<br>8 | | | | | | | |
| Acknowledged user on FPACH | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | |
| User sending on PRACH 0 | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |

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

**Table CB.2~~E-2~~: Two PRACHs, TTI=10ms, WT=4, L =2, SF8 PRACH**

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

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

**Table CB.3~~E-3~~: Four PRACHs, TTI=20ms, WT=4, L =4, SF16 PRACH**

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

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

**Table CB.4E-4: Two PRACHs, TTI=20ms, WT=4, L =4, SF16 PRACH**

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

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 sub-frames would have passed since the UpPCH.

# Annex DF (informative): Change history

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 14/01/00 | RAN_05 | RP-99594 | - | | Approved at TSG RAN #5 and placed under Change Control | - | 3.0.0 |
| 14/01/00 | RAN_06 | RP-99698 | 001 | 01 | Primary and Secondary CCPCH in TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99698 | 002 | - | Measurement procedure of received reference power for OL-TPC in TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99699 | 004 | 1 | STTD capability for P-CCPCH, TDD component | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99697 | 005 | 1 | Alignment of Terminology Regarding Spreading for TDD Mode | 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-000070 | 003 | 2 | Cycling of cell parameters | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 007 | 2 | Clarifications on the UL synchronisation and Timing advance | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 008 | - | Modification of SIR threshold on setting TPC | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 009 | 1 | New section describing the random access procedure | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 011 | - | Removal of Synchronisation Case 3 in TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 012 | 1 | Clarifications on power control procedures | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 013 | - | Signal Point Constellation | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 014 | 2 | Out-of-sync handling for UTRA TDD | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000070 | 015 | - | Removal of ODMA from the TDD specifications | 3.1.1 | 3.2.0 |
| 26/06/00 | RAN_08 | RP-000274 | 016 | - | Editorial correction for the power control section in 25.224 | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000274 | 017 | - | Power control for TDD during DTX | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000274 | 018 | 1 | Power Control for PDSCH | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000274 | 020 | 1 | Editorial modification of 25.224 | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000274 | 021 | - | Clarifications on TxDiversity for UTRA TDD | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000274 | 022 | 1 | Introduction of the TDD DSCH detection procedure in TS 25.224 | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000274 | 023 | - | Downlink power control on timeslot basis | 3.2.0 | 3.3.0 |
| 23/09/00 | RAN_09 | RP-000347 | 019 | 1 | Gain Factors for TDD Mode | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000347 | 025 | - | Terminology regarding the beacon function | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000347 | 026 | 1 | Synchronisation of timing advance adjustment and timing deviation measurement | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000347 | 027 | 1 | CCTrCH UL/DL pairing for DL inner loop power control | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000347 | 028 | 1 | RACH timing in TDD mode | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000347 | 030 | 1 | TDD Access Bursts for HOV | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000347 | 032 | - | Removal of ODMA related abbreviations and correction of references | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000347 | 033 | - | Clarifications on the Out-of-sync handling for UTRA TDD | 3.3.0 | 3.4.0 |
| 15/12/00 | RAN_10 | RP-000544 | 035 | 1 | Radio Link establishment and sync status reporting | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000544 | 040 | - | Clarification on PICH power setting | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000544 | 042 | - | Correction to TDD timing advance description | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000544 | 043 | - | Limit on maximum value of alpha used for open loop power control | 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-010065 | 036 | - | DTX and Special Burst Scheduling | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010065 | 037 | 1 | RACH random access procedure | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010065 | 045 | - | Introduction of closed-loop Tx diversity for the PDSCH and DTX for the PUSCH/PDSCH | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010065 | 046 | 2 | Corrections of TDD power control sections | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010065 | 050 | - | Use of a special burst in reconfiguration | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010065 | 053 | - | Known TFCI for the TDD special burst | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010073 | 044 | 2 | Layer 1 procedure for Node B synchronisation | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010071 | 047 | 1 | Inclusion of 1,28 Mcps TDD in TS 25.224 | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010072 | 048 | 1 | Idle periods for IPDL location method | 3.5.0 | 4.0.0 |
| 15/06/01 | RAN_12 | RP-010338 | 057 | - | Correction of Timing Advance section for 3.84 Mcps TDD | 4.0.0 | 4.1.0 |
| 15/06/01 | RAN_12 | RP-010338 | 059 | - | Addition to the abbreviation list | 4.0.0 | 4.1.0 |
| 15/06/01 | RAN_12 | RP-010343 | 049 | - | Clarification of IP_Frame(x) definition | 4.0.0 | 4.1.0 |
| 15/06/01 | RAN_12 | RP-010343 | 055 | 1 | Correction of IPDL burst parameters | 4.0.0 | 4.1.0 |
| 21/09/01 | RAN_13 | RP-010525 | 064 | 1 | Correction of criteria for OOS indication | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010531 | 060 | - | Corrections for TS 25.224 | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010531 | 062 | 1 | Corrections of Annex E in 25.224 | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010531 | 061 | - | Corrections and Clarifications for calculation of idle period position in subclause 4.10.3 in 25.224 | 4.1.0 | 4.2.0 |
| 14/12/01 | RAN_14 | RP-010742 | 066 | - | Removal of the remark on power control | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010742 | 068 | 1 | Transmit Diversity for P-CCPCH and PICH | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010742 | 070 | 1 | Correction to random access procedure (Primitive from MAC) | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010749 | 073 | 1 | Random access procedure for 1.28Mcps TDD | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010749 | 074 | - | Transmit diversity for P-CCPCH and PICH | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010749 | 075 | - | Correction of Annex A.3 in 25.224 | 4.2.0 | 4.3.0 |

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 14/12/01 | RAN_14 | RP-010749 | 076 | - | Removal of the remark on power control | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010749 | 077 | - | Corrections to DL-PC sections for 1.28 Mcps TDD | 4.2.0 | 4.3.0 |
| 08/03/02 | RAN_15 | RP-020052 | 079 | 1 | Removal of quantisation of bj gain factor when calculated from a reference TFC | 4.3.0 | 4.4.0 |
| 08/03/02 | RAN_15 | RP-020052 | 084 | 1 | TDD MAC layer subchannel assignment | 4.3.0 | 4.4.0 |
| 08/03/02 | RAN_15 | RP-020052 | 086 | - | Transmit diversity on PICH | 4.3.0 | 4.4.0 |
| 08/03/02 | RAN_15 | RP-020057 | 080 | - | Introduction of “UE Positioning Enhancements for 1.28 Mcps TDD” | 4.3.0 | 5.0.0 |
| 08/03/02 | RAN_15 | RP-020055 | 082 | 1 | Introduction of “Node B synchronization for 1.28 Mcps TDD” | 4.3.0 | 5.0.0 |
| 08/03/02 | RAN_15 | RP-020058 | 081 | 1 | Power Control and Procedures for HSDPA | 4.3.0 | 5.0.0 |
| 07/06/02 | RAN_16 | RP-020315 | 088 | - | Clarification on power control and TxDiversity procedure for 1.28 Mcps TDD | 5.0.0 | 5.1.0 |
| 07/06/02 | RAN_16 | RP-020317 | 089 | - | TxDiversity for HSDPA in TDD | 5.0.0 | 5.1.0 |
| 07/06/02 | RAN_16 | RP-020317 | 090 | - | Correction to HS-SCCH Power Control (TDD) | 5.0.0 | 5.1.0 |
| 20/09/02 | RAN_17 | RP-020586 | 091 | 1 | Corrections to 25.224 for HSDPA | 5.1.0 | 5.2.0 |
| 20/09/02 | RAN_17 | RP-020572 | 094 | 2 | Corrections to transmit diversity mode for TDD beacon-function physical channels | 5.1.0 | 5.2.0 |
| 20/09/02 | RAN_17 | RP-020577 | 097 | 1 | Corrections to uplink synchronisation procedure | 5.1.0 | 5.2.0 |
| 20/09/02 | RAN_17 | RP-020577 | 099 | - | Correction to the PRACH open loop power control procedure for 1.28 Mcps TDD | 5.1.0 | 5.2.0 |
| 20/09/02 | RAN_17 | RP-020579 | 101 | 1 | Corrections to transmit diversity mode for TDD beacon-function physical channels | 5.1.0 | 5.2.0 |
| 15/10/02 | - | - | - | - | Separate subclause 5.1.1.3, which was by accident merged into the header of subclause 5.1.1.4 | 5.2.0 | 5.2.1 |
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