TSGR1#7(99)e70

TS 25.211 V2.4.1 (1999-09)

Technical Specification

3rd Generation Partnership Project (3GPP); Technical Specification Group (TSG) Radio Access Network (RAN); Working Group 1 (WG1); Physical channels and mapping of transport channels onto physical channels (FDD)

Reference

<Workitem> (<Shortfilename>.PDF)

Keywords

<keyword[, keyword]>

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Foreword

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

This specification describes the characteristics of the Layer 1 transport channels and physicals channels in the FDD mode of UTRA. The main objectives of the document are to be a part of the full description of the UTRA Layer 1, and to serve as a basis for the drafting of the actual technical specification (TS).

2 References

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

[1] TS 25.201: “Physical layer - general description”

[2] TS 25.211: “Physical channels and mapping of transport channels onto physical channels (FDD)”

[3] TS 25.212: “Multiplexing and channel coding (FDD)”

[4] TS 25.213: “Spreading and modulation (FDD)”

[5] TS 25.214: “Physical layer procedures (FDD)”

[6] TS 25.221: “Transport channels and physical channels (TDD)”

[7] TS 25.222: “Multiplexing and channel coding (TDD)”

[8] TS 25.223: “Spreading and modulation (TDD)”

[9] TS 25.224: “Physical layer procedures (TDD)”

[10] TS 25.231: “Measurements”

[11] TS 25.301: “Radio Interface Protocol Architecture”

[12] TS 25.302: “Services Provided by the Physical Layer”

[13] TS 25.401: “UTRAN Overall Description”

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the [following] terms and definitions [given in ... and the following] apply.

<defined term>: <definition>.

example: text used to clarify abstract rules by applying them literally.

3.2 Symbols

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

<symbol> <Explanation>

3.3 Abbreviations

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

<ACRONYM> <Explanation>

AI	Acquisition Indicatior
AICH	Acquisition Indication Channel
AP	Access Preamble
BCH	Broadcast Channel
CCPCH	Common Control Physical Channel

CCTrCH	Coded Composite Transport Channel
CD	Collision Detection
CPCH	Common Packet Channel
CPICH	Common Pilot Channel
DCH	Dedicated Channel
DPCCH	Dedicated Physical Control Channel
DPCH	Dedicated Physical Channel
DPDCH	Dedicated Physical Data Channel
DSCH	Downlink Shared Channel
FACH	Forward Access Channel
FBI	Feedback Information
MUI	Mobile User Identifier
PCH	Paging Channel
P-CCPCH	Primary Common Control Physical Channel
PCPCH	Physical Common Packet Channel
PDSCH	Physical Downlink Shared Channel
PI	Page Indicatior
PICH	Page Indication Channel
PRACH	Physical Random Access Channel
RACH	Random Access Channel
RNC	Radio Network Controller
S-CCPCH	Secondary Common Control Physical Channel
SCH	Synchronisation Channel
SF	Spreading Factor
SFN	System Frame Number
STTD	Space Time Transmit Diversity
TFCI	Transport Format Combination Indicator
TSTD	Time Switched Transmit Diversity
TPC	Transmit Power Control
UE	User Equipment

4 Transport channels

<Editors note (to be deleted after approval of section 4): Streamline chapter 4 in order to avoid overlapping with TS 25.302.>

Transport channels are the services offered by Layer 1 to the higher layers. General concepts about transport channels are described in [12].

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:

- Common Channels ~~(where there is a need for in-band identification of the UEs when particular UEs are addressed)~~
- Dedicated Channels ~~(where the UEs are identified by the physical channel, i.e. code and frequency)~~

~~General concepts about transport channels are described in 3GPP RAN TS25.302 (L2 specification).~~

4.1 Dedicated transport channels

There exists only one type of dedicated transport channel, the Dedicated Channel (DCH).

4.1.1 DCH – Dedicated Channel

The Dedicated Channel (DCH) is a downlink or uplink transport channel. ~~that is used to carry user or control information between the network and the UE. [The DCH thus corresponds to the three channels Dedicated Traffic~~

~~Channel (DTCH), Stand-Alone Dedicated Control Channel (SDCCH), and Associated Control Channel (ACCH) defined within ITU-R M.1035.]~~ The DCH is transmitted over the entire cell or over only a part of the cell using ~~lobe~~beam-forming antennas. The Dedicated Channel (DCH) is characterized by the possibility of fast rate change (every 10ms), fast power control and inherent addressing of UEs.

4.2 Common transport channels

There are six types of common transport channels: BCH, FACH, PCH, RACH, CPCH and DSCH.

4.2.1 BCH – Broadcast Channel

The Broadcast Channel (BCH) is a downlink transport channel that is used to broadcast system- and cell-specific information. The BCH is always transmitted over the entire cell with a low fixed bit rate.

4.2.2 FACH – Forward Access Channel

The Forward Access Channel (FACH) is a downlink transport channel. ~~that is used to carry control information to a UE when the system knows the location cell of the UE. The FACH may also carry short user packets.~~ The FACH is transmitted over the entire cell or over only a part of the cell using ~~lobe~~beam-forming antennas. The FACH uses slow power control. ~~and requires in-band identification of the UEs.~~

4.2.3 PCH – Paging Channel

The Paging Channel (PCH) is a downlink transport channel. ~~that is used to carry control information to a UE when the system does not know the location cell of the UE.~~ The PCH is always transmitted over the entire cell ~~and requires inband identification of the UE~~. The transmission of the PCH is associated with the transmission of a physical layer signal, the Paging Indicator, to support efficient sleep-mode procedures.

4.2.4 RACH – Random Access Channel

The Random Access Channel (RACH) is an uplink transport channel. ~~that is used to carry control information from the UE. The RACH may also carry short user packets.~~ The RACH is always received from the entire cell. The RACH is characterized by a limited size data field, a collision risk and by the use of open loop power control.

4.2.5 CPCH – Common Packet Channel

The Common Packet Channel (CPCH) is an uplink transport channel. ~~that is used to carry small and medium sized packets.~~ The CPCH is a contention based random access channel used for transmission of bursty data traffic. CPCH is associated with a dedicated channel on the downlink which provides power control for the uplink CPCH.

4.2.6 DSCH – Downlink Shared Channel

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

5 Physical channels

Physical channels typically consist of a three-layer structure of superframes, radio frames, and time slots, although this is not true for all physical channels. Depending on the symbol rate of the physical channel, the configuration of radio frames or time slots varies.

- Superframe : A Superframe has a duration of 720ms and consists of 72 radio frames. The superframe boundaries are defined by the System Frame Number (SFN):
  - The head radio frame of superframe : SFN mod 72=0.

- The tail radio frame of superframe: SFN mod 72=71.

- Radio frame : A Radio frame is a processing unit which consists of 15 time slots.
- Time slot : A Time slot is a unit which consists of fields containing bits.~~the set of information symbols.~~ The number of ~~symbols~~ bits per time slot depends on the physical channel.
- ~~Symbol : One symbol consists of a number of chips. The number of chips per symbol is equivalent to the spreading factor of the physical channel.~~

5.1 The physical resource

The basic physical resource is the code/frequency plane. In addition, on the uplink, different information streams may be transmitted on the I and Q branch. Consequently, a physical channel corresponds to a specific carrier frequency, code, and, on the uplink, relative phase (0 or $\pi/2$).

5.2 Uplink physical channels

5.2.1 Dedicated uplink physical channels

There are two types of uplink dedicated physical channels, the uplink Dedicated Physical Data Channel (uplink DPDCH) and the uplink Dedicated Physical Control Channel (uplink DPCCH).

The DPDCH and the DPCCH are I/Q code multiplexed within each radio frame (see [4]).

The uplink DPDCH is used to carry dedicated data generated at Layer 2 and above, i.e. the dedicated transport channel (DCH). There may be zero, one, or several uplink DPDCHs on each Layer 1 connection.

The uplink DPCCH is used to carry control information generated at Layer 1. The Layer 1 control information consists of known pilot bits to support channel estimation for coherent detection, transmit power-control (TPC) commands, feedback information (FBI), and an optional transport-format combination indicator (TFCI). The transport-format combination indicator informs the receiver about the instantaneous parameters of the different transport channels multiplexed on the uplink DPDCH, and corresponds to the data transmitted in the same frame. It is the UTRAN that determines if a TFCI should be transmitted, hence making it is mandatory for all UEs to support the use of TFCI in the uplink. There is one and only one uplink DPCCH on each Layer 1 connection.

Figure 1 shows the frame structure of the uplink dedicated physical channels. Each frame of length 10 ms is split into 15 slots, each of length T_{slot} = 2560 chips, corresponding to one power-control period. A super frame corresponds to 72 consecutive frames, i.e. the super-frame length is 720 ms.

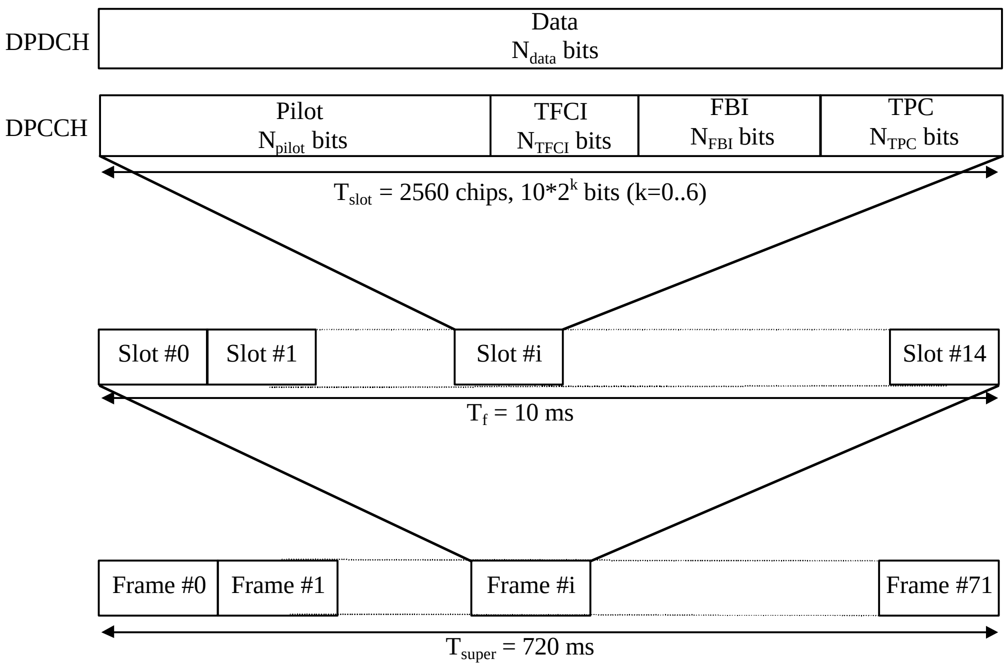


Figure 1: Frame structure for uplink DPDCH/DPCCH.

The parameter k in Figure 1 determines the number of bits per uplink DPDCH/DPCCH slot. It is related to the spreading factor SF of the physical channel as SF = $256/2^k$. The DPDCH spreading factor may thus range from 256 down to 4. Note that an uplink DPDCH and uplink DPCCH on the same Layer 1 connection generally are of different rates, i.e. have different spreading factors and different values of k.

The exact number of bits of the different uplink DPCCH fields (N_{pilot}, N_{TPC}, N_{FBI}, and N_{TFCI}) is determined in Table 2.. The field order and total number of bits/slot are fixed, though the number of bits per field may vary during a connection.

The values for the number of bits per field are given in Table 1 and Table 2. The channel bit and symbol rates given in Table 1 are the rates immediately before spreading. The pilot patterns are given in Table 3 and Table 4, the TPC bit pattern is given in Table 5.

The N_{FBI} bits are used to support techniques requiring feedback between the UE and the UTRAN Access Point (=cell transceiver), including ~~feedback~~closed loop ~~(FB)~~ mode transmit diversity and site selection diversity (SSDT). The exact details of the FBI field are shown in Figure 2 and described below.

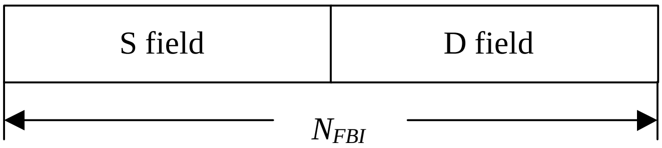


Figure 2: Details of FBI field

The S field is used for SSDT signalling, while the D field is used for FB Mode Transmit Diversity Signalling. Each of the S and D fields can be length 0, 1 or 2, with a total FBI field size N_{FBI} according to Table 2 (DPCCH fields). Simultaneous use of SSDT power control and FB Mode Transmit Diversity requires that both the S and D fields be of length 1. The use of these FBI fields is described in [5].

Table 1: DPDCH fields

Slot Format #i	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/ Frame	Bits/ Slot	N_{data}
0	15	15	256	150	10	10
1	30	30	128	300	20	20
2	60	60	64	600	40	40
3	120	120	32	1200	80	80
4	240	240	16	2400	160	160
5	480	480	8	4800	320	320
6	960	960	4	9600	640	640

There are two types of Uplink Dedicated Physical Channels; those that include TFCI(e.g. for several simultaneous services) and those that do not include TFCI(e.g. for fixed-rate services). These types are reflected by the duplicated rows of Table 2. The channel bit and symbol rates given in Table 2 are the rates immediately before spreading.

Table 2: DPCCH fields

Slot Format #i	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/ Frame	Bits/ Slot	N_{pilot}	N_{TPC}	N_{TFCI}	N_{FBI}
0	15	15	256	150	10	6	2	2	0
1	15	15	256	150	10	8	2	0	0
2	15	15	256	150	10	5	2	2	1
3	15	15	256	150	10	7	2	0	1
4	15	15	256	150	10	6	2	0	2
5	15	15	256	150	10	5	1	2	2

The pilot bit pattern is described in Table 3 and Table 4. The shadowed part can be used as frame synchronization words. (The value of the pilot bit other than the frame synchronization word shall be "1".)

Table 3: Pilot bit patterns for uplink DPCCH with N_{pilot} = 5 and 6.

	N_{pilot} = 5					N_{pilot} = 6					
Bit #	0	1	2	3	4	0	1	2	3	4	5
Slot #0~~1~~	1	1	1	1	0	1	1	1	1	1	0
1~~2~~	0	0	1	1	0	1	0	0	1	1	0
2~~3~~	0	1	1	0	1	1	0	1	1	0	1
3~~4~~	0	0	1	0	0	1	0	0	1	0	0
4~~5~~	1	0	1	0	1	1	1	0	1	0	1
5~~6~~	1	1	1	1	0	1	1	1	1	1	0
6~~7~~	1	1	1	0	0	1	1	1	1	0	0
7~~8~~	1	0	1	0	0	1	1	0	1	0	0
8~~9~~	0	1	1	1	0	1	0	1	1	1	0
9~~10~~	1	1	1	1	1	1	1	1	1	1	1
10~~1~~	0	1	1	0	1	1	0	1	1	0	1
11~~2~~	1	0	1	1	1	1	1	0	1	1	1
12~~3~~	1	0	1	0	0	1	1	0	1	0	0
13~~4~~	0	0	1	1	1	1	0	0	1	1	1
14~~5~~	0	0	1	1	1	1	0	0	1	1	1

Table 4: Pilot bit patterns for uplink DPCCH with N_{pilot} = 7 and 8.

	N_{pilot} = 7							N_{pilot} = 8							
Bit #	0	1	2	3	4	5	6	0	1	2	3	4	5	6	7
Slot #0~~1~~	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0
1~~2~~	1	0	0	1	1	0	1	1	0	1	0	1	1	1	0
2~~3~~	1	0	1	1	0	1	1	1	0	1	1	1	0	1	1
3~~4~~	1	0	0	1	0	0	1	1	0	1	0	1	0	1	0
4~~5~~	1	1	0	1	0	1	1	1	1	1	0	1	0	1	1
5~~6~~	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0
6~~7~~	1	1	1	1	0	0	1	1	1	1	1	1	0	1	0
7~~8~~	1	1	0	1	0	0	1	1	1	1	0	1	0	1	0
8~~9~~	1	0	1	1	1	0	1	1	0	1	1	1	1	1	0
9~~10~~	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10~~1~~	1	0	1	1	0	1	1	1	0	1	1	1	0	1	1
11~~2~~	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1
12~~3~~	1	1	0	1	0	0	1	1	1	1	0	1	0	1	0
13~~4~~	1	0	0	1	1	1	1	1	0	1	0	1	1	1	1
14~~5~~	1	0	0	1	1	1	1	1	0	1	0	1	1	1	1

The relationship between the TPC bit pattern and transmitter power control command is presented in Table 5.

Table 5: TPC Bit Pattern

TPC Bit Pattern		Transmitter power control command
N_{TPC} = 1	N_{TPC} = 2	
1	11	1
0	00	0

~~In each radio frame,~~ For slot formats using TFCI, the TFCI value in each radio frame corresponds to a certain combination of bit rates of the DCHs currently in use. This correspondence is (re-)negotiated at each DCH addition/removal. ~~For default TFCI there is one code word of length 30 bits. For extended TFCI there are 2 code words of length 15 bits giving the same total number of encoded TFCI bits per frame as for default TFCI. The 30 encoded TFCI bits are divided evenly among the 15 time slots, 2 bits per slot.~~ The mapping of the TFCI bits onto slots is described in [3].

Multi-code operation is possible for the uplink dedicated physical channels. When multi-code transmission is used, several parallel DPDCH are transmitted using different channelization codes, see [4]. However, there is only one DPCCH per connection.

5.2.2 Common uplink physical channels

5.2.2.1 Physical Random Access Channel (PRACH)

The Physical Random Access Channel (PRACH) is used to carry the RACH.

5.2.2.1.1 RACH transmission

The random-access transmission is based on a Slotted ALOHA approach with fast acquisition indication. The UE can start the transmission at a number of well-defined time-offsets, ~~relative to the frame boundary of every second frame of the received BCH of the current cell. The different time offsets are~~ denoted *access slots*. There are 15 access slots per two frames and they are spaced 5120 chips apart. Timing information on the access slots and the acquisition indication is given in section 7.3. ~~Figure~~ Figure 3~~2~~ shows the access slot numbers and their spacing to each other. Information on what access slots are available in the current cell is given by higher layers.~~broadcast on the BCH.~~

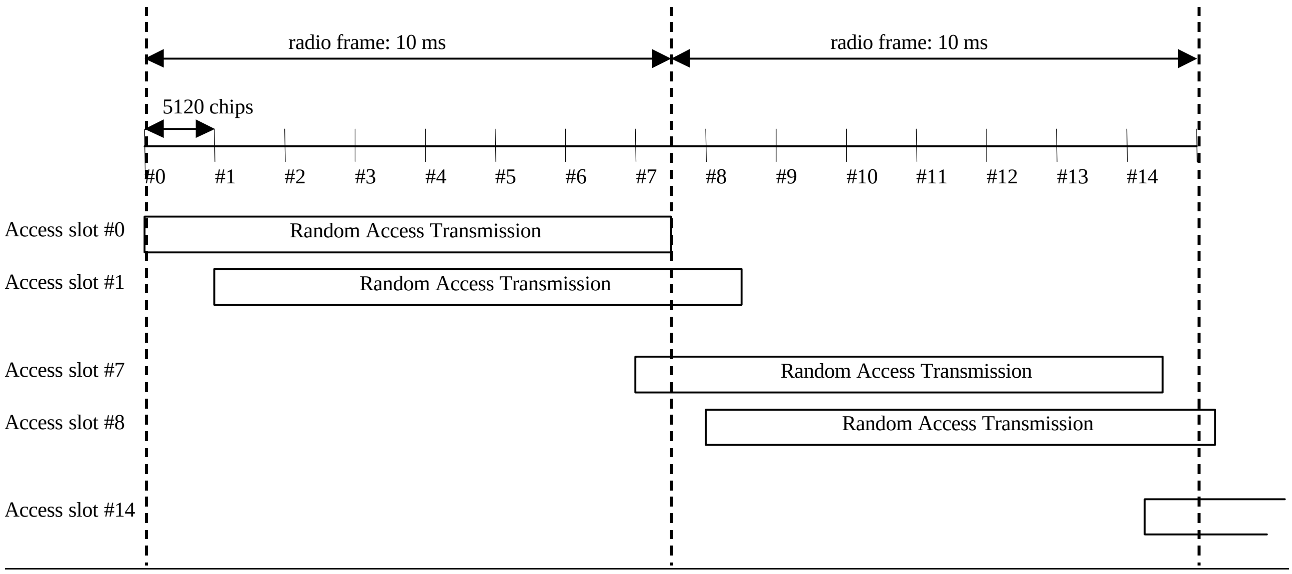
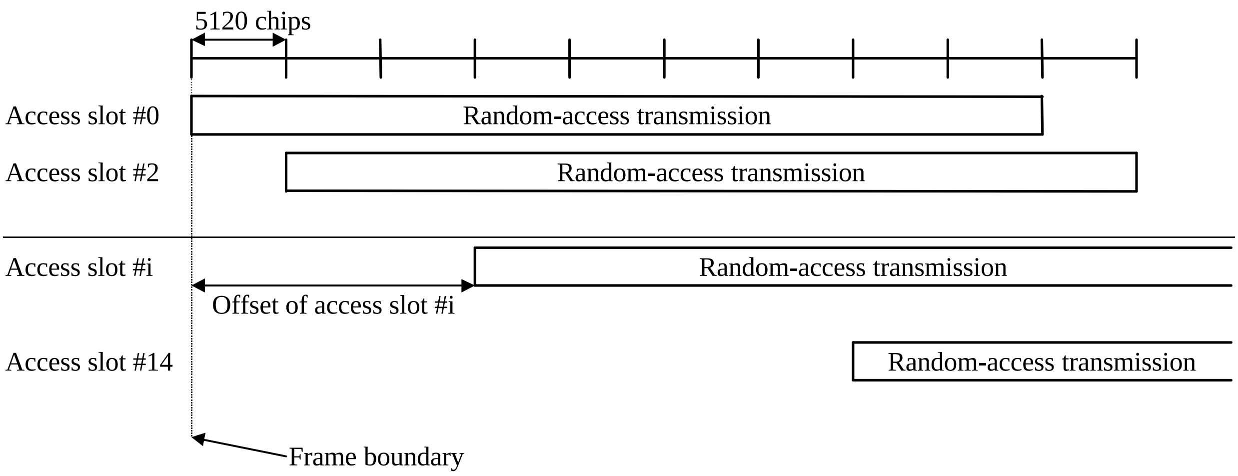


Figure 3: RACH access slot numbers and their spacing.



~~**Figure 4: PRACH allocated for RACH access slots.**~~

The structure of the random-access transmission ~~of Figure 4,~~ is shown in Figure 5. The random-access transmission consists of one or several *preambles* of length 4096 chips and a *message* of length 10 ms.

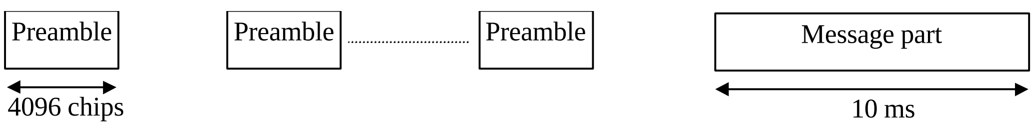


Figure 5: Structure of the random-access transmission.

5.2.2.1.2 RACH preamble part

The preamble part of the random-access burst consists of 256 repetitions of a signature, which is comprised of 16 complex symbols (±1+j). There are a total of 16 different signatures, based on the Hadamard code set of length 16 (see [4] for more details).

5.2.2.1.3 RACH message part

Figure 6 shows the structure of the Random-access message part. The 10 ms message is split into 15 slots, each of length T_{slot} = 2560 chips. Each slot consists of two parts, a data part that carries Layer 2 information and a control part that carries Layer 1 control information. The data and control parts are transmitted in parallel.

The data part consists of $10*2^k$ bits, where k=0,1,2,3. This corresponds to a spreading factor of 256, 128, 64, and 32 respectively for the message data part.

The control part consists of 8 known pilot bits to support channel estimation for coherent detection and 2 TFCI bits. This corresponds to a spreading factor of 256 for the message control part. The pilot bit pattern is described in Table 8. The total number of TFCI bits in the random-access message is 15*2 = 30. The TFCI value corresponds to a certain transport format of the current Random-access message.

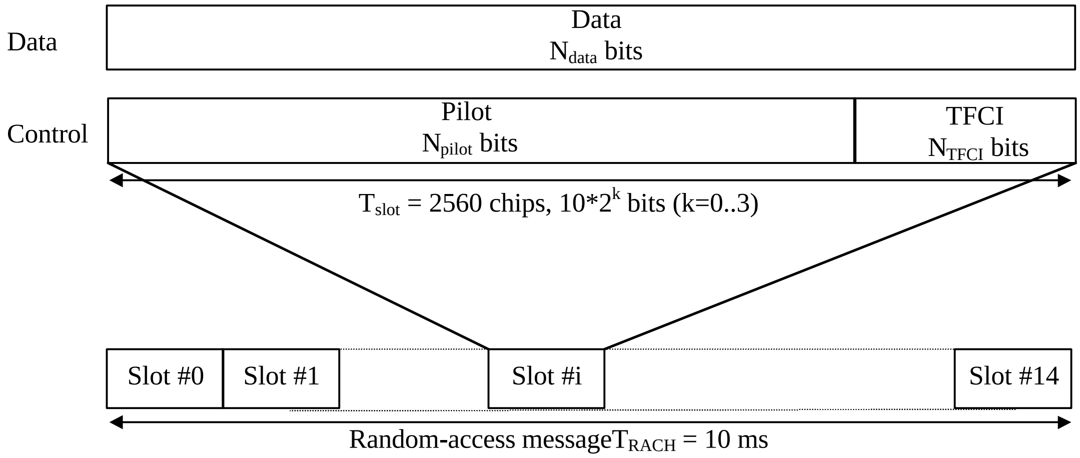


Figure 6: Structure of the random-access message part.

Table 6: Random-access message data fields.

Slot Format #i	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/ Frame	Bits/ Slot	N_{data}
0	15	15	256	150	10	10
1	30	30	128	300	20	20
2	60	60	64	600	40	40
3	120	120	32	1200	80	80

Table 7: Random-access message control fields.

Slot Format #i	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/ Frame	Bits/ Slot	N_{pilot}	N_{TFCI}
0	15	15	256	150	10	8	2

Table 8: Pilot bit patterns for RACH message part with N_{pilot} = 8.

	N_{pilot} = 8							
Bit #	0	1	2	3	4	5	6	7
Slot #0~~1~~	1	1	1	1	1	1	1	0
1~~2~~	1	0	1	0	1	1	1	0
2~~3~~	1	0	1	1	1	0	1	1
3~~4~~	1	0	1	0	1	0	1	0
4~~5~~	1	1	1	0	1	0	1	1
5~~6~~	1	1	1	1	1	1	1	0
6~~7~~	1	1	1	1	1	0	1	0
7~~8~~	1	1	1	0	1	0	1	0
8~~9~~	1	0	1	1	1	1	1	0
9~~10~~	1	1	1	1	1	1	1	1
10~~1~~	1	0	1	1	1	0	1	1
11~~2~~	1	1	1	0	1	1	1	1
12~~3~~	1	1	1	0	1	0	1	0
13~~4~~	1	0	1	0	1	1	1	1
14~~5~~	1	0	1	0	1	1	1	1

~~1.1.1.2~~5.2.2.2 Physical Common Packet Channel (PCPCH)

The Physical Common Packet Channel (PCPCH) is used to carry the CPCH.

5.2.2.2.1 CPCH transmission

The CPCH transmission is based on DSMA-CD approach with fast acquisition indication. The UE can start transmission at a number of well-defined time-offsets, relative to the frame boundary of the received BCH of the current cell. The access slot timing and structure is identical to RACH in section 5.2.2.1.1. The structure of the CPCH random access transmission is shown in Figure 7. The CPCH random access transmission consists of one or several Access Preambles [A-P] of length 4096 chips, one Collision Detection Preamble (CD-P) of length 4096 chips, a [10] ms DPCCH Power Control Preamble (PC-P) and a message of variable length Nx10 ms.

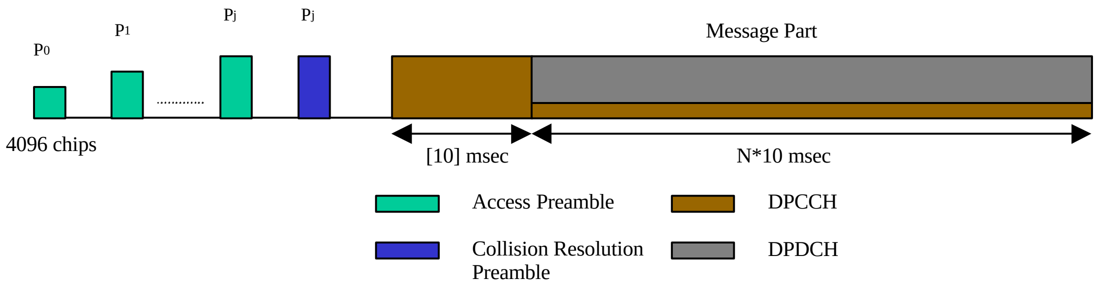


Figure 7: Structure of the CPCH random access transmission.

5.2.2.2.2 CPCH access preamble part

Similar to 5.2.2.1.2 (RACH preamble part). The RACH preamble signature sequences could be used. The number of sequences used could be less than the ones used in the RACH preamble. The scrambling code could either be chosen to be a different code segment of the Gold code used to form the scrambling code of the RACH preambles (see [4] for more details) or could be the same scrambling code in case the signature set is shared.

5.2.2.2.3 CPCH collision detection preamble part

Similar to 5.2.2.1.2 (RACH preamble part). The RACH preamble signature sequences are used. The scrambling code is chosen to be a different code segment of the Gold code used to form the scrambling code for the RACH and CPCH preambles (see [4] for more details).

5.2.2.2.4 CPCH power control preamble part

A [10] ms DPCCH Power Control Preamble (PC-P). Row 2 of Table 2 in 5.2.1 is the recommended DPCCH fields which only includes Pilot and TPC bits. Power Control Preamble length is ffs.

5.2.2.2.5 CPCH message part

Figure 1 in 5.2.1 shows the structure of the CPCH message part. Each message consists of N_Max_frames 10 ms frames. Each 10 ms frame is split into 15 slots, each of length T_{slot} = 2560 chips. Each slot consists of two parts, a data part that carries Layer 2 information and a control part that carries Layer 1 control information. The data and control parts are transmitted in parallel.

The data part consists of $10*2^k$ bits, where k = 2, 3, 4, 5, 6, corresponding to spreading factors of 64, 32, 16, 8, 4 respectively. Note that various rates might be mapped to different signature sequences.

.The spreading factor for the DPCCH (message control part) will be 256. The entries in Table 1 corresponding to spreading factors of 64 and below and Table 2 [both in section5.2.1] apply to the DPDCH and DPCCH fields respectively for the CPCH message part.

5.3 Downlink physical channels

5.3.1 Downlink Transmit Diversity

Table 9 summarizes the possible application of open and closed loop Transmit diversity modes on different downlink physical channels.

Table 9: Application of Tx diversity modes on downlink physical channels.

Channel	Open loop mode	Closed loop mode	Note
P-CCPCH	X	N/A	STTD applied only to data symbols. The last odd data symbol in every frame (10 msec.) is not STTD encoded.
SCH	X	N/A	TSTD used.
S-CCPCH	X	N/A	
DPCH	X	X	For the 7.5 ksps channel, the last odd data symbol in every frame (10 msec.) is not STTD encoded.
PICH	X	N/A	Only if closed loop Tx diversity is used in the cell and/or open loop mode is used on P-CCPCH.
PDSCH (associated with DPCH)	X	X	
AICH	X	N/A	Only if closed loop Tx diversity is used in the cell and/or open loop mode is used on P-CCPCH.

N/A = Not applied
X = Can be applied

5.3.1.1 Open loop transmit diversity

5.3.1.1.1 Space time block coding based transmit antenna diversity (STTD)

The open loop downlink transmit diversity employs a space time block coding based transmit diversity (STTD). The STTD encoding is ~~used~~ optional~~l~~y at the ~~base station~~node B. STTD support is mandatory at the UE.~~Its use at the mobile is mandatory.~~ A block diagram of the transmitter and a generic STTD encoder are shown in the Figure 8 and Figure 9 below. Channel coding, rate matching and interleaving is done as in the non-diversity mode.

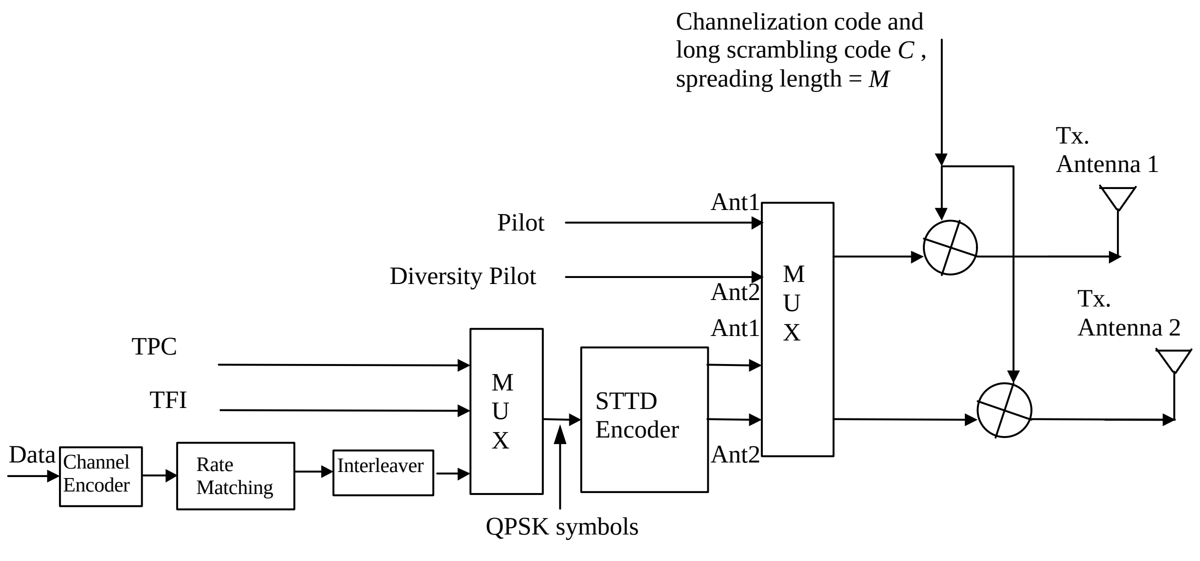


Figure 8: Block diagram of the transmitter (STTD).

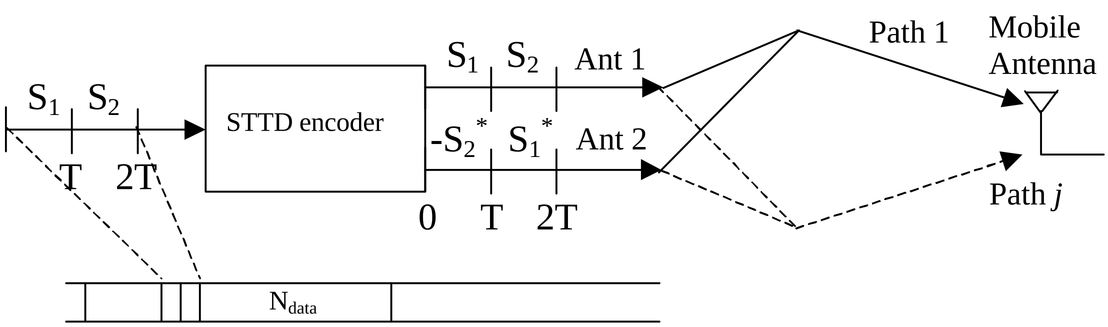


Figure 9: Block diagram of STTD encoder. The symbols S_1, S_2 are QPSK or discontinuous transmission (DTX) symbols and T denotes the symbol time.

5.3.1.1.2 Time Switched Transmit Diversity for SCH (TSTD)

TSTD is ~~used~~ optional~~ly~~ at the ~~base station~~node B. TSTD support is mandatory at the UE.~~Its use at the UE is mandatory.~~ A block diagram of the transmitter using TSTD for SCH and STTD for P-CCPCH is shown in Figure 10.

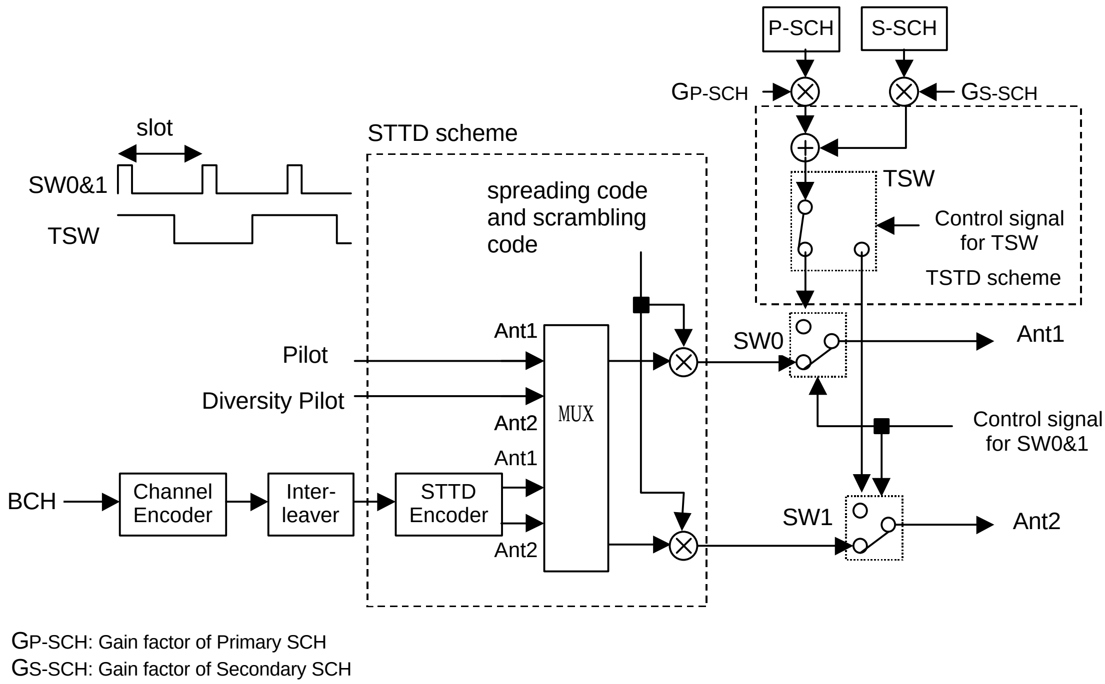


Figure 10: Multiplexing scheme of SCH (TSTD) and P-CCPCH (STTD)

5.3.2 Dedicated downlink physical channels

There is only one type of downlink dedicated physical channel, the Downlink Dedicated Physical Channel (downlink DPCH).

Within one downlink DPCH, dedicated data generated at Layer 2 and above, i.e. the dedicated transport channel (DCH), is transmitted in time-multiplex with control information generated at Layer 1 (known pilot bits, TPC commands, and an optional TFCI). The downlink DPCH can thus be seen as a time multiplex of a downlink DPDCH and a downlink DPCCH, compare Section 5.2.1. It is the UTRAN that determines if a TFCI should be transmitted, hence making it is mandatory for all UEs to support the use of TFCI in the downlink.

Figure 11 shows the frame structure of the downlink DPCH. Each frame of length 10 ms is split into 15 slots, each of length T_{slot} = 2560 chips, corresponding to one power-control period. A super frame corresponds to 72 consecutive frames, i.e. the super-frame length is 720 ms.

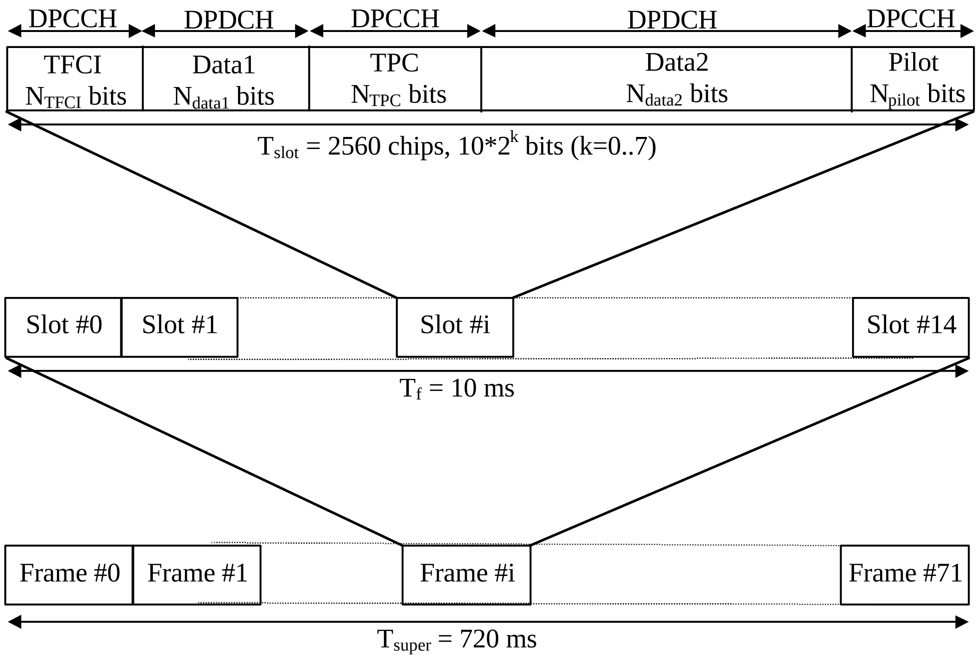


Figure 11: Frame structure for downlink DPCH.

The parameter k in Figure 11 determines the total number of bits per downlink DPCH slot. It is related to the spreading factor SF of the physical channel as $SF = 512/2^k$. The spreading factor may thus range from 512 down to 4.

The exact number of bits of the different downlink DPCH fields (N_{pilot}, N_{TPC}, N_{TFCI}, N_{data1} and N_{data2}) is determined in Table 10.The overhead due to the DPCCH transmission has to be negotiated at the connection set-up and can be re-negotiated during the communication, in order to match particular propagation conditions.

There are basically two types of downlink Dedicated Physical Channels; those that include TFCI (e.g. for several simultaneous services) and those that do not include TFCI(e.g. for fixed-rate services). These types are reflected by the duplicated rows of Table 10. The channel bit and symbol rates given in Table 10 are the rates immediately before spreading.

Table 10: DPDCH and DPCCH fields

Slot Format #i	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/Frame			Bits/ Slot	DPDCH Bits/Slot		DPCCH Bits/Slot		
				DPDCH	DPCCH	TOT		N_{Data1}	N_{Data2}	N_{TFCI}	N_{TPC}	N_{Pilot}
0	15	7.5	512	60	90	150	10	2	2	0	2	4
1	15	7.5	512	30	120	150	10	0	2	2	2	4
2	30	15	256	240	60	300	20	2	14	0	2	2
3	30	15	256	210	90	300	20	0	14	2	2	2
4	30	15	256	210	90	300	20	2	12	0	2	4
5	30	15	256	180	120	300	20	0	12	2	2	4
6	30	15	256	150	150	300	20	2	8	0	2	8
7	30	15	256	120	180	300	20	0	8	2	2	8
8	60	30	128	510	90	600	40	6	28	0	2	4
9	60	30	128	480	120	600	40	4	28	2	2	4
10	60	30	128	450	150	600	40	6	24	0	2	8
11	60	30	128	420	180	600	40	4	24	2	2	8
12	120	60	64	900	300	1200	80	4	56	8*	4	8
13	240	120	32	2100	300	2400	160	20	120	8*	4	8
14	480	240	16	4320	480	4800	320	48	240	8*	8	16
15	960	480	8	9120	480	9600	640	112	496	8*	8	16
16	1920	960	4	18720	480	19200	1280	240	1008	8*	8	16

* If no TFCI, then the TFCI field is blank.

The pilot symbol pattern is described in Table 11. The shadowed part can be used as frame synchronization words. (The symbol pattern of the pilot symbols other than the frame synchronization word shall be "11".) In Table 11, the transmission order is from left to right. (Each two-bit pair represents an I/Q pair of QPSK modulation.)

Table 11: Pilot Symbol Pattern

	N_{pilot} = 4		N_{pilot} = 8				N_{pilot} = 16							
Symbol #	0	1	0	1	2	3	0	1	2	3	4	5	6	7
Slot #0~~1~~	11	11	11	11	11	10	11	11	11	10	11	11	11	10
1~~2~~	11	00	11	00	11	10	11	00	11	10	11	11	11	00
2~~3~~	11	01	11	01	11	01	11	01	11	01	11	10	11	00
3~~4~~	11	00	11	00	11	00	11	00	11	00	11	01	11	10
4~~5~~	11	10	11	10	11	01	11	10	11	01	11	11	11	11
5~~6~~	11	11	11	11	11	10	11	11	11	10	11	01	11	01
6~~7~~	11	11	11	11	11	00	11	11	11	00	11	10	11	11
7~~8~~	11	10	11	10	11	00	11	10	11	00	11	10	11	00
8~~9~~	11	01	11	01	11	10	11	01	11	10	11	00	11	11
9~~10~~	11	11	11	11	11	11	11	11	11	11	11	00	11	11
10~~1~~	11	01	11	01	11	01	11	01	11	01	11	11	11	10
11~~2~~	11	10	11	10	11	11	11	10	11	11	11	00	11	10
12~~3~~	11	10	11	10	11	00	11	10	11	00	11	01	11	01
13~~4~~	11	00	11	00	11	11	11	00	11	11	11	00	11	00
14~~5~~	11	00	11	00	11	11	11	00	11	11	11	10	11	01

The relationship between the TPC symbol and the transmitter power control command is presented in Table 12.

Table 12: TPC Bit Pattern

TPC Bit Pattern			Transmitter power control command
N_{TPC} = 2	N_{TPC} = 4	N_{TPC} = 8	
11	1111	11111111	1
00	0000	00000000	0

~~In each radio frame~~For slot formats using TFCI, the TFCI value in each radio frame corresponds to a certain combination of bit rates of the DCHs currently in use. This correspondence is (re-)negotiated at each DCH addition/removal. ~~For default TFCI there is one code word of length 30 bits. For extended TFCI there are 2 code words of length 15 bits giving the same total number of encoded TFCI bits per frame as for default TFCI. The 30 encoded TFCI bits are divided evenly among the 15 time slots, 2 bits per slot. At the channel bit rates higher than 60 ksps, each 2-bit pair is repeated four times.~~ The mapping of the TFCI bits onto slots is described in [3].

When the total bit rate to be transmitted on one downlink CCTrCHexceeds the maximum bit rate for a downlink physical channel, multicode transmission is employed, i.e. several parallel downlink DPCHs are transmitted for one CCTrCH using the same spreading factor. In this case, the Layer 1 control information is put on only the first downlink DPCH. The additional downlink DPCHs belonging to the CCTrCH do not transmit any data during the corresponding time period, see Figure 12.

In the case of different CCTrCH of dedicated type for one UE different spreading factors could be used and only one DPCCH would be transmitted for them in the downlink.

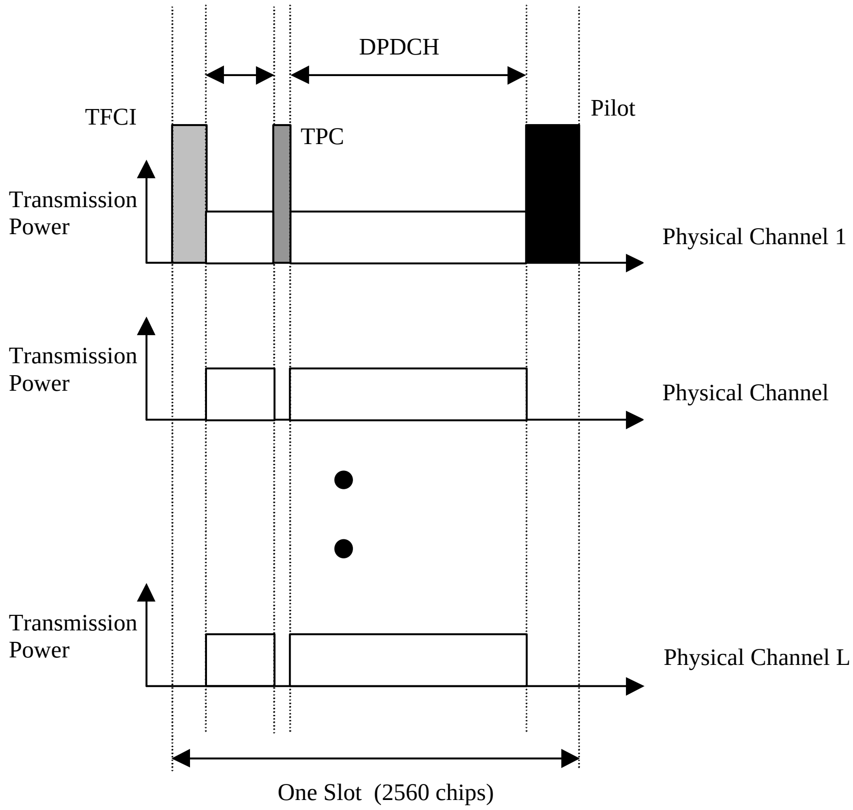


Figure 12: Downlink slot format in case of multi-code transmission.

5.3.2.1 STTD for DPCH

The block diagrams shown in Figure 8and Figure 9 are used to STTD encode the DPDCH, TPC and TFCI symbols. The pilot symbol pattern for the DPCH channel transmitted on the diversity antenna is given in Table 13. For the 7.5 ksps DPCH the last odd data symbol in every frame (10 ms~~ec.~~) is not STTD encoded and the same symbol is transmitted with equal power from the two antennas.

Table 13: Pilot pattern of the DPCH channel for the diversity antenna using STTD.

	N_{pilot} = 4		N_{pilot} = 8				N_{pilot} = 16							
Symbol #	0	1	0	1	2	3	0	1	2	3	4	5	6	7
Slot #0~~1~~	01	10	11	00	00	10	11	00	00	10	11	00	00	10
1~~2~~	10	10	11	00	00	01	11	00	00	01	11	10	00	10
2~~3~~	11	10	11	11	00	00	11	11	00	00	11	10	00	11
3~~4~~	10	10	11	10	00	01	11	10	00	01	11	00	00	00
4~~5~~	00	10	11	11	00	11	11	11	00	11	11	01	00	10
5~~6~~	01	10	11	00	00	10	11	00	00	10	11	11	00	00
6~~7~~	01	10	11	10	00	10	11	10	00	10	11	01	00	11
7~~8~~	00	10	11	10	00	11	11	10	00	11	11	10	00	11
8~~9~~	11	10	11	00	00	00	11	00	00	00	11	01	00	01
9~~10~~	01	10	11	01	00	10	11	01	00	10	11	01	00	01
10~~1~~	11	10	11	11	00	00	11	11	00	00	11	00	00	10
11~~2~~	00	10	11	01	00	11	11	01	00	11	11	00	00	01
12~~3~~	00	10	11	10	00	11	11	10	00	11	11	11	00	00
13~~4~~	10	10	11	01	00	01	11	01	00	01	11	10	00	01
14~~5~~	10	10	11	01	00	01	11	01	00	01	11	11	00	11

~~At call setup phase the UE is informed if Transmit diversity will be used on DPCH or not. If the base station allows diversity mode, the base station starts the transmission of dedicated physical channel(s) using open loop diversity mode by default. As soon as the reverse link transmission has started, the base station can command the UE to either use open loop diversity mode or feedback mode by using higher level signalling. During hand over between cells and sectors open loop antenna diversity is used on dedicated physical channels.~~

5.3.2.2 Dedicated channel pilots with closed loop mode transmit diversity

In ~~feedback~~closed loop mode 1 orthogonal pilot patterns are used between the transmit antennas. Pilot patterns defined in the Table 11 will be used on the non-diversity antenna and pilot patterns defined in the Table 13 on the diversity antenna. This is illustrated in the Figure 13 a which indicates the difference in the pilot patterns with different shading.

In ~~feedback~~closed loop mode 2 same pilot pattern is used on both of the antennas (see Figure 13 b). The pattern to be used is according to the Table 11.

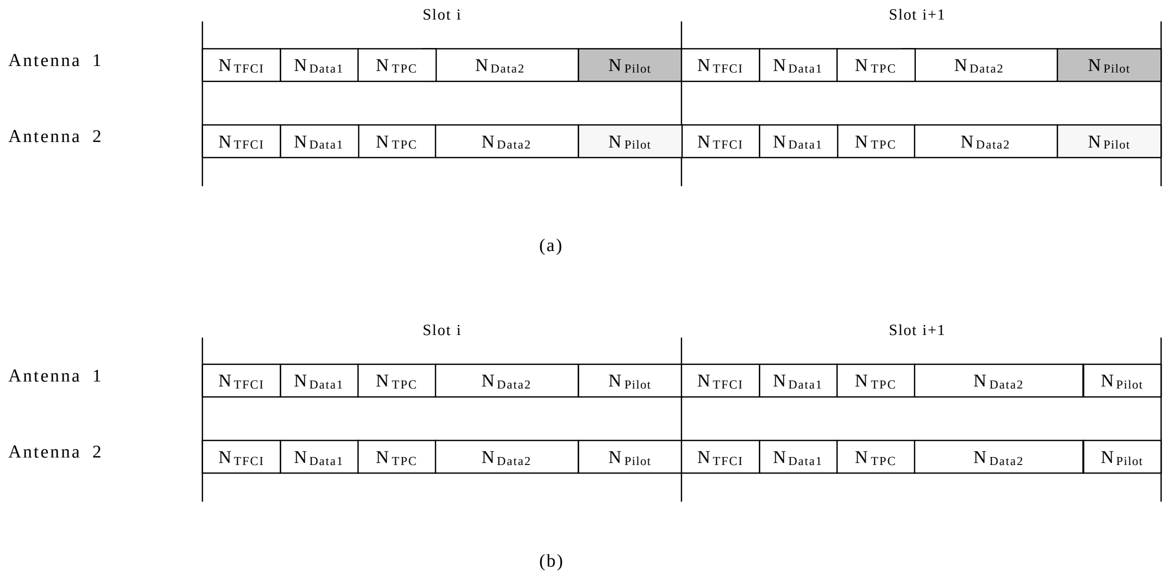


Figure 13: Slot structures for downlink dedicated physical channel diversity transmission. Structure (a) is used in ~~feedback~~closed loop mode 1. Structure (b) is used in ~~feedback~~closed loop mode 2. Different shading of the pilots indicate orthogonality of the patterns.

5.3.3 Common downlink physical channels

5.3.3.1 Common Pilot Channel (CPICH)

This physical channel consists of two parts:

- Antenna 1 common pilot (always present) and
- Antenna 2 common pilot (in the case of open and closed loop Tx diversity)

These are continuous channels with the same spreading and scrambling codes transmitted on the different antennas in the case of downlink transmit diversity. The spreading factor is always 256. They differ only in the modulation pattern used. The modulation patterns are shown in Figure 14.

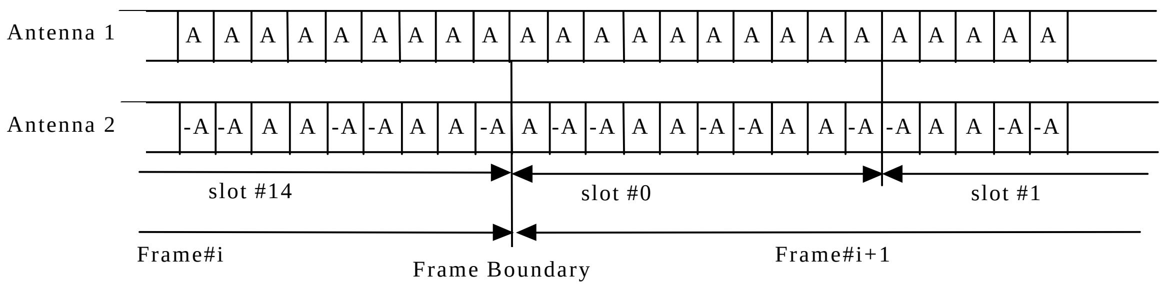


Figure 14: Modulation pattern for Common Pilot Channel (with A = 1+j)

Additionally there are two types of Common pilot channels, the primary and secondary, they differ in their use and there are some limitations placed on their physical features.

When receiving a physical channel transmitted with the same antenna characteristics as a common pilot the UE should use this common pilot for its channel estimation.

5.3.3.1.1 Primary Common Pilot Channel

The Primary Common Pilot Channel is a specific case of the Common Pilot Channel as defined above with the following limitations:

- The same channelization code is always reserved for this channel, defined in [4].
- Assigned the primary scrambling code,
- One per cell,
- Broadcast over entire cell.

5.3.3.1.2 Secondary Common Pilot Channel

The Secondary Common Pilot Channel is a specific case of the Common Pilot Channel as defined above with the following characteristics:

- Assigned an arbitrary channelization code,
- Can be assigned either the primary or a secondary scrambling code,
- There may exist any number of these.

5.3.3.2 Primary Common Control Physical Channel (P-CCPCH)

The Primary CCPCH is a fixed rate (30 kbps, SF=256) downlink physical channels used to carry the BCH.

Figure 15 shows the frame structure of the Primary CCPCH. The frame structure differs from the downlink DPCH in that no TPC commands, no TFCI and no pilot bits are transmitted The Primary CCPCH is not transmitted during the first 256 chips of each slot. Instead, Primary SCH and Secondary SCH are transmitted during this period (see section 5.3.3.4).

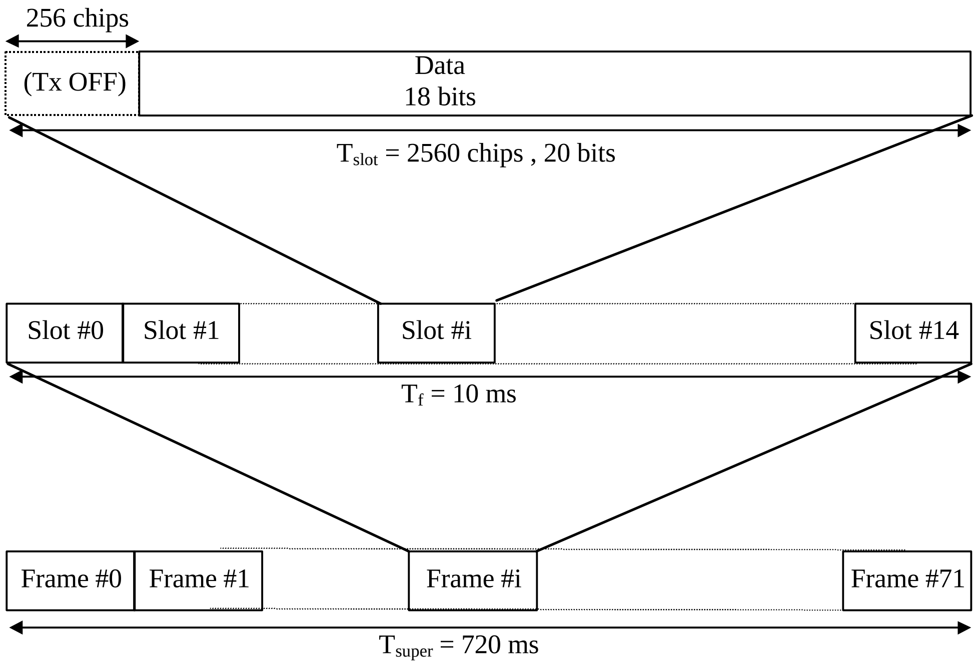


Figure 15: Frame structure for Primary Common Control Physical Channel.

5.3.3.2.1 Primary CCPCH structure with STTD encoding

In case the diversity antenna is present at the ~~base station~~node B and the P-CCPCH is to be transmitted using open loop transmit diversity, the data symbols of the P-CCPCH are STTD encoded as given in section 5.3.1.1.1, Figure 8 and Figure 9. The last odd data symbol in every frame (10 ms~~ec.~~) is not STTD encoded and the same symbol is transmitted with equal power from the two antennas. The ~~base station~~node B transmits a L3 message on the broadcast channel (BCH) indicating whether STTD encoding is used for the P-CCPCH or not. In addition, the ~~base station~~node B indicates the presence/absence of STTD encoding on P-CCPCH, by modulating the SCH. During power on and hand over between cells the UE determines the presence of STTD encoding on the P-CCPCH, by either receiving the L3 message, by demodulating the SCH channel or by a combination of the above two schemes.

The STTD encoding for the data symbols of the slots 1 and 2 of a P-CCPCH frame is given in the figure below. The same procedure is used for the data symbols of slots 3 and 4, 5 and 6 and henceforth, respectively.

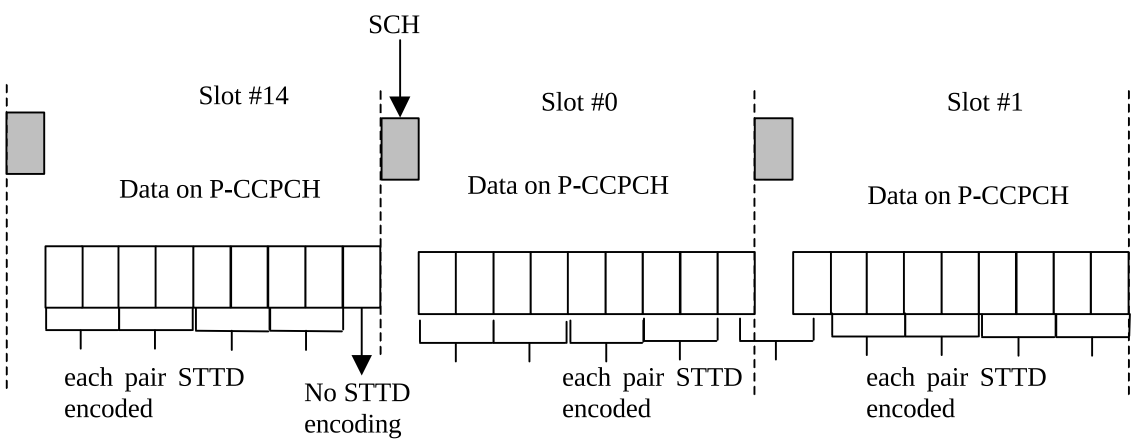


Figure 16: STTD encoding for the data symbols of the P-CCPCH.

5.3.3.3 Secondary Common Control Physical Channel (S-CCPCH)

The Secondary CCPCH is used to carry the FACH and PCH. There are two types of Secondary CCPCH: those that include TFCI and those that do not include TFCI. It is the UTRAN that determines if a TFCI should be transmitted, hence making it mandatory for all UEs to support the use of TFCI. The set of possible rates is the same as for the downlink DPCH, see Section 5.3.2. The frame structure of the Secondary CCPCH is shown in Figure 17.

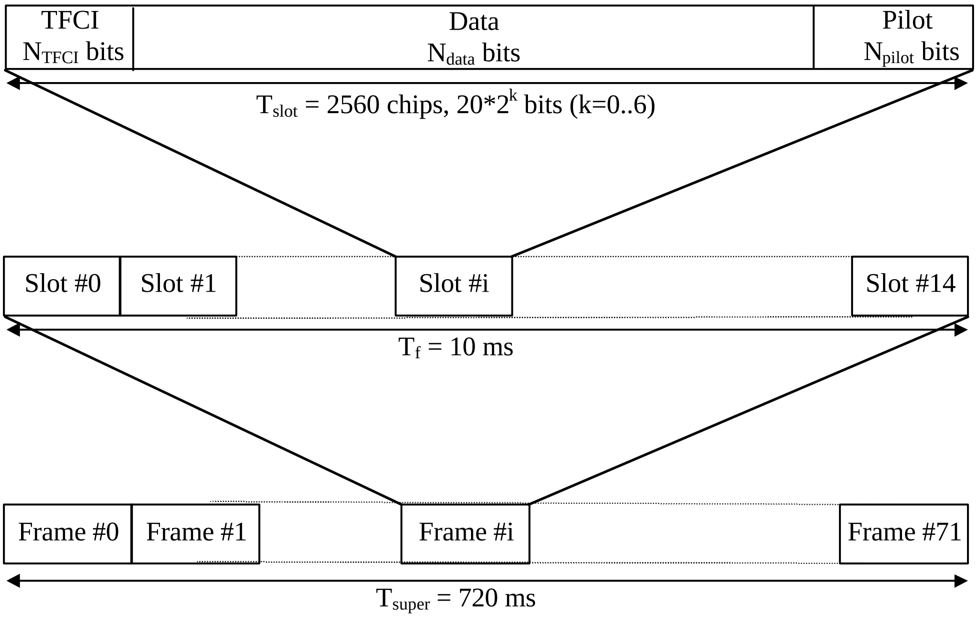


Figure 17: Frame structure for Secondary Common Control Physical Channel.

The parameter k in Figure 17 determines the total number of bits per downlink Secondary CCPCH slot. It is related to the spreading factor SF of the physical channel as $SF = 256/2^k$. The spreading factor range is from 256 down to 4.

The values for the number of bits per field are given in Table 14 and Table 15. The channel bit and symbol rates given in Table 14 are the rates immediately before spreading. The pilot patterns are given in Table 16.

The FACH and PCH can be mapped to the same or to separate Secondary CCPCHs. The main difference between a CCPCH and a downlink dedicated physical channel is that a CCPCH is not ~~closed~~inner-loop power controlled. The main difference between the Primary and Secondary CCPCH is that the Primary CCPCH has a fixed predefined rate while the Secondary CCPCH can support variable rate with the help of the TFCI field included. Furthermore, a Primary CCPCH is continuously transmitted over the entire cell while a Secondary CCPCH is only transmitted when there is data available and may be transmitted in a narrow lobe in the same way as a dedicated physical channel (only valid for a Secondary CCPCH carrying the FACH).

Table 14: Secondary CCPCH fields with pilot bits

Slot Format #i	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/ Frame	Bits/ Slot	N_{data}	N_{pilot}	N_{TFCI}
0	30	15	256	300	20	12	8	0
1	30	15	256	300	20	10	8	2
2	60	30	128	600	40	32	8	0
3	60	30	128	600	40	30	8	2
4	120	60	64	1200	80	64	8	8*
5	240	120	32	2400	160	144	8	8*
6	480	240	16	4800	320	296	16	8*
7	960	480	8	9600	640	616	16	8*
8	1920	960	4	19200	1280	1256	16	8*

* If no TFCI, then the TFCI field is blank.

Table 15: Secondary CCPCH fields without pilot bits

Slot Format #i	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/ Frame	Bits/ Slot	N_{data}	N_{pilot}	N_{TFCI}
0	30	15	256	300	20	20	0	0
1	30	15	256	300	20	18	0	2
2	60	30	128	600	40	40	0	0
3	60	30	128	600	40	38	0	2
4	120	60	64	1200	80	72	0	8*
5	240	120	32	2400	160	152	0	8*
6	480	240	16	4800	320	312	0	8*
7	960	480	8	9600	640	632	0	8*
8	1920	960	4	19200	1280	1272	0	8*

* If no TFCI, then the TFCI field is blank.

The pilot symbol pattern is described in Table 16. The shadowed part can be used as frame synchronization words. (The symbol pattern of pilot symbols other than the frame synchronization word shall be “11”.) In Table 16, the transmission order is from left to right. (Each two-bit pair represents an I/Q pair of QPSK modulation.)

Table 16: Pilot Symbol Pattern

	$N_{pilot} = 8$				$N_{pilot} = 16$							
Symbol #	0	1	2	3	0	1	2	3	4	5	6	7
Slot #0~~1~~	11	11	11	10	11	11	11	10	11	11	11	10
1~~2~~	11	00	11	10	11	00	11	10	11	11	11	00
2~~3~~	11	01	11	01	11	01	11	01	11	10	11	00
3~~4~~	11	00	11	00	11	00	11	00	11	01	11	10
4~~5~~	11	10	11	01	11	10	11	01	11	11	11	11
5~~6~~	11	11	11	10	11	11	11	10	11	01	11	01
6~~7~~	11	11	11	00	11	11	11	00	11	10	11	11
7~~8~~	11	10	11	00	11	10	11	00	11	10	11	00
8~~9~~	11	01	11	10	11	01	11	10	11	00	11	11
9~~10~~	11	11	11	11	11	11	11	11	11	00	11	11
10~~1~~	11	01	11	01	11	01	11	01	11	11	11	10
11~~2~~	11	10	11	11	11	10	11	11	11	00	11	10
12~~3~~	11	10	11	00	11	10	11	00	11	01	11	01
13~~4~~	11	00	11	11	11	00	11	11	11	00	11	00
14~~5~~	11	00	11	11	11	00	11	11	11	10	11	01

~~In each radio frame~~For slot formats using TFCI, the TFCI value in each radio frame corresponds to a certain transport format combination of the FACHs and/or PCHs currently in use. This correspondence is (re-)negotiated at each FACH/PCH addition/removal. ~~For default TFCI there is one code word of length 30 bits. For extended TFCI there are 2 code words of length 15 bits giving the same total number of encoded TFCI bits per frame as for default TFCI. The 30 encoded TFCI bits are divided evenly among the 15 time slots, 2 bits per slot. At the channel bit rates higher than 60 ksps, each 2-bit pair is repeated four times.~~The mapping of the TFCI bits onto slots is described in [3].

5.3.3.3.1 Secondary CCPCH structure with STTD encoding

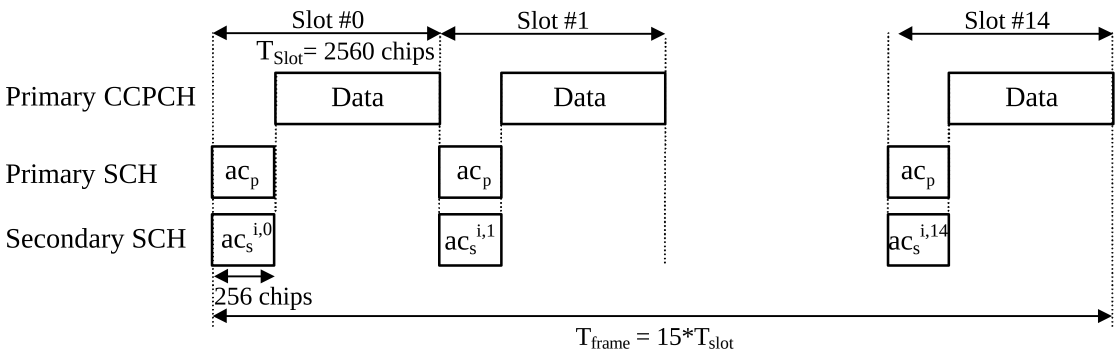
In case the diversity antenna is present at the ~~base station~~node B and the S-CCPCH is to be transmitted using open loop transmit diversity, the data symbols of the S-CCPCH are STTD encoded as given in Section 5.3.1.1.1, Figure 8 and Figure 9. The diversity antenna pilot symbol pattern for the S-CCPCH is given in Table 17 below.

Table 17: Pilot symbol pattern for the diversity antenna when STTD encoding is used on the S-CCPCH.

	$N_{pilot} = 8$				$N_{pilot} = 16$							
Symbol #	0	1	2	3	0	1	2	3	4	5	6	7
Slot #0~~1~~	11	00	00	10	11	00	00	10	11	00	00	10
1~~2~~	11	00	00	01	11	00	00	01	11	10	00	10
2~~3~~	11	11	00	00	11	11	00	00	11	10	00	11
3~~4~~	11	10	00	01	11	10	00	01	11	00	00	00
4~~5~~	11	11	00	11	11	11	00	11	11	01	00	10
5~~6~~	11	00	00	10	11	00	00	10	11	11	00	00
6~~7~~	11	10	00	10	11	10	00	10	11	01	00	11
7~~8~~	11	10	00	11	11	10	00	11	11	10	00	11
8~~9~~	11	00	00	00	11	00	00	00	11	01	00	01
9~~10~~	11	01	00	10	11	01	00	10	11	01	00	01
10~~1~~	11	11	00	00	11	11	00	00	11	00	00	10
11~~2~~	11	01	00	11	11	01	00	11	11	00	00	01
12~~3~~	11	10	00	11	11	10	00	11	11	11	00	00
13~~4~~	11	01	00	01	11	01	00	01	11	10	00	01
14~~5~~	11	01	00	01	11	01	00	01	11	11	00	11

~~1.1.1.4~~5.3.3.4 Synchronisation Channel (SCH)

The Synchronisation Channel (SCH) is a downlink signal used for cell search. The SCH consists of two sub channels, the Primary and Secondary SCH. Figure 18 illustrates the structure of the SCH and the transmission timing relationship with the Primary CCPCH:



c_p : Primary Synchronization Code
$c_s^{i,k}$: One of 16 possible Secondary Synchronization Codes
($c_s^{i,0}$, $c_s^{i,1}$, ..., $c_s^{i,14}$) encode cell specific long scrambling code group i
a: Modulation on primary and secondary synchronization codes to indicate STTD encoding on PCCPCH

Figure 18: Structure of Synchronisation Channel (SCH).

The Primary SCH consists of a modulated code of length 256 chips, the Primary Synchronisation Code, transmitted once every slot. The Primary Synchronisation Code is the same for every cell in the system and is transmitted time-aligned with the period where the Primary CCPCH is not transmitted as illustrated in Figure 18.

The Secondary SCH consists of repeatedly transmitting a length 15 sequence of modulated codes of length 256 chips, the Secondary Synchronisation Codes, transmitted in parallel with the Primary Synchronisation channel. Each Secondary Synchronisation code is chosen from a set of 16 different codes of length 256. This sequence on the Secondary SCH indicates which of the 32 different code the cell's downlink scrambling code belongs. 32 sequences are used to encode the 32 different code groups each containing 16 scrambling codes.

The primary and secondary synchronization codes are modulated by the symbol *a* shown in Figure 18, which indicates the presence/ absence of STTD encoding on the P-CCPCH and is given by the following table:

P-CCPCH STTD encoded	a = +1
P-CCPCH not STTD encoded	a = -1

5.3.3.4.1 SCH transmitted by TSTD

Figure 19 illustrates the structure of the SCH transmitted by the TSTD scheme. In this Figure, STTD is applied to the Primary CCPCH.

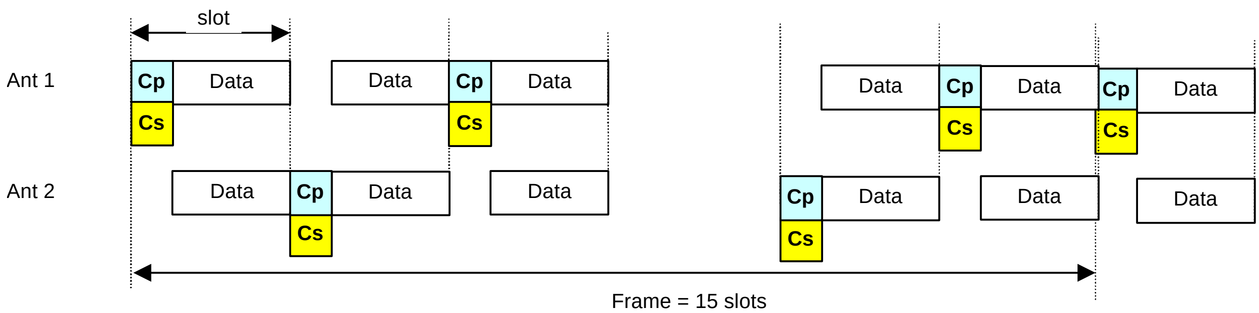


Figure 19: Structure of SCH transmitted by TSTD scheme

~~1.1.1.5~~5.3.3.5 Physical Downlink Shared Channel (PDSCH)

The Physical Downlink Shared Channel (PDSCH), used to carry the Downlink Shared Channel (DSCH), is shared by users based on code multiplexing. It is always associated with DPCH.

This is described respectively in Section 5.3.3.5.1.

The PDSCH does not comprise any pilot symbols, since this does not seem to be required at this stage, given information provided on the associated DPCH. This still needs to be verified.

5.3.3.5.1 DSCH associated with a DCH

The frame structure of the DSCH, when associated with a DCH, is shown on Figure 20.

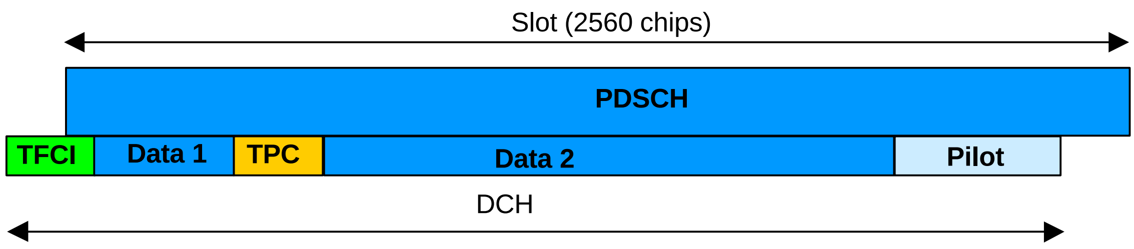


Figure 20: Frame structure for the DSCH when associated to a DCH.

To indicate for UE that there is data to decode on the DSCH, two signalling methods are possible, either using the TFCI field, or higher layer signalling.

The DSCH transmission with associated DCH is a special case of multicode transmission. The channels do not have necessary the same spreading factor and for DSCH the spreading factor may vary from frame to frame. The relevant Layer 1 control information is transmitted on DCH, the PDSCH does not contain DPCCH information.

For DSCH the allowed spreading factors may vary from 256 to 4. DSCH may consist of multiple parallel codes as well as negotiated at higher layer prior to starting data transmission. In such a case the parallel codes shall be operated with frame synchronization between each other.

5.3.3.6 Acquisition Indication Channel (AICH)

The Acquisition Indicator channel (AICH) is a physical channel used to carry Acquisition Indicators (AI). Acquisition Indicator AI_i corresponds to signature *i* on the PRACH or PCPCH. Note that for PCPCH, the AICH is either in response to an access preamble or a CD preamble. The corresponding to the access preamble AICH is the AP-AICH and the corresponding to the CD preamble AICH is the CD-AICH. The AP-AICH and CD-AICH use different channelization codes, see further[4], Section 4.3.3.2.

Figure 21 illustrates the frame structure of the AICH. Two AICH frames of total length 20 ms consist of 15 *access slots* (AS), each of length 20 symbols (5120 chips). Each access slot consists of two parts, an *Acquisition-Indicator* (AI) part and an empty part.

The AI-part of the access slot is generated as described in [4]. The empty part of the access slot consists of 4 zeros. The phase reference for the AICH is the CPICH.

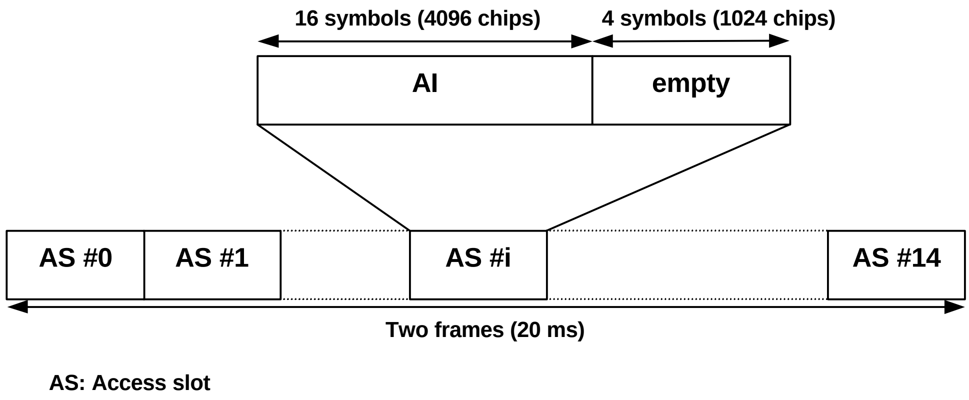


Figure 21: Structure of Acquisition Indicator Channel (AICH)

5.3.3.7 Page Indication Channel (PICH)

The Page Indicator Channel (PICH) is a fixed rate (SF=256) physical channel used to carry the Page Indicators (PI). The PICH is always associated with an S-CCPCH to which a PCH transport channel is mapped.

Figure 22 illustrates the frame structure of the PICH. One PICH frame of length 10 ms consists 300 bits. Of these, 288 bits are used to carry Page Indicators. The remaining 12 bits are not used.

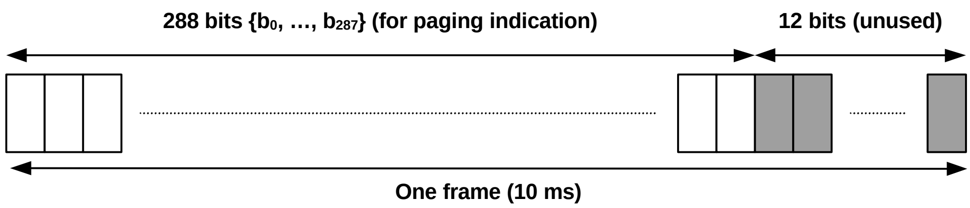


Figure 22: Structure of Page Indicator Channel (PICH)

N Page Indicators $\{PI_0, \ldots, PI_{N-1}\}$ are transmitted in each PICH frame, where N=18, 36, 72, or 144. The mapping from $\{PI_0, \ldots, PI_{N-1}\}$ to the PICH bits $\{b_0, \ldots, b_{287}\}$ are according to Table 18.

Table 18: Mapping of Page Indicators (PI) to PICH bits

Number of PI per frame (N)	$PI_i = 1$	$PI_i = 0$
N=18	$\{b_{16i}, \ldots, b_{16i+15}\} = \{1,1,\ldots,1\}$	$\{b_{16i}, \ldots, b_{16i+15}\} = \{0,0,\ldots,0\}$
N=36	$\{b_{8i+}, \ldots, b_{8i+7}\} = \{1,1,\ldots,1\}$	$\{b_{8i}, \ldots, b_{8i+7}\} = \{0,0,\ldots,0\}$
N=72	$\{b_{4i}, \ldots, b_{4i+3}\} = \{1, 1,\ldots,1\}$	$\{b_{4i}, \ldots, b_{4i+3}\} = \{0, 0,\ldots,0\}$
N=144	$\{b_{2i},$ ~~…,~~ $b_{2i+1}\} = \{1,1\}$	$\{b_{2i},$ ~~…,~~ $b_{2i+1}\} = \{0,0\}$

If a Paging Indicator in a certain frame is set to "1" it is an indication that UEs associated with this Page Indicator should read the corresponding frame of the associated S-CCPCH.

6 Mapping of transport channels onto physical channels

Figure 23 summarises the mapping of transport channels onto physical channels.

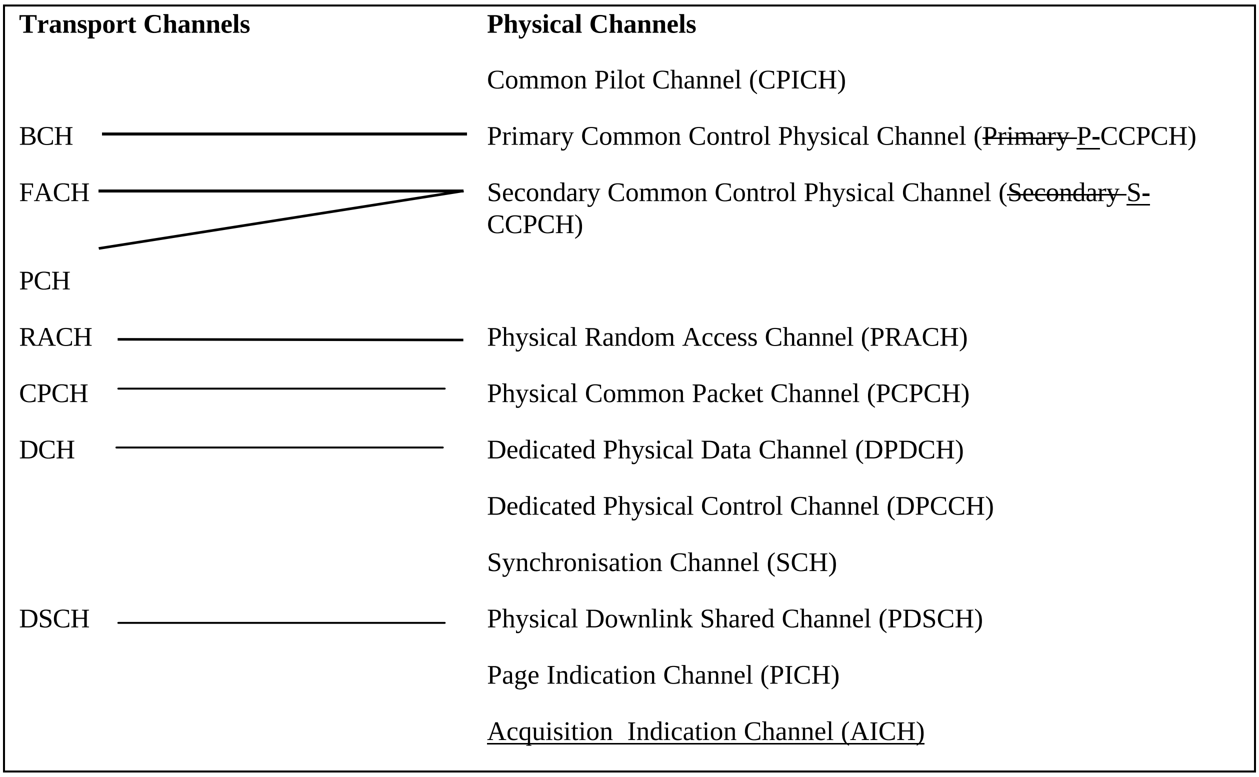


Figure 23: Transport-channel to physical-channel mapping.

The DCHs are coded and multiplexed as described in[3] , and the resulting data stream is mapped sequentially (first-in-first-mapped) directly to the physical channel(s). The mapping of BCH and FACH/PCH is equally straightforward, where the data stream after coding and interleaving is mapped sequentially to the Primary and Secondary CCPCH respectively. Also for the RACH, the coded and interleaved bits are sequentially mapped to the physical channel, in this case the message part of the random access burst on the PRACH.

7 Timing relationship between physical channels

In general, a Node B covers *N* cells, where $N \geq 1$. Each Node B has a Reference System Frame Number (SFN), which counts from *0* to *M-1* in Radio Frame (10 ms) intervals. *M* is a multiple of the superframe (72), and is TBD. The purpose of the Reference SFN is to make sure that the correct frames are combined at soft handover. Each cell has a Cell SFN, which is broadcast on the BCH.

The physical channel timing is shown in [13].

7.1 DPCCH/DPDCH timing relations

7.1.1 Uplink

In uplink the DPCCH and all the DPDCHs transmitted from one UE have the same frame timing.

7.1.2 Downlink

In downlink, the DPCCH and all the DPDCHs carrying CCTrCHs of dedicated type to one UE have the same frame timing.

7.1.3 Uplink/downlink timing at UE

At the UE, the uplink DPCCH/DPDCH frame transmission takes place approximately T_0 chips after the reception of the first significant path of the corresponding downlink DPCCH/DPDCH frame. T_0 is a constant defined to be 1024 chips. More information about the uplink/downlink timing relation and meaning of T_0 can be found in [5] section 4.5.

7.2 DSCH timing

The relative timing between a DSCH and DCH is given as follows:

DSCH timing is identical to the cell primary CCPCH.

DCH timing is asynchronous with max 1 slot (2560 chips) ahead or max 14 slots (35840 chips) behind. This determines explicitly which frame on DSCH carries the user data based on the TFCI or higher layer signaling on DCH.

7.3 PRACH/AICH timing relation:

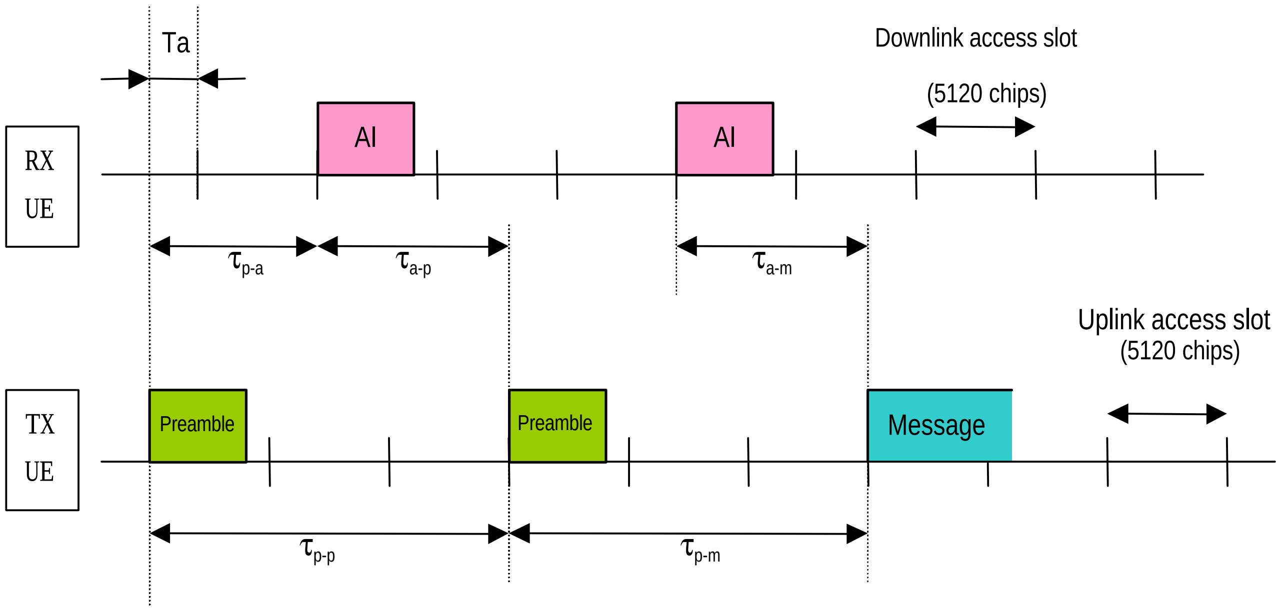


Figure 24: Timing of PRACH and AICH transmission as seen by the UE, with AICH transmission timing set to 0.

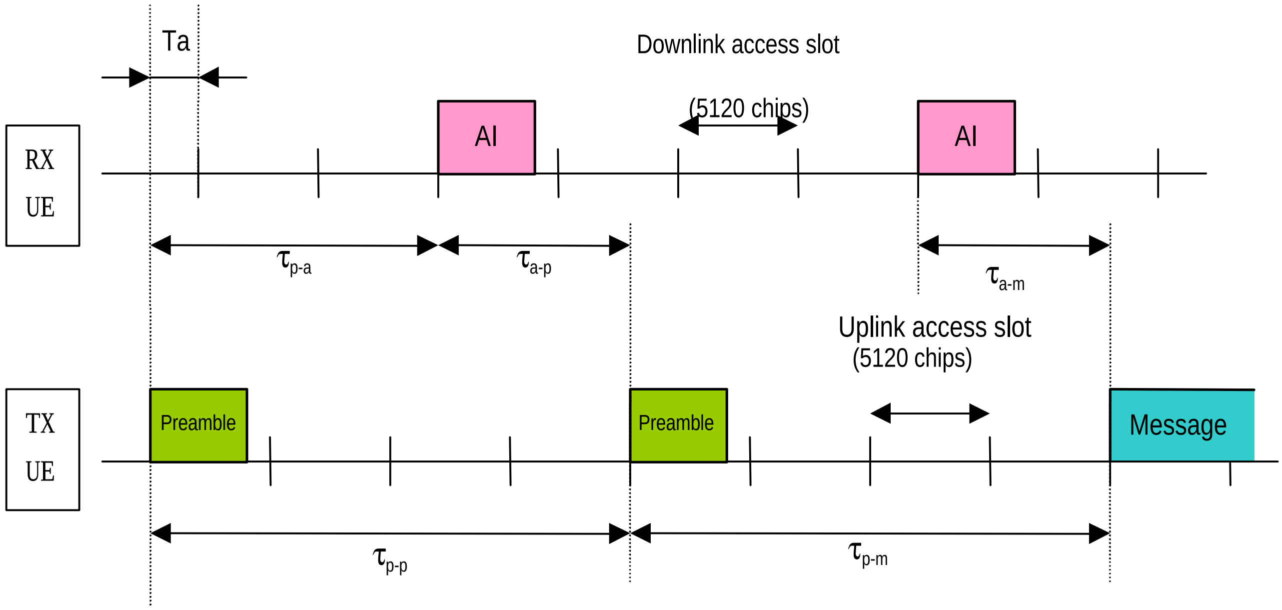


Figure 25: Timing of PRACH and AICH transmission as seen by the UE, with AICH transmission timing set to 1.

Figure 24 and Figure 25 illustrate the timing relation between PRACH and AICH as seen by the UE, with AICH transmission timing set to 0 and 1, respectively.

- Both uplink and downlink access slots of length 5120 chips are defined.

- For each downlink access slot there is a corresponding uplink access slot.

- The preambles are to be transmitted time aligned with the uplink access slots.

-The downlink access slot #0 is transmitted time aligned with the P-CCPCH frame boundary with SFN mod 2 = 0.

- An uplink access slot is transmitted a specified time τ_{p-a} before the corresponding downlink access slot.

- Subsequent preambles can be transmitted either three or four access slots after the latest transmitted preambles (τ_{p-p} is either 3 or 4 access slots), depending on the AICH transmission timing value.

- The message can be transmitted either three or four access slots after the latest transmitted preamble (τ_{p-m} is either 3 or 4 access slots), depending on the AICH transmission timing value.

The timing offset (T_a) between uplink and downlink access slots, as seen by the UE, is the same as 1 slot duration of 2560 chips.

The timing of preamble-to-AICH (τ_{p-a}) has two alternative values: 7680 chips or 12800 chips, depending on the AICH transmission timing value.

The timing of AICH-to-preamble(τ_{a-p}) has one value: 7680 chips.

The timing of AICH-to-message(τ_{a-m}) has one value: 7680 chips.

7.4 PCPCH/AICH timing relation

Everything in the previous section [PRACH/AICH] applies to this section as well. The timing relationship between preambles, AICH, and the message is the same as PRACH/AICH. Note that the collision resolution preambles follow the access preambles in PCPCH/AICH. However, the timing relationships between CD-Preamble and CD-AICH is identical to RACH Preamble and AICH. The timing relationship between CD-AICH and the Power Control Preamble in CPCH is identical to AICH to message in RACH. However, the set of values for T_{cpch} is TBD. As an example, when T_{cpch} is set to zero or one, the following PCPCH/AICH timing values apply:

Note that a1 corresponds to AP-AICH and a2 corresponds to CD-AICH.

τ_{p-p} = Time between Access Preamble (AP) to the next AP. is either 3 or 4 access slots, depending on $T_{cpch.}$

τ_{p-a1} = Time between Access Preamble and AP-AICH has two alternative values: 7680 chips or 12800 chips, depending on T_{cpch}

τ_{a1-cdp} = Time between receipt of AP-AICH and transmission of the CD Preamble has one value: 7680 chips.

τ_{p-cdp} = Time between the last AP and CD Preamble. is either 3 or 4 access slots, depending on T_{cpch}

τ_{cdp-a2} = Time between the CD Preamble and the CD-AICH has two alternative values: 7680 chips or 12800 chips, depending on T_{cpch}

$\tau_{cdp-pcp}$= Time between CD Preamble and the start of the Power Control Preamble is either 3 or 4 access slots, depending on $T_{cpch.}$

Figure 1 shows the timing of the CPCH uplink transmission with the associated DPCCH control channel in the downlink.

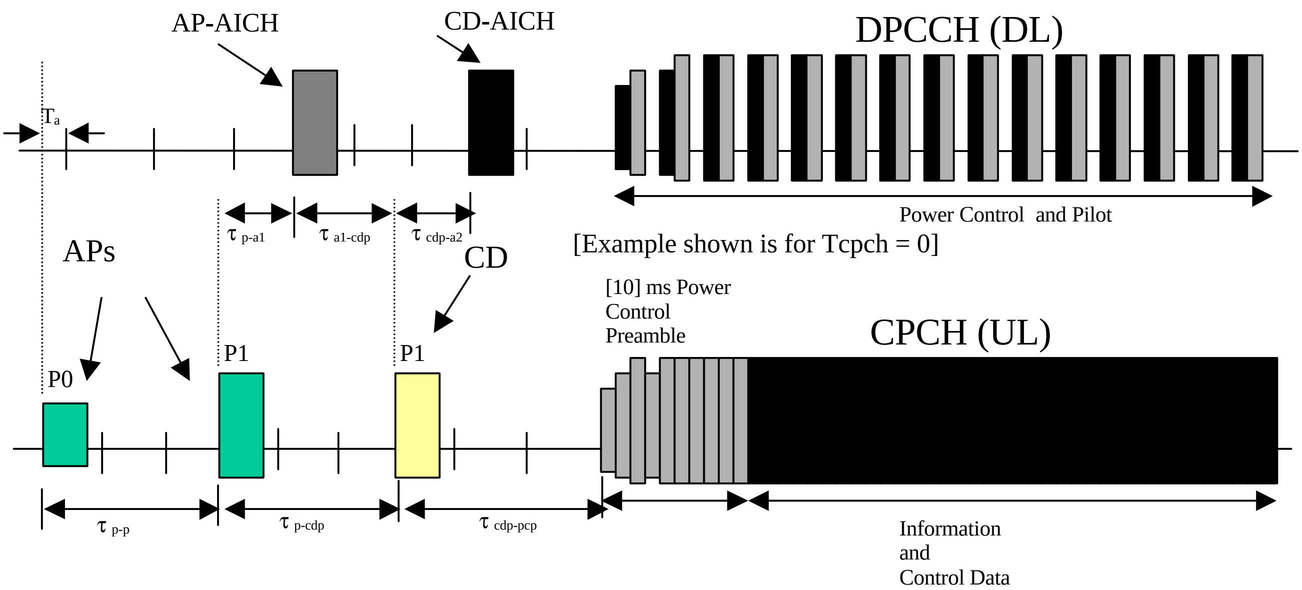


Figure 26: Timing of PCPCH and AICH transmission as seen by the UE, with T_{cpch}= 0.

7.5 Paging timing relation

Figure 27 illustrates the timing between an S-CCPCH frame and the corresponding frame of an associated PICH. The frame of the associated PICH precedes the corresponding S-CCPCH frame by τ_{PICH} = 3×2560 chips.

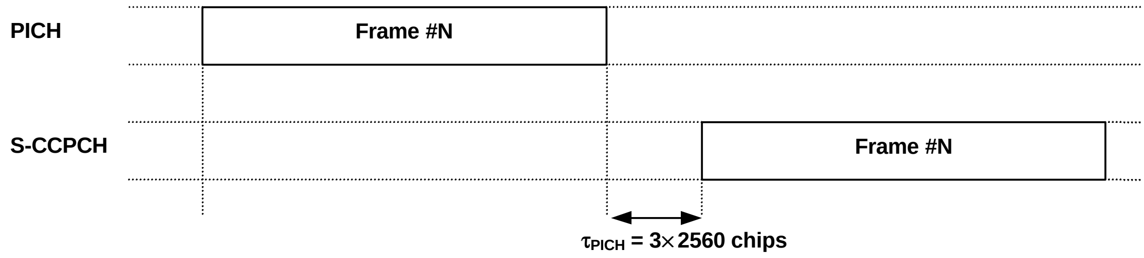


Figure 27: Timing between S-CCPCH and associated PICH.

History

Document history		
V0.0.0	1999-02-12	Created document from UMTS XX.03, V1.3.0
V0.0.1	1999-02-18	Small changes
V0.1.0	1999-02-26	Version approved by WG1#2. The changes agreed at the meeting to incorporate e.g. ad hoc conclusions not yet included
V1.0.0	1999-03-05	Version approved by RAN. Identical to V0.1.0
V1.0.1	1999-03-17	Included adhoc conclusions from WG1#2 and editorial changes.
V1.0.2	1999-03-23	Added adhoc conclusions from WG1#3
V1.0.3	1999-03-24	Added further text from Adhoc 6
V1.1.0	1999-03-24	Version approved by WG1#3
V1.1.1	1999-04-14	Updated RACH and Tx diversity description. Updated multicode figure. Added pilot table for PCCPCH. Removed FACH mapping section.
V1.1.2	1999-04-19	Added adhoc conclusions and text proposals from WG1#4
V1.1.3	1999-04-20	Added further text proposals from WG1#4
V2.0.0	1999-04-20	Version approved by WG1#4
TS 25.211 V2.0.0	1999-04-22	Endorsed by TSG-RAN as TS 25.211 v2.0.0
V2.0.1	1999-06-04	Added adhoc conclusions and text proposals from WG1#5
V2.1.0	1999-06-04	Version approved by WG1#5
V2.1.1	1999-07-07	Updated according to chiprate change and CPICH
V2.2.0	1999-07-13	Approved by WG1#6
V2.2.1	1999-08-12	Further changes including text proposals from WG1#6
V2.3.0	1999-08-30	Approved by WG1#7
V2.3.1	1999-09-03	Changes including text proposals from WG1#7
V2.4.0	1999-09-03	Approved by WG1#7

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This document is written in Microsoft Word 97.