TSG RAN Meeting #27 **RP-050088**
Tokyo, Japan, 9 - 11 March 2005

Title	**Linked CRs (Rel-6 Category B) to TS25.211 & TS25.212 & TS25.213 & TS25.214 & TS25.215 & for Introduction of F-DPCH**
Source	**TSG RAN WG1**
Agenda Item	**9.2.1.1**

RAN1 Tdoc	Spec	CR	Rev	Rel	Cat	Current Version	Subject	Work item	Remarks
R1-050178	25.211	200	1	Rel-6	B	6.3.0	Introduction of F-DPCH without pilot field	RANimp-RABSE-CodeOptFDD	
R1-050080	25.212	193	1	Rel-6	B	6.3.0	Introduction of F-DPCH	RANimp-RABSE-CodeOptFDD	
R1-050081	25.213	70	1	Rel-6	B	6.1.0	Introduction of F-DPCH	RANimp-RABSE-CodeOptFDD	
R1-050179	25.214	368	1	Rel-6	B	6.4.0	Introduction of F-DPCH without pilot field	RANimp-RABSE-CodeOptFDD	
R1-050133	25.215	155	-	Rel-6	B	6.1.0	Introduction of F-DPCH without pilot field	RANimp-RABSE-CodeOptFDD	

3GPP TSG-RAN WG1 Meeting #40 **_Tdoc R1-050178_** ⌘
Scottsdale, USA, 14th- 18th February 2025

CR-Form-v7

CHANGE REQUEST

⌘	**25.211**	**CR**	**200**	⌘ **rev**	**1**	⌘	Current version:	**6.3.0** ⌘

*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:	⌘	Introduction of F-DPCH without pilot field		
Source:	⌘	RAN WG1		
Work item code:	⌘	RANimp-RABSE-CodeOptFDD	***Date:*** ⌘	08/02/2005
Category:	⌘	**B**	***Release:*** ⌘	Rel-6
		Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

Reason for change:	⌘	This CR introduces Fractional DPCH without pilot field into the specifications
Summary of change:	⌘	A new section 5.3.2.6 is introduced to describe F-DPCH as a new physical channel, other relevant sections are updated: - abbreviations - downlink transmit diversity - dedicated downlink physical channels - STTD for DPCH - P-CPICH - S-CPICH -downlink phase reference - mapping of transport channels onto physical channels - timing relationship between physical channels (UL/DL and DPCCH/HS-DPCCH)
Consequences if not approved:	⌘	

Clauses affected:	⌘	3.2, 5.3.1, 5.3.2, 5.3.2.1, 5.3.2.6 (new section), 5.3.3.1.1, 5.3.3.1.2, 5.3.3.2, 6.1, 7.1, 7.6.3, 7.7				
		Y	**N**			
Other specs	⌘	**Y**		Other core specifications	⌘	25.212, 25.213, 25.214, 25.215, 25.302, 25.331, 25.423, 25.433, 25.101, 25.133
affected:				Test specifications		
				O&M Specifications		
Other comments:	⌘					

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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.

3 Symbols and abbreviations

3.1 Symbols

N_{data1}	The number of data bits per downlink slot in Data1 field.
N_{data2}	The number of data bits per downlink slot in Data2 field. If the slot format does not contain a Data2 field, $N_{data2} = 0$.

3.2 Abbreviations

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

16QAM	16 Quadrature Amplitude Modulation
AI	Acquisition Indicator
AICH	Acquisition Indicator Channel
AP	Access Preamble
AP-AICH	Access Preamble Acquisition Indicator Channel
API	Access Preamble Indicator
BCH	Broadcast Channel
CA	Channel Assignment
CAI	Channel Assignment Indicator
CCC	CPCH Control Command
CCPCH	Common Control Physical Channel
CCTrCH	Coded Composite Transport Channel
CD	Collision Detection
CD/CA-ICH	Collision Detection/Channel Assignment Indicator Channel
CDI	Collision Detection Indicator
CPCH	Common Packet Channel
CPICH	Common Pilot Channel
CQI	Channel Quality Indicator
CSICH	CPCH Status Indicator Channel
DCH	Dedicated Channel
DPCCH	Dedicated Physical Control Channel
DPCH	Dedicated Physical Channel
DPDCH	Dedicated Physical Data Channel
DSCH	Downlink Shared Channel
DSMA-CD	Digital Sense Multiple Access - Collison Detection
DTX	Discontinuous Transmission
E-AGCH	E-DCH Absolute Grant Channel
E-DCH	Enhanced Dedicated Channel
E-DPCCH	E-DCH Dedicated Physical Control Channel
E-DPDCH	E-DCH Dedicated Physical Data Channel
E-HICH	E-DCH Hybrid ARQ Indicator Channel
E-RGCH	E-DCH Relative Grant Channel
FACH	Forward Access Channel
FBI	Feedback Information
F-DPCH	Fractional Dedicated Physical Channel
FSW	Frame Synchronization Word
HS-DPCCH	Dedicated Physical Control Channel (uplink) for HS-DSCH
HS-DSCH	High Speed Downlink Shared Channel
HS-PDSCH	High Speed Physical Downlink Shared Channel
HS-SCCH	Shared Control Channel for HS-DSCH
ICH	Indicator Channel
MICH	MBMS Indicator Channel
MUI	Mobile User Identifier
NI	MBMS Notification Indicator
PCH	Paging Channel
P-CCPCH	Primary Common Control Physical Channel
PCPCH	Physical Common Packet Channel

PDSCH Physical Downlink Shared Channel

5.3 Downlink physical channels

5.3.1 Downlink transmit diversity

Table 10 summarises the possible application of open and closed loop transmit diversity modes on different downlink physical channel types. Simultaneous use of STTD and closed loop modes on the same physical channel is not allowed. In addition, if Tx diversity is applied on any of the downlink physical channels it shall also be applied on P-CCPCH and SCH. Regarding CPICH transmission in case of transmit diversity, see subclause 5.3.3.1.

With respect to the usage of Tx diversity for DPCH on different radio links within an active set, the following rules apply:

- Different Tx diversity modes (STTD and closed loop) shall not be used on the radio links within one active set.
- No Tx diversity on one or more radio links shall not prevent UTRAN to use Tx diversity on other radio links within the same active set.
- If STTD is activated on one or several radio links in the active set, the UE shall operate STTD on only those radio links where STTD has been activated. Higher layers inform the UE about the usage of STTD on the individual radio links in the active set.
- If closed loop TX diversity is activated on one or several radio links in the active set, the UE shall operate closed loop TX diversity on only those radio links where closed loop TX diversity has been activated. Higher layers inform the UE about the usage of closed loop TX diversity on the individual radio links in the active set.

Furthermore, the transmit diversity mode used for a PDSCH frame shall be the same as the transmit diversity mode used for the DPCH associated with this PDSCH frame. The transmit diversity mode on the associated DPCH may not change during a PDSCH frame and within the slot prior to the PDSCH frame. This includes any change between no Tx diversity, open loop, closed loop mode 1 or closed loop mode 2.

Also, if a DPCH is associated with an HS-PDSCH subframe, the transmit diversity mode used for ~~a~~ the HS-PDSCH subframe shall be the same as the transmit diversity mode used for the DPCH associated with this HS-PDSCH subframe. If a F-DPCH is associated with an HS-PDSCH subframe, the transmit diversity mode used for the HS-PDSCH subframe shall be the same as the transmit diversity mode signalled for the F-DPCH associated with this HS-PDSCH subframe. If the DPCH associated with an HS-SCCH subframe is using either open or closed loop transmit diversity on the radio link transmitted from the HS-DSCH serving cell, the HS-SCCH subframe from this cell shall be transmitted using STTD, otherwise no transmit diversity shall be used for this HS-SCCH subframe. If a F-DPCH for which STTD is signalled is associated with an HS-SCCH subframe, the HS-SCCH subframe shall be transmitted using STTD, otherwise no transmit diversity shall be used for this HS-SCCH subframe. The transmit diversity mode on the associated DPCH or F-DPCH may not change during a HS-SCCH and or HS-PDSCH subframe and within the slot prior to the HS-SCCH subframe. This includes any change between no Tx diversity and either open loop or closed loop mode.

If the UE is receiving a DPCH on which transmit diversity is used from a cell, or if the UE is receiving a F-DPCH for which STTD is signalled from a cell, the UE shall assume that the E-AGCH, E-RGCH, and E-HICH from the same cell are transmitted using STTD.

Table 10: Application of Tx diversity modes on downlink physical channel types "X" – can be applied, "–" – not applied

Physical channel type	Open loop mode		Closed loop mode	
	TSTD	STTD	Mode 1	Mode 2
P-CCPCH	–	X	–	–
SCH	X	–	–	–
S-CCPCH	–	X	–	–
DPCH	–	X	X	X
F-DPCH	–	X	–	–
PICH	–	X	–	–
MICH	–	X	–	–
PDSCH	–	X	X	X
HS-PDSCH	–	X	X	–
HS-SCCH	–	X	–	–
E-AGCH	–	X	–	–
E_RGCH	–	X	–	–
E-HICH	–	X	–	–
AICH	–	X	–	–
CSICH	–	X	–	–
AP-AICH	–	X	–	–
CD/CA-ICH	–	X	–	–
DL-DPCCH for CPCH	–	X	X	X

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 optional in UTRAN. STTD support is mandatory at the UE.

If higher layers signal that neither P-CPICH nor S-CPICH can be used as phase reference for the downlink DPCH for a radio link in a cell, the UE shall assume that STTD is not used for the downlink DPCH (and the associated PDSCH if applicable) in that cell.

A block diagram of a generic STTD encoder is shown in the figure 8 and figure 8A below. Channel coding, rate matching and interleaving are done as in the non-diversity mode. For QPSK, the STTD encoder operates on 4 symbols b_0, b_1, b_2, b_3 as shown in figure 8. For AICH, E-RGCH, E-HICH, AP-AICH and CD/CA-ICH, the b_i are real valued signals, and $\bar{b}_i$ is defined as $-b_i$. For channels other than AICH, E-RGCH, E-HICH, AP-AICH and CD/CA-ICH, the b_i are 3-valued digits, taking the values 0, 1, "DTX", and $\bar{b}_i$ is defined as follows: if b_i = 0 then $\bar{b}_i$ = 1, if b_i = 1 then $\bar{b}_i$ = 0, otherwise $\bar{b}_i$ = b_i.

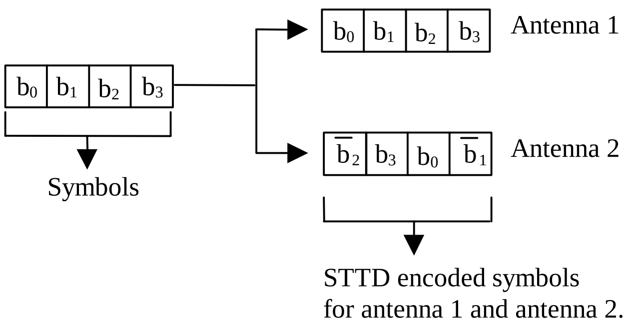


Figure 8: Generic block diagram of the STTD encoder for QPSK

For 16QAM, STTD operates on blocks of 8 consecutive symbols b_0, b_1, b_2, b_3, b_4, b_5, b_6, b_7 as shown in figure 8A below.

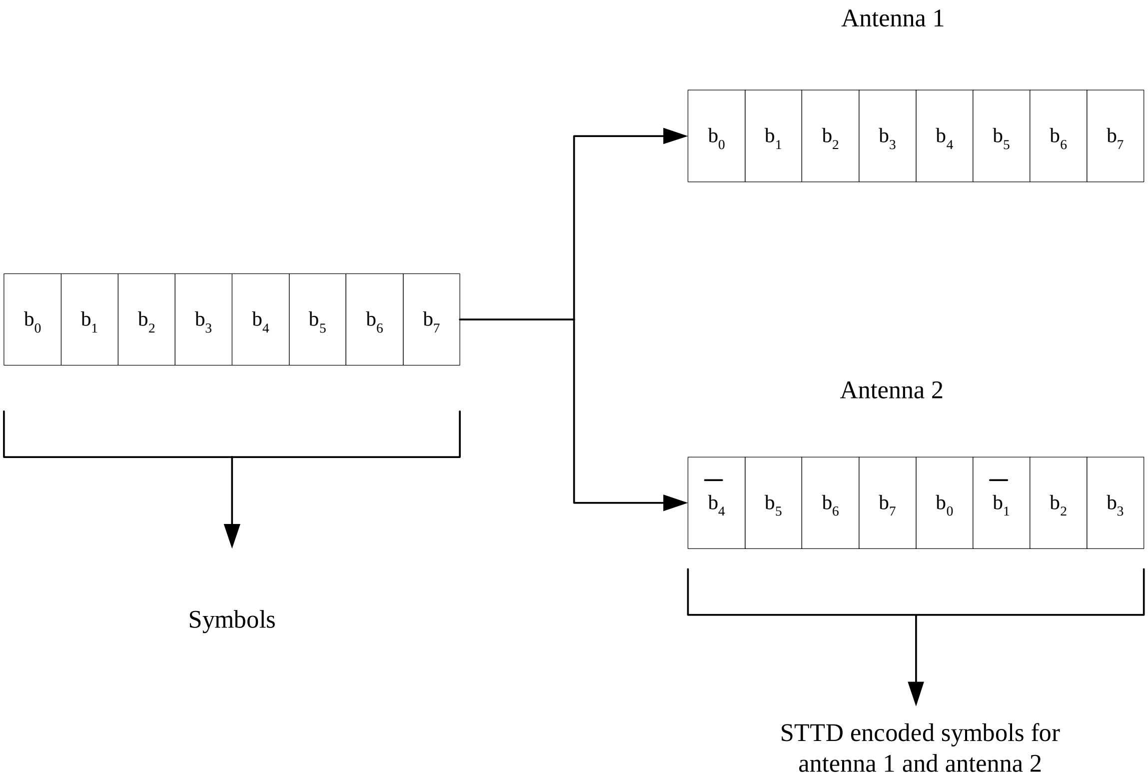


Figure 8A: Generic block diagram of the STTD encoder for 16QAM

5.3.1.1.2 Time Switched Transmit Diversity for SCH (TSTD)

Transmit diversity, in the form of Time Switched Transmit Diversity (TSTD), can be applied to the SCH. TSTD for the SCH is optional in UTRAN, while TSTD support is mandatory in the UE. TSTD for the SCH is described in subclause 5.3.3.5.1.

5.3.1.2 Closed loop transmit diversity

Closed loop transmit diversity is described in [5]. Both closed loop transmit diversity modes shall be supported at the UE and may be supported in the UTRAN.

5.3.2 Dedicated downlink physical channels

There are ~~three~~ four types of downlink dedicated physical channels, the Downlink Dedicated Physical Channel (downlink DPCH), the Fractional Dedicated Physical Channel (F-DPCH), the E-DCH Relative Grant Channel (E-RGCH), and the E-DCH Hybrid ARQ Indicator Channel (E-HICH).

The F-DPCH is described in subclause 5.3.2.6.

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 subclause 5.2.1.

Figure 9 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.

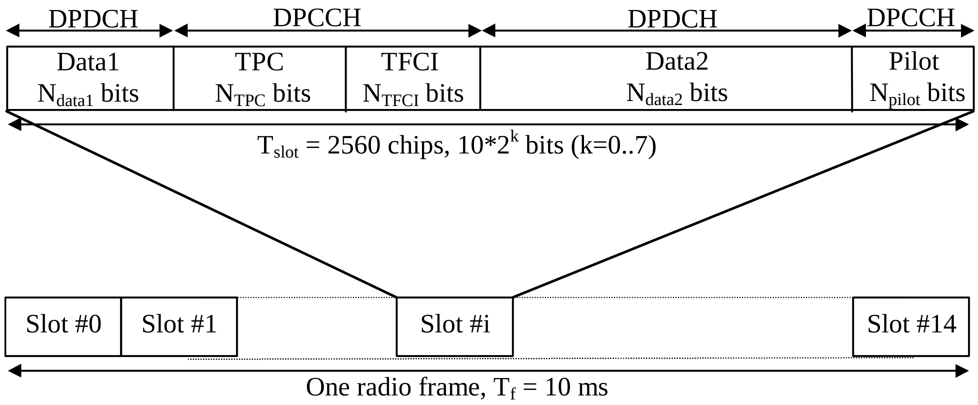


Figure 9: Frame structure for downlink DPCH

The parameter k in figure 9 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 given in table 11. What slot format to use is configured by higher layers and can also be reconfigured by higher layers.

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 11. It is the UTRAN that determines if a TFCI should be transmitted and it is mandatory for all UEs to support the use of TFCI in the downlink. The mapping of TFCI bits onto slots is described in [3].

In compressed frames, a different slot format is used compared to normal mode. There are two possible compressed slot formats that are labelled A and B. Slot format B shall be used in frames compressed by spreading factor reduction and slot format A shall be used in frames compressed by puncturing or higher layer scheduling. The channel bit and symbol rates given in table 11 are the rates immediately before spreading.

Table 11: DPDCH and DPCCH fields

Slot Format #i	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/ Slot	DPDCH Bits/Slot		DPCCH Bits/Slot			Transmitted slots per radio frame N_{Tr}
					N_{Data1}	N_{Data2}	N_{TPC}	N_{TFCI}	N_{Pilot}	
0	15	7.5	512	10	0	4	2	0	4	15
0A	15	7.5	512	10	0	4	2	0	4	8-14
0B	30	15	256	20	0	8	4	0	8	8-14
1	15	7.5	512	10	0	2	2	2	4	15
1B	30	15	256	20	0	4	4	4	8	8-14
2	30	15	256	20	2	14	2	0	2	15
2A	30	15	256	20	2	14	2	0	2	8-14
2B	60	30	128	40	4	28	4	0	4	8-14
3	30	15	256	20	2	12	2	2	2	15
3A	30	15	256	20	2	10	2	4	2	8-14
3B	60	30	128	40	4	24	4	4	4	8-14
4	30	15	256	20	2	12	2	0	4	15
4A	30	15	256	20	2	12	2	0	4	8-14
4B	60	30	128	40	4	24	4	0	8	8-14
5	30	15	256	20	2	10	2	2	4	15
5A	30	15	256	20	2	8	2	4	4	8-14
5B	60	30	128	40	4	20	4	4	8	8-14
6	30	15	256	20	2	8	2	0	8	15
6A	30	15	256	20	2	8	2	0	8	8-14
6B	60	30	128	40	4	16	4	0	16	8-14
7	30	15	256	20	2	6	2	2	8	15
7A	30	15	256	20	2	4	2	4	8	8-14
7B	60	30	128	40	4	12	4	4	16	8-14
8	60	30	128	40	6	28	2	0	4	15
8A	60	30	128	40	6	28	2	0	4	8-14
8B	120	60	64	80	12	56	4	0	8	8-14
9	60	30	128	40	6	26	2	2	4	15
9A	60	30	128	40	6	24	2	4	4	8-14
9B	120	60	64	80	12	52	4	4	8	8-14
10	60	30	128	40	6	24	2	0	8	15
10A	60	30	128	40	6	24	2	0	8	8-14
10B	120	60	64	80	12	48	4	0	16	8-14
11	60	30	128	40	6	22	2	2	8	15
11A	60	30	128	40	6	20	2	4	8	8-14
11B	120	60	64	80	12	44	4	4	16	8-14
12	120	60	64	80	12	48	4	8*	8	15
12A	120	60	64	80	12	40	4	16*	8	8-14
12B	240	120	32	160	24	96	8	16*	16	8-14
13	240	120	32	160	28	112	4	8*	8	15
13A	240	120	32	160	28	104	4	16*	8	8-14
13B	480	240	16	320	56	224	8	16*	16	8-14
14	480	240	16	320	56	232	8	8*	16	15
14A	480	240	16	320	56	224	8	16*	16	8-14
14B	960	480	8	640	112	464	16	16*	32	8-14
15	960	480	8	640	120	488	8	8*	16	15
15A	960	480	8	640	120	480	8	16*	16	8-14
15B	1920	960	4	1280	240	976	16	16*	32	8-14
16	1920	960	4	1280	248	1000	8	8*	16	15
16A	1920	960	4	1280	248	992	8	16*	16	8-14

* If TFCI bits are not used, then DTX shall be used in TFCI field.

NOTE 1: Compressed mode is only supported through spreading factor reduction for SF=512 with TFCI.

NOTE 2: Compressed mode by spreading factor reduction is not supported for SF=4.

NOTE 3: If the Node B receives an invalid combination of data frames for downlink transmission, the procedure specified in [15], sub-clause 5.1.2,may require the use of DTX in both the DPDCH and theTFCI field of the DPCCH.

The pilot bit patterns are described in table 12. The shadowed column part of pilot bit pattern is defined as FSW and FSWs can be used to confirm frame synchronization. (The value of the pilot bit pattern other than FSWs shall be "11".) In table 12, the transmission order is from left to right.

In downlink compressed mode through spreading factor reduction, the number of bits in the TPC and Pilot fields are doubled. Symbol repetition is used to fill up the fields. Denote the bits in one of these fields in normal mode by x_1, x_2, x_3, …, x_X. In compressed mode the following bit sequence is sent in corresponding field: x_1, x_2, x_1, x_2, x_3, x_4, x_3, x_4,…, x_X,.

Table 12: Pilot bit patterns for downlink DPCCH with N_{pilot} = 2, 4, 8 and 16

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

NOTE *1: This pattern is used except slot formats 2B and 3B.
NOTE *2: This pattern is used except slot formats 0B, 1B, 4B, 5B, 8B, and 9B.
NOTE *3: This pattern is used except slot formats 6B, 7B, 10B, 11B, 12B, and 13B.
NOTE: For slot format *n*B where *n* = 0, …, 15, the pilot bit pattern corresponding to N_{pilot}/2 is to be used and symbol repetition shall be applied.

The relationship between the TPC symbol and the transmitter power control command is presented in table 13.

Table 13: 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

Multicode transmission may be employed in the downlink, i.e. the CCTrCH (see [3]) is mapped onto several parallel downlink DPCHs using the same spreading factor. In this case, the Layer 1 control information is transmitted only on the first downlink DPCH. DTX bits are transmitted during the corresponding time period for the additional downlink DPCHs, see figure 10.

In case there are several CCTrCHs mapped to different DPCHs transmitted to the same UE different spreading factors can be used on DPCHs to which different CCTrCHs are mapped. Also in this case, Layer 1 control information is only transmitted on the first DPCH while DTX bits are transmitted during the corresponding time period for the additional DPCHs.

Note : support of multiple CCTrChs of dedicated type is not part of the current release.

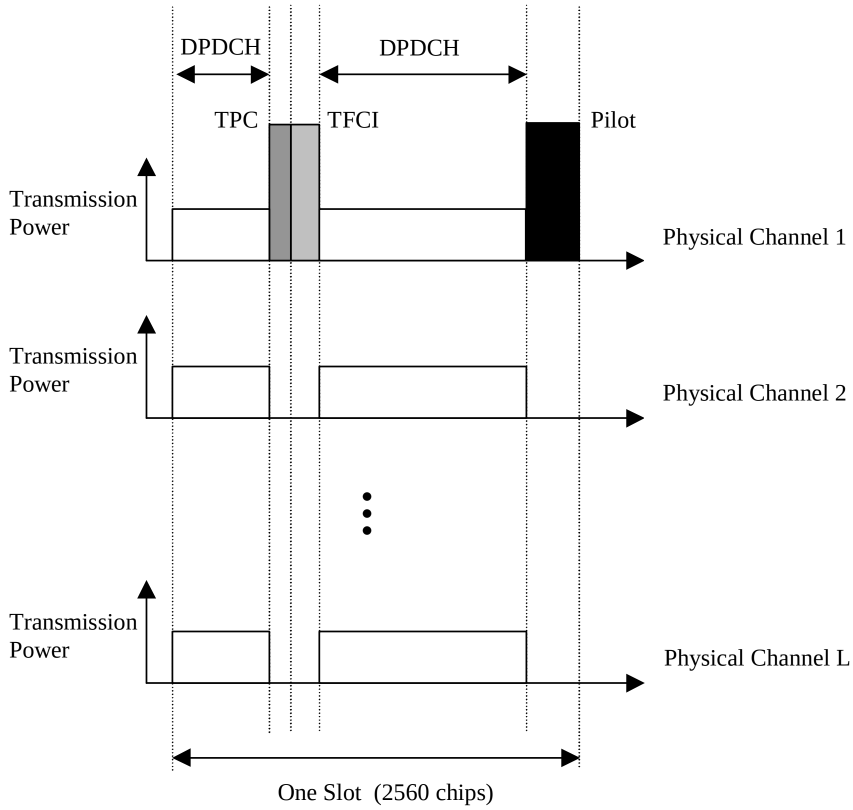


Figure 10: Downlink slot format in case of multi-code transmission

5.3.2.1 STTD for DPCH and F-DPCH

The pilot bit pattern for the DPCH channel transmitted on antenna 2 is given in table 14.

- For N_{pilot} = 8, 16 the shadowed part indicates pilot bits that are obtained by STTD encoding the corresponding (shadowed) bits in Table 12. The non-shadowed pilot bit pattern is orthogonal to the corresponding (non-shadowed) pilot bit pattern in table 12.

- For N_{pilot} = 4, the diversity antenna pilot bit pattern is obtained by STTD encoding both the shadowed and non-shadowed pilot bits in table 12.

- For N_{pilot} = 2, the diversity antenna pilot pattern is obtained by STTD encoding the two pilot bits in table 12 with the last two bits (data or DTX) of the second data field (data2) of the slot. Thus for N_{pilot} = 2 case, the last two bits of the second data field (data 2) after STTD encoding, follow the diversity antenna pilot bits in Table 14.

STTD encoding for the DPDCH, TPC, and TFCI fields is done as described in subclause 5.3.1.1.1. For the SF=512 DPCH, the first two bits in each slot, i.e. TPC bits, are not STTD encoded and the same bits are transmitted with equal power from the two antennas. The remaining four bits are STTD encoded.

For F-DPCH, the TPC bits are not STTD encoded and the same bits are transmitted with equal power from the two antennas.

For compressed mode through spreading factor reduction and for N_{pilot} > 4, symbol repetition shall be applied to the pilot bit patterns of table 14, in the same manner as described in 5.3.2. For slot formats 2B and 3B, i.e. compressed mode through spreading factor reduction and N_{pilot} = 4, the pilot bits transmitted on antenna 2 are STTD encoded, and thus the pilot bit pattern is as shown in the most right set of table 14.

Table 14: Pilot bit patterns of downlink DPCCH for antenna 2 using STTD

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

NOTE *1: The pilot bits precede the last two bits of the data2 field.
NOTE *2: This pattern is used except slot formats 2B and 3B.
NOTE *3: This pattern is used except slot formats 0B, 1B, 4B, 5B, 8B, and 9B.
NOTE *4: This pattern is used except slot formats 6B, 7B, 10B, 11B, 12B, and 13B.
NOTE *5: This pattern is used for slot formats 2B and 3B.
NOTE: For slot format *n*B where n = 0, 1, 4, 5, 6, …, 15, the pilot bit pattern corresponding to $N_{pilot}/2$ is to be used and symbol repetition shall be applied.

5.3.2.6 Fractional Dedicated Physical Channel (F-DPCH)

The F-DPCH carries control information generated at layer 1 (TPC commands). It is a special case of downlink DPCCH.

Figure 12B shows the frame structure of the F-DPCH. Each frame of length 10ms is split into 15 slots, each of length T_{slot} = 2560 chips, corresponding to one power-control period.

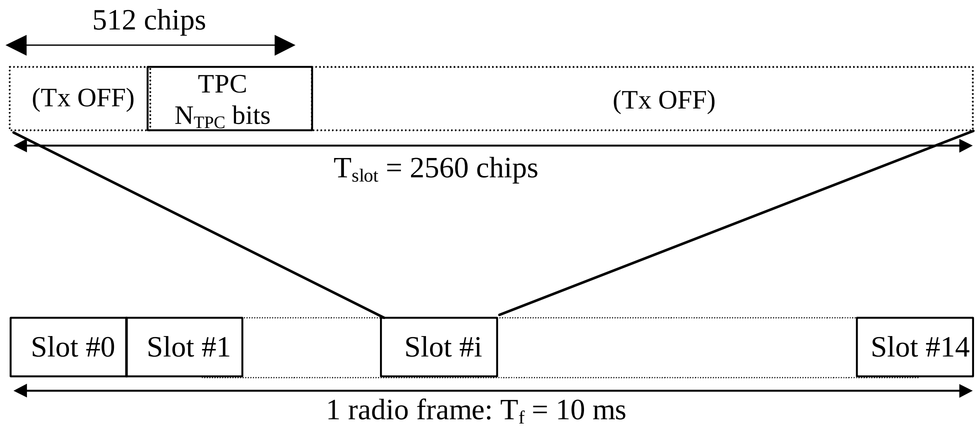


Figure 12B: Frame structure for F-DPCH

The exact number of bits of the F-DPCH fields (N_{TPC}) is described in table 16B.

Table 16B: F-DPCH fields

Slot Format #i	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/ Slot	F-DPCH Bits/Slot
					N_{TPC}
0	3	1.5	256	2	2

In compressed frames, F-DPCH is not transmitted in downlink transmission gaps given by transmission gap pattern sequences signalled by higher layers.

The relationship between the TPC symbol and the transmitter power control command is according to table 13.

5.3.3 Common downlink physical channels

5.3.3.1 Common Pilot Channel (CPICH)

The CPICH is a fixed rate (30 kbps, SF=256) downlink physical channel that carries a pre-defined bit sequence. Figure 13 shows the frame structure of the CPICH.

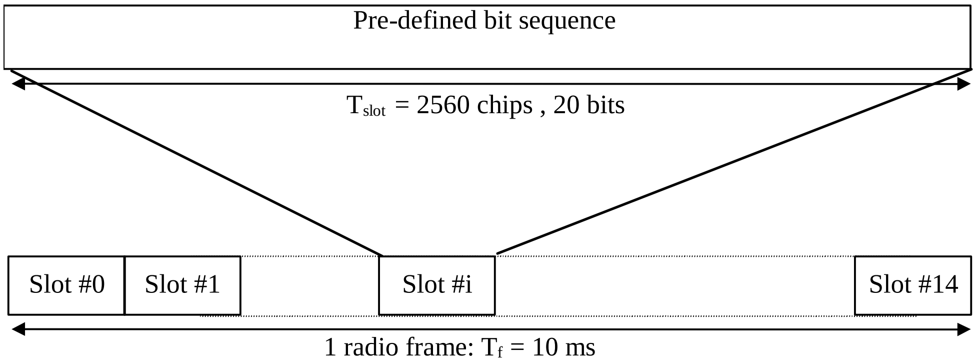


Figure 13: Frame structure for Common Pilot Channel

In case transmit diversity (open or closed loop) is used on any downlink channel in the cell, the CPICH shall be transmitted from both antennas using the same channelization and scrambling code. In this case, the pre-defined bit sequence of the CPICH is different for Antenna 1 and Antenna 2, see figure 14. In case of no transmit diversity, the bit sequence of Antenna 1 in figure 14 is used.

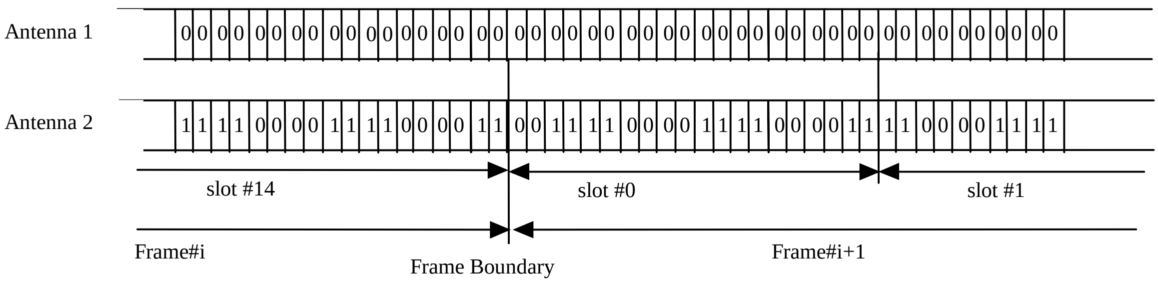


Figure 14: Modulation pattern for Common Pilot Channel

There are two types of Common pilot channels, the Primary and Secondary CPICH. They differ in their use and the limitations placed on their physical features.

5.3.3.1.1 Primary Common Pilot Channel (P-CPICH)

The Primary Common Pilot Channel (P-CPICH) has the following characteristics:

- The same channelization code is always used for the P-CPICH, see [4];
- The P-CPICH is scrambled by the primary scrambling code, see [4];
- There is one and only one P-CPICH per cell;
- The P-CPICH is broadcast over the entire cell.

The Primary CPICH is a phase reference for the following downlink channels: SCH, Primary CCPCH, AICH, PICH AP-AICH, CD/CA-ICH, CSICH, DL-DPCCH for CPCH and the S-CCPCH. By default, the Primary CPICH is also a phase reference for downlink DPCH or F-DPCH and any associated PDSCH, HS-PDSCH and HS-SCCH. The UE is informed by higher layer signalling if the P-CPICH is not a phase reference for a downlink DPCH or F-DPCH and any associated PDSCH, HS-PDSCH and HS-SCCH.

5.3.3.1.2 Secondary Common Pilot Channel (S-CPICH)

A Secondary Common Pilot Channel (S-CPICH) has the following characteristics:

- An arbitrary channelization code of SF=256 is used for the S-CPICH, see [4];
- A S-CPICH is scrambled by either the primary or a secondary scrambling code, see [4];
- There may be zero, one, or several S-CPICH per cell;

- A S-CPICH may be transmitted over the entire cell or only over a part of the cell;

A Secondary CPICH may be a phase reference for a downlink DPCH or F-DPCH. If this is the case, the UE is informed about this by higher-layer signalling.

The Secondary CPICH can be a phase reference for a downlink physical channel using open loop or closed loop TX diversity, instead of the Primary CPICH being a phase reference.

Note that it is possible that neither the P-CPICH nor any S-CPICH is a phase reference for a downlink DPCH.

5.3.3.2 Downlink phase reference

Table 17 summarizes the possible phase references usable on different downlink physical channel types.

Table 17: Application of phase references on downlink physical channel types "X" – can be applied, "–" – not applied

Physical channel type	Primary-CPICH	Secondary-CPICH	Dedicated pilot
P-CCPCH	X	–	–
SCH	X	–	–
S-CCPCH	X	–	–
DPCH	X	X	X
F-DPCH	X	X	–
PICH	X	–	–
MICH	X	–	–
PDSCH*	X	X	X
HS-PDSCH*	X	X	X
HS-SCCH*	X	X	X
E-AGCH*	X	X	X
E-RGCH*	X	X	X
E-HICH*	X	X	X
AICH	X	–	–
CSICH	X	–	–
DL-DPCCH for CPCH	X	–	–

Note *: The same phase reference as with the associated DPCH or F-DPCH shall be used. The support for dedicated pilots as phase reference for HS-PDSCH, HS-SCCH, E-AGCH, E-RGCH and E-HICH is optional for the UE.

Furthermore, during a PDSCH frame, and within the slot prior to that PDSCH frame, the phase reference on the associated DPCH shall not change. During a DPCH or F-DPCH frame overlapping with any part of an associated HS-DSCH or HS-SCCH subframe, the phase reference on this DPCH or F-DPCH shall not change.

6 Mapping and association of physical channels

6.1 Mapping of transport channels onto physical channels

Figure 27 summarises the mapping of transport channels onto physical channels.

Transport Channels	**Physical Channels**
DCH	Dedicated Physical Data Channel (DPDCH)
	Dedicated Physical Control Channel (DPCCH)
E-DCH	E-DCH Dedicated Physical Data Channel (E-DPDCH)
	E-DCH Dedicated Physical Control Channel (E-DPCCH)
	E-DCH Absolute Grant Channel (E-AGCH)
	E-DCH Relative Grant Channel (E-RGCH)
	E-DCH Hybrid ARQ Indicator Channel (E-HICH)
RACH	Physical Random Access Channel (PRACH)
CPCH	Physical Common Packet Channel (PCPCH)
	Common Pilot Channel (CPICH)
BCH	Primary Common Control Physical Channel (P-CCPCH)
~~FACH~~	~~Secondary Common Control Physical Channel (S-CCPCH)~~
PCH	
	Synchronisation Channel (SCH)
DSCH	Physical Downlink Shared Channel (PDSCH)
	Acquisition Indicator Channel (AICH)
	Access Preamble Acquisition Indicator Channel (AP-AICH)
	Paging Indicator Channel (PICH)
	MBMS Notification Indicator Channel (MICH)
	CPCH Status Indicator Channel (CSICH)
	Collision-Detection/Channel-Assignment Indicator Channel (CD/CA-ICH)
HS-DSCH	High Speed Physical Downlink Shared Channel (HS-PDSCH)
	HS-DSCH-related Shared Control Channel (HS-SCCH)
	Dedicated Physical Control Channel (uplink) for HS-DSCH (HS-DPCCH)

ransport Channels	Physical Channels
CH	Dedicated Physical Data Channel (DPDCH)
	Dedicated Physical Control Channel (DPCCH)
	Fractional Dedicated Physical Channel (F-DPCH)
-DCH	E-DCH Dedicated Physical Data Channel (E-DPDCH)
	E-DCH Dedicated Physical Control Channel (E-DPCCH)
	E-DCH Absolute Grant Channel (E-AGCH)
	E-DCH Relative Grant Channel (E-RGCH)
	E-DCH Hybrid ARQ Indicator Channel (E-HICH)
ACH	Physical Random Access Channel (PRACH)
PCH	Physical Common Packet Channel (PCPCH)
	Common Pilot Channel (CPICH)
CH	Primary Common Control Physical Channel (P-CCPCH)
ACH	Secondary Common Control Physical Channel (S-CCPCH)
CH	
	Synchronisation Channel (SCH)
SCH	Physical Downlink Shared Channel (PDSCH)
	Acquisition Indicator Channel (AICH)
	Access Preamble Acquisition Indicator Channel (AP-AICH)
	Paging Indicator Channel (PICH)
	MBMS Notification Indicator Channel (MICH)
	CPCH Status Indicator Channel (CSICH)
	Collision-Detection/Channel-Assignment Indicator Channel (CD/CA-ICH)
S-DSCH	High Speed Physical Downlink Shared Channel (HS-PDSCH)
	HS-DSCH-related Shared Control Channel (HS-SCCH)
	Dedicated Physical Control Channel (uplink) for HS-DSCH (HS-DPCCH)

Figure 27: 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 PRACH. The E-DCH is coded as described in [3], and the resulting data stream is mapped sequentially (first-in-first-mapped) directly to the physical channel(s).

6.2 Association of physical channels and physical signals

Figure 28 illustrates the association between physical channels and physical signals.

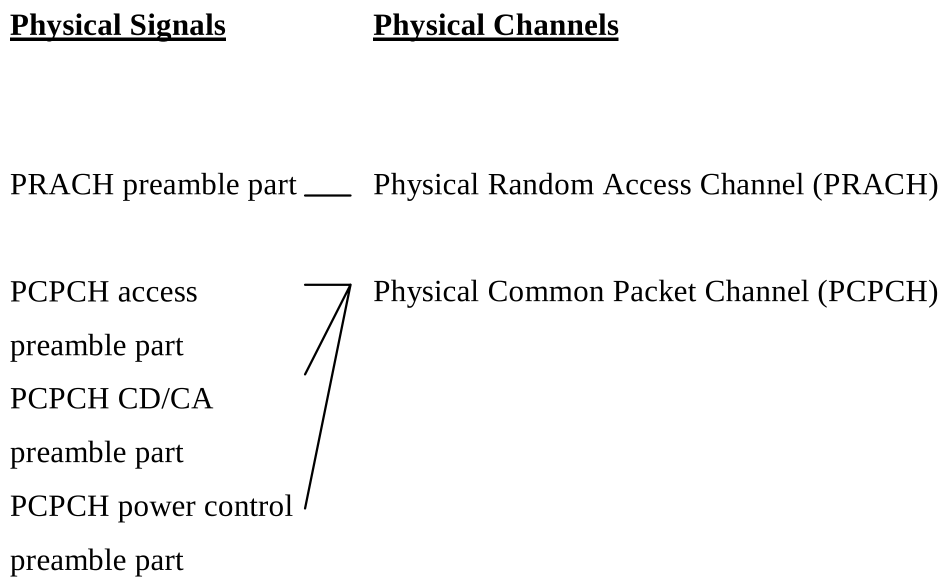


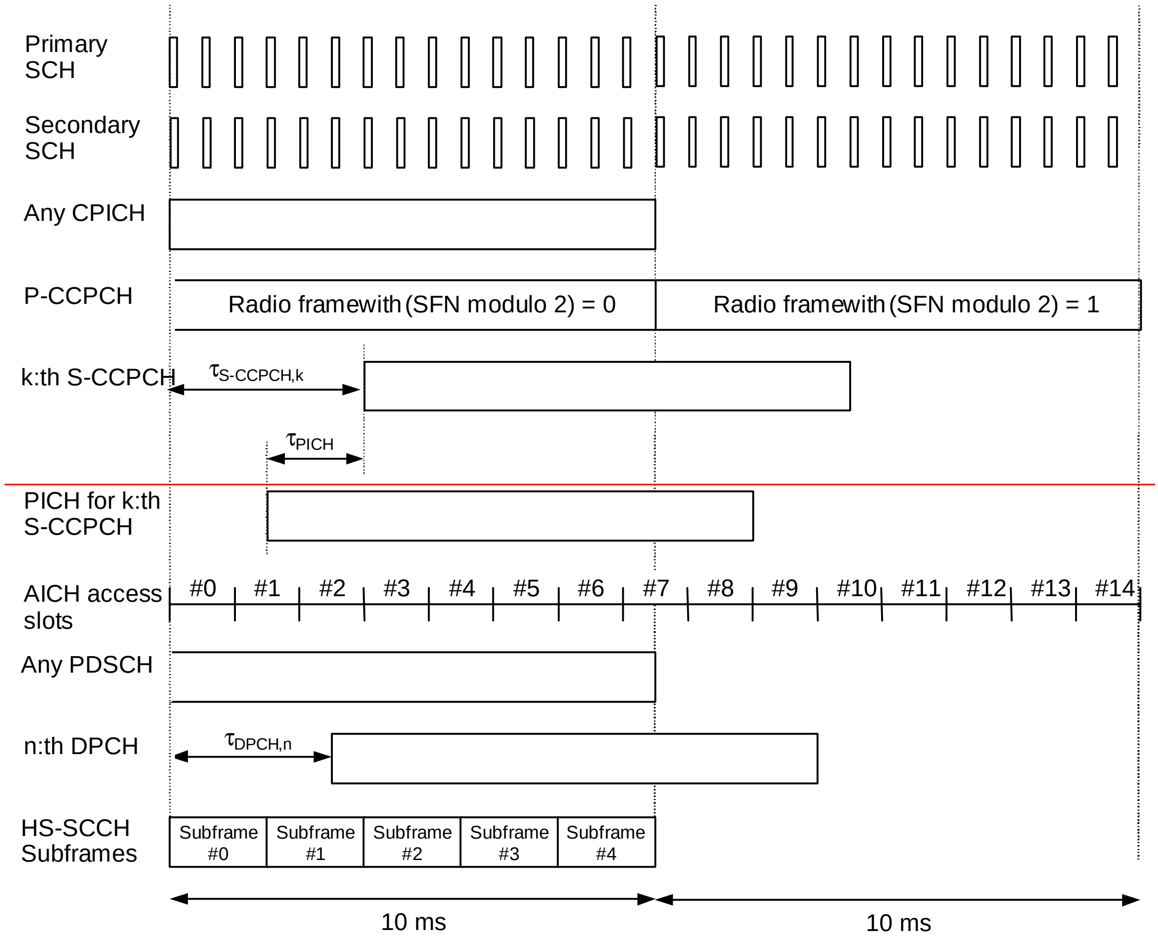
Figure 28: Physical channel and physical signal association

7 Timing relationship between physical channels

7.1 General

The P-CCPCH, on which the cell SFN is transmitted, is used as timing reference for all the physical channels, directly for downlink and indirectly for uplink.

Figure 29 below describes the frame timing of the downlink physical channels. For the AICH the access slot timing is included. Transmission timing for uplink physical channels is given by the received timing of downlink physical channels, as described in the following subclauses.


Primary SCH
Secondary SCH
Any CPICH
P-CCPCH
Radio frame with (SFN modulo 2) = 0
Radio frame with (SFN modulo 2) = 1
k:th S-CCPCH
τS-CCPCH,k
τPICH
PICH for k:th S-CCPCH
AICH access slots
#0 #1 #2 #3 #4 #5 #6 #7 #8 #9 #10 #11 #12 #13 #14
Any PDSCH
n:th DPCH
τDPCH,n
HS-SCCH Subframes
Subframe #0
Subframe #1
Subframe #2
Subframe #3
Subframe #4
10 ms
10 ms

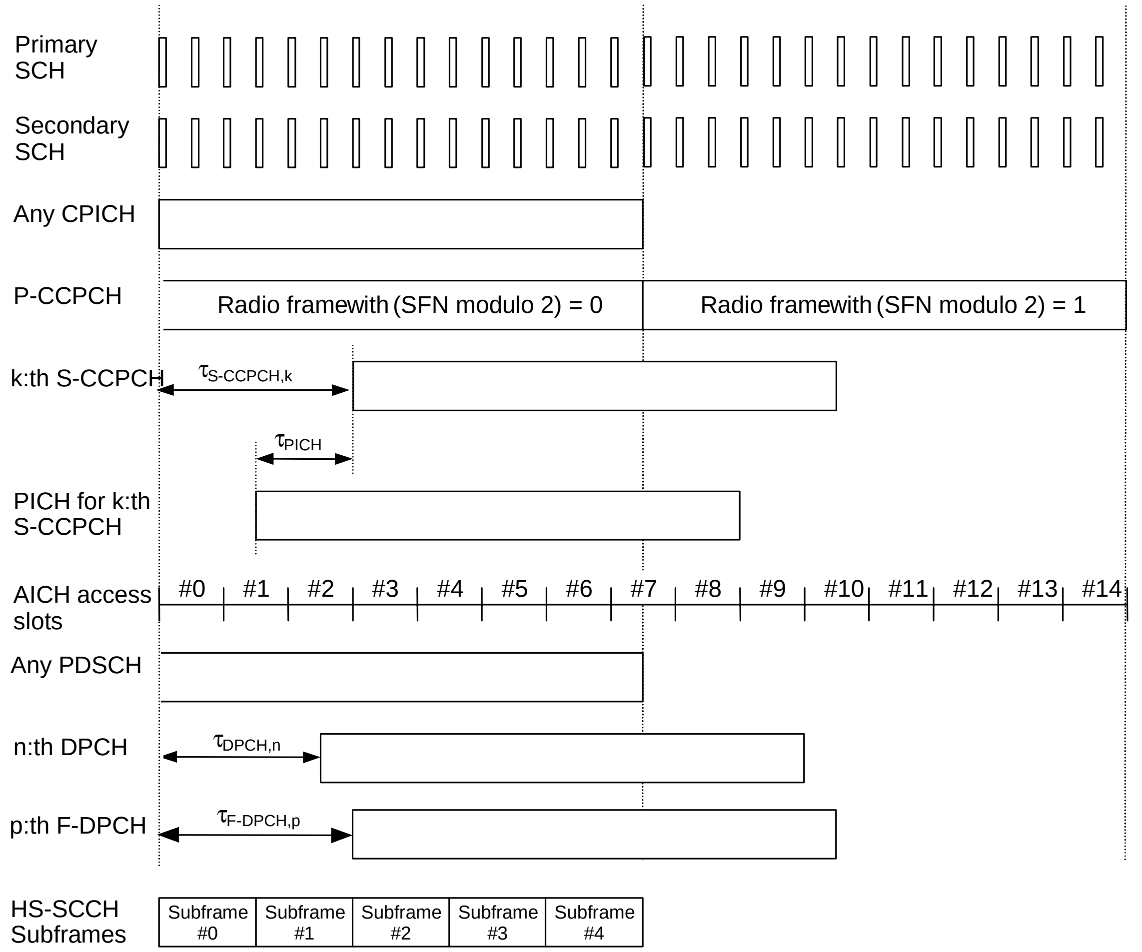


Figure 29: Radio frame timing and access slot timing of downlink physical channels

The following applies:

- SCH (primary and secondary), CPICH (primary and secondary), P-CCPCH, and PDSCH have identical frame timings.
- The S-CCPCH timing may be different for different S-CCPCHs, but the offset from the P-CCPCH frame timing is a multiple of 256 chips, i.e. $\tau_{S\text{-}CCPCH,k} = T_k \times 256$ chip, $T_k \in \{0, 1, \ldots, 149\}$.
- The PICH timing is $\tau_{PICH} = 7680$ chips prior to its corresponding S-CCPCH frame timing, i.e. the timing of the S-CCPCH carrying the PCH transport channel with the corresponding paging information, see also subclause 7.2.
- AICH access slots #0 starts the same time as P-CCPCH frames with (SFN modulo 2) = 0. The AICH/PRACH and AICH/PCPCH timing is described in subclauses 7.3 and 7.4 respectively.
- The relative timing of associated PDSCH and DPCH is described in subclause 7.5.
- The DPCH timing may be different for different DPCHs, but the offset from the P-CCPCH frame timing is a multiple of 256 chips, i.e. $\tau_{DPCH,n} = T_n \times 256$ chip, $T_n \in \{0, 1, \ldots, 149\}$. The DPCH (DPCCH/DPDCH) timing relation with uplink DPCCH/DPDCHs is described in subclause 7.6.
- The F-DPCH timing may be different for different F-DPCHs, but the offset from the P-CCPCH frame timing is a multiple of 256 chips, i.e. $\tau_{F\text{-}DPCH,p} = T_p \times 256$ chip, $T_p \in \{0, 1, \ldots, 149\}$. The F-DPCH timing relation with uplink DPCCH/DPDCHs is described in subclause 7.6.
- The start of HS-SCCH subframe #0 is aligned with the start of the P-CCPCH frames. The relative timing between a HS-PDSCH and the corresponding HS-SCCH is described in subclause 7.8.

- The E-DPCCH and all E-DPDCHs transmitted from one UE have the same frame timing as the DPCCH.

7.6 DPCCH/DPDCH timing relations

7.6.1 Uplink

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

7.6.2 Downlink

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

Note: support of multiple CCTrChs of dedicated type is not part of the current release.

7.6.3 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 detected path (in time) of the corresponding downlink DPCCH/DPDCH or F-DPCH frame. T_0 is a constant defined to be 1024 chips. The first detected path (in time) is defined implicitly by the relevant tests in [14]. More information about the uplink/downlink timing relation and meaning of T_0 can be found in [5].

7.7 Uplink DPCCH/HS-DPCCH/HS-PDSCH timing at the UE

Figure 34 shows the timing offset between the uplink DPCH, the HS-PDSCH and the HS-DPCCH at the UE. An HS-DPCCH sub-frame starts $m \times 256$ chips after the start of an uplink DPCH frame that corresponds to the DL DPCH or F-DPCH frame from the HS-DSCH serving cell containing the beginning of the related HS-PDSCH subframe with *m* calculated as

$m = (T_{TX\_diff} / 256) + 101$

where T_{TX_diff} is the difference in chips (T_{TX_diff} =0, 256, ..., 38144), between

- the transmit timing of the start of the related HS-PDSCH subframe (see sub-clauses 7.8 and 7.1)

and

- the transmit timing of the start of the downlink DPCH or F-DPCH frame from the HS-DSCH serving cell that contains the beginning of the HS-PDSCH subframe (see sub-clause 7.1).

At any one time, *m* therefore takes one of a set of five possible values according to the transmission timing of HS-DSCH sub-frame timings relative to the DPCH or F-DPCH frame boundary. The UE and Node B shall only update the set of values of *m* in connection to UTRAN reconfiguration of downlink timing.

More information about uplink timing adjustments can be found in [5].

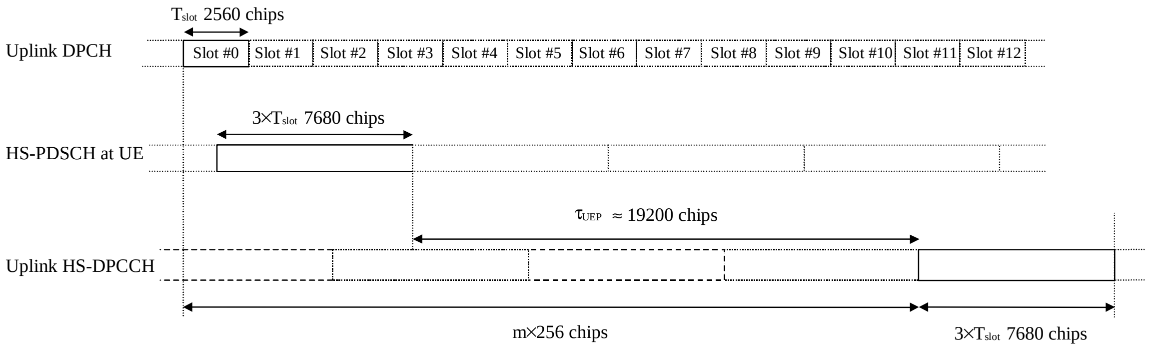


Figure 34: Timing structure at the UE for HS-DPCCH control signalling

3GPP TSG-RAN WG1 Meeting #40
Scottsdale, USA, Feb 14th- 18th

Tdoc R1-050080 ⌘

CR-Form-v7

CHANGE REQUEST

⌘	**25.212**	**CR**	**193**	⌘ **rev**	**1**	⌘	Current version:	**6.3.0** ⌘

*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:	⌘	Introduction of F-DPCH		
Source:	⌘	RAN WG1		
Work item code:	⌘	RANimp-RABSE-CodeOptFDD	***Date:*** ⌘	07/02/2005
Category:	⌘	**B** *Use <u>one</u> of the following categories:* ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.	***Release:*** ⌘	Rel-6 *Use <u>one</u> of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

Reason for change:	⌘	This CR introduces Fractional DPCH in the specifications
Summary of change:	⌘	A new section 4.4.2A is introduced to describe F-DPCH frame structure during compressed frames, other relevant sections are updated: - abbreviations - Compressed mode (transmission time reduction method, transmission gap position, idle lengths)
Consequences if not approved:	⌘	

Clauses affected:	⌘	3.3, 4.4.2A, 4.4.3, 4.4.4, Annex B				
		Y	**N**			
Other specs affected:	⌘	**Y**		Other core specifications	⌘	25.211, 25.213, 25.214, 25.215, 25.302, 25.331, 25.423, 25.433, 25.101, 25.133
				Test specifications		
				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.

3.3 Abbreviations

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

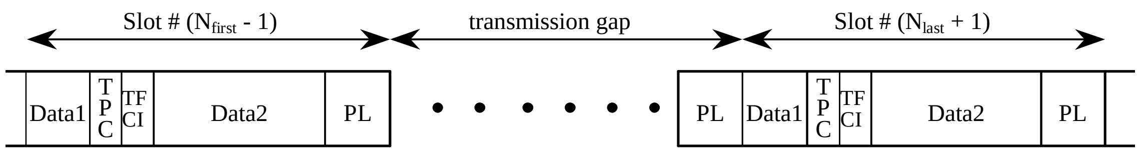
ARQ	Automatic Repeat Request
BCH	Broadcast Channel
BER	Bit Error Rate
BLER	Block Error Rate
BS	Base Station
CCPCH	Common Control Physical Channel
CCTrCH	Coded Composite Transport Channel
CFN	Connection Frame Number
CRC	Cyclic Redundancy Check
DCH	Dedicated Channel
DL	Downlink (Forward link)
DPCCH	Dedicated Physical Control Channel
DPCH	Dedicated Physical Channel
DPDCH	Dedicated Physical Data Channel
DS-CDMA	Direct-Sequence Code Division Multiple Access
DSCH	Downlink Shared Channel
DTX	Discontinuous Transmission
FACH	Forward Access Channel
E-AGCH	E-DCH Absolute Grant Channel
E-DCH	Enhanced Dedicated Channel
E-DPCCH	E-DCH Dedicated Physical Control Channel
E-DPDCH	E-DCH Dedicated Physical Data Channel
E-HICH	E-DCH Hybrid ARQ Indicator Channel
E-RGCH	E-DCH Relative Grant Channel
FDD	Frequency Division Duplex
F-DPCH	Fractional Dedicated Physical Channel
FER	Frame Error Rate
GF	Galois Field
HARQ	Hybrid Automatic Repeat reQuest
HS-DPCCH	Dedicated Physical Control Channel (uplink) for HS-DSCH
HS-DSCH	High Speed Downlink Shared Channel
HS-PDSCH	High Speed Physical Downlink Shared Channel
HS-SCCH	Shared Control Channel for HS-DSCH
MAC	Medium Access Control
Mcps	Mega Chip Per Second
MS	Mobile Station
OVSF	Orthogonal Variable Spreading Factor (codes)
PCCC	Parallel Concatenated Convolutional Code
PCH	Paging Channel
PhCH	Physical Channel
PRACH	Physical Random Access Channel
RACH	Random Access Channel
RSC	Recursive Systematic Convolutional Coder
RV	Redundancy Version
RX	Receive
SCH	Synchronisation Channel
SF	Spreading Factor
SFN	System Frame Number
SIR	Signal-to-Interference Ratio
SNR	Signal to Noise Ratio
TF	Transport Format
TFC	Transport Format Combination
TFCI	Transport Format Combination Indicator
TPC	Transmit Power Control
TrCH	Transport Channel
TTI	Transmission Time Interval
TX	Transmit

4.4.2 Frame structure types in the downlink

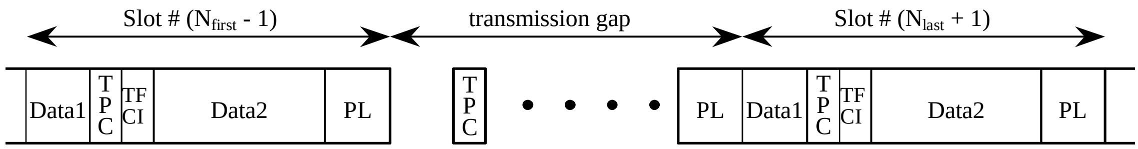
There are two different types of frame structures defined for downlink compressed frames. Type A maximises the transmission gap length and type B is optimised for power control. The frame structure type A or B is set by higher layers independent from the downlink slot format type A or B.

- With frame structure of type A, the pilot field of the last slot in the transmission gap is transmitted. Transmission is turned off during the rest of the transmission gap (figure 13(a)). In case the length of the pilot field is 2 bits and STTD is used on the radio link, the pilot bits in the last slot of the transmission gap shall be STTD encoded assuming DTX indicators as the two last bits in the Data2 field.

- With frame structure of type B, the TPC field of the first slot in the transmission gap and the pilot field of the last slot in the transmission gap is transmitted. Transmission is turned off during the rest of the transmission gap (figure 13(b)). In case the length of the pilot field is 2 bits and STTD is used on the radio link, the pilot bits in the last slot of the transmission gap shall be STTD encoded assuming DTX indicators as the two last bits of the Data2 field. Similarly, the TPC bits in the first slot of the transmission gap shall be STTD encoded assuming DTX indicators as the two last bits in the Data1 field.



(a) Frame structure type A



(b) Frame structure type B

Figure 13: Frame structure types in downlink compressed transmission

4.4.2A Frame structure in the downlink for F-DPCH

There is only one type of frame structure defined for downlink F-DPCH compressed frames: transmission is turned off during the whole transmission gap i.e. in slots N_{first} to N_{last}.

4.4.3 Transmission time reduction method

When in compressed mode, the information normally transmitted during a 10 ms frame is compressed in time. The mechanisms provided for achieving this are puncturing, reduction of the spreading factor by a factor of two , and higher layer scheduling. In the downlink, all methods are supported while compressed mode by puncturing is not used in the uplink. The maximum idle length is defined to be 7 slots per one 10 ms frame. The slot formats that are used in compressed frames are listed in [2].

In case F-DPCH is configured in the downlink, no transmission time reduction method is needed during compressed frames. The same slot format is used in compressed frames and normal frames.

4.4.3.1 Compressed mode by puncturing

Rate matching is applied for creating a transmission gap in one or two frames. The algorithm for rate matching as described in subclause 4.2.7 is used.

4.4.3.2 Compressed mode by reducing the spreading factor by 2

The spreading factor (SF) can be reduced by 2 during one compressed radio frame to enable the transmission of the information bits in the remaining time slots of the compressed frame. This method is not supported for SF=4.

On the downlink, UTRAN can also order the UE to use a different scrambling code in a compressed frame than in a non-compressed frame. If the UE is ordered to use a different scrambling code in a compressed frame, then there is a one-to-one mapping between the scrambling code used in the non-compressed frame and the one used in the compressed frame, as described in [3] subclause 5.2.1.

4.4.3.3 Compressed mode by higher layer scheduling

Compressed frames can be obtained by higher layer scheduling. Higher layers then set restrictions so that only a subset of the allowed TFCs are used in a compressed frame. The maximum number of bits that will be delivered to the physical layer during the compressed radio frame is then known and a transmission gap can be generated. Note that in the downlink, the TFCI field is expanded on the expense of the data fields and this shall be taken into account by higher layers when setting the restrictions on the TFCs. Compressed mode by higher layer scheduling shall not be used with fixed starting positions of the TrCHs in the radio frame.

4.4.4 Transmission gap position

Transmission gaps can be placed at different positions as shown in figures 14 and 15 for each purpose such as interfrequency power measurement, acquisition of control channel of other system/carrier, and actual handover operation.

The restrictions listed below apply to DPCCH/DPDCH in the uplink and DPCH or F-DPCH in the downlink.

When using single frame method, the transmission gap is located within the compressed frame depending on the transmission gap length (TGL) as shown in figure 14 (1). When using double frame method, the transmission gap is located on the center of two connected frames as shown in figure 14 (2).

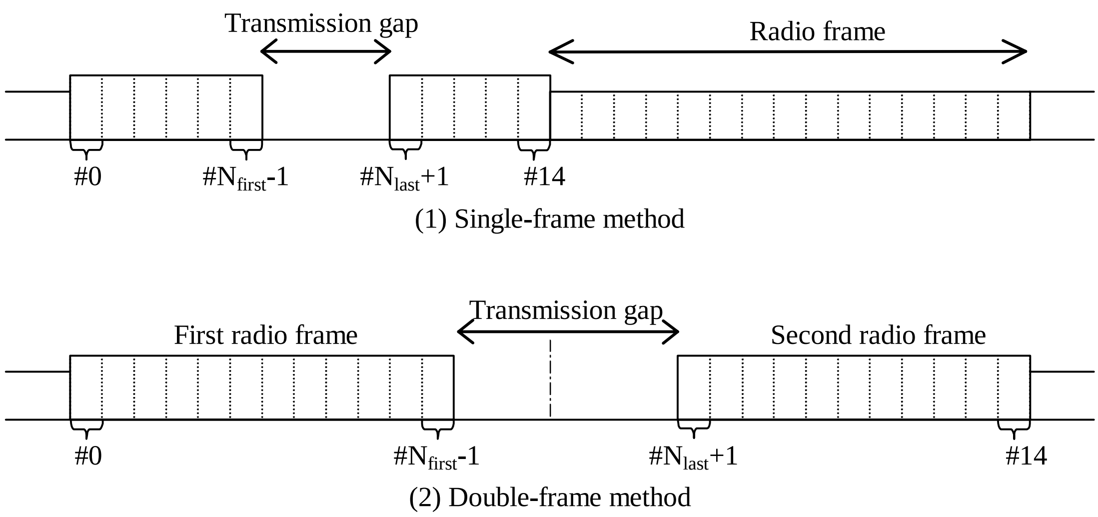


Figure 14: Transmission gap position

Parameters of the transmission gap positions are calculated as follows.

TGL is the number of consecutive idle slots during the compressed mode transmission gap:

TGL = 3, 4, 5, 7, 10, 14

N_{first} specifies the starting slot of the consecutive idle slots,

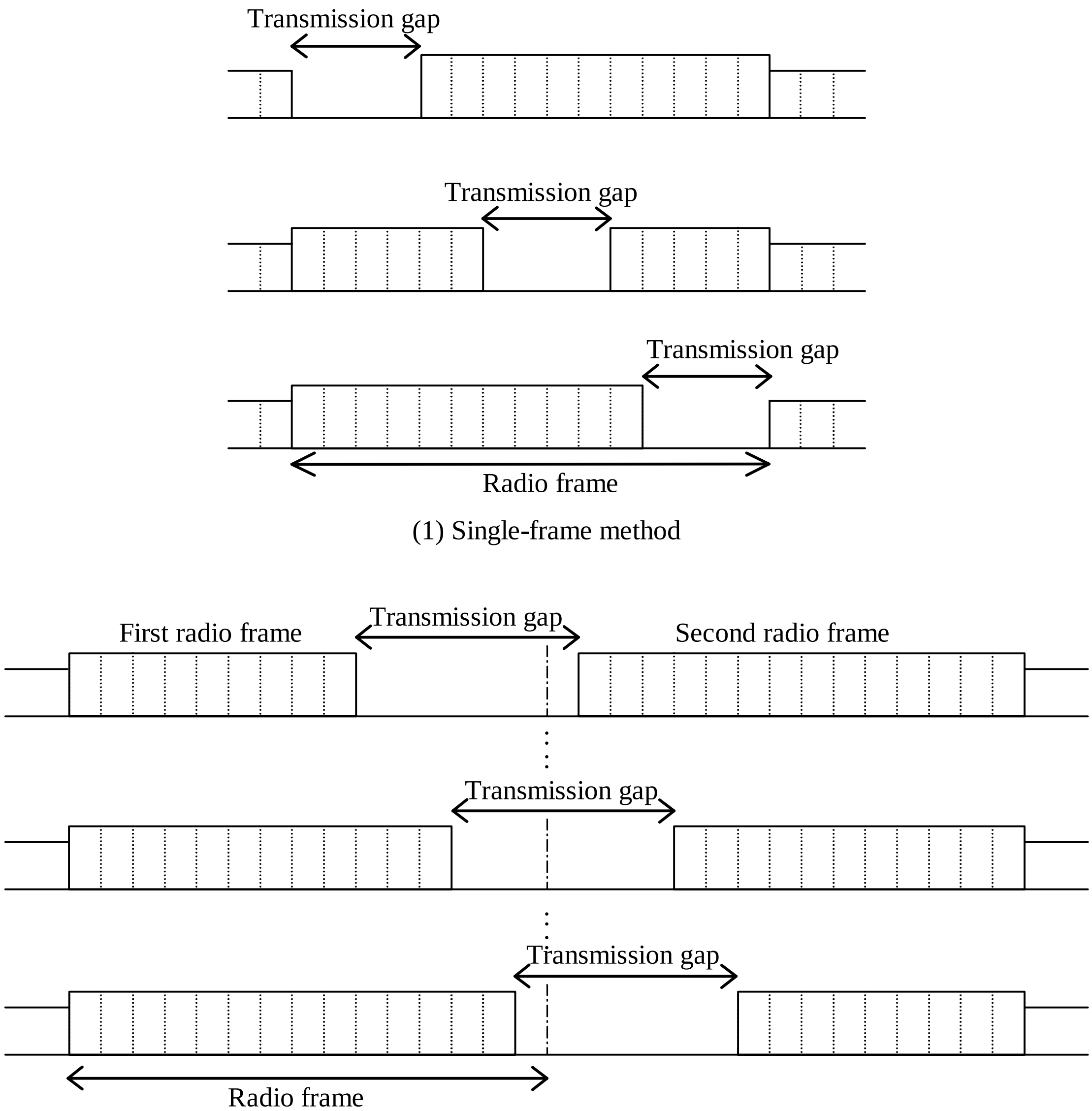
N_{first} = 0,1,2,3,…,14.

N_{last} shows the number of the final idle slot and is calculated as follows;

If N_{first} + TGL ≤ 15, then N_{last} = N_{first} + TGL –1 (in the same frame),

If N_{first} + TGL > 15, then N_{last} = (N_{first} + TGL – 1) mod 15 (in the next frame).

When the transmission gap spans two consecutive radio frames, N_{first} and TGL must be chosen so that at least 8 slots in each radio frame are transmitted.



(1) Single-frame method

(2) Double-frame method

Figure 15: Transmission gap positions with different Nfirst

Annex B (informative): Compressed mode idle lengths

The tables B.1-B.3 show the resulting idle lengths for different transmission gap lengths, UL/DL modes and DL frame types when DPCCH/DPDCH are used in the uplink and DPCH in the downlink. The idle lengths given are calculated purely from the slot and frame structures and the UL/DL offset. They do not contain margins for e.g. synthesizer switching.

B.1 Idle lengths for DL, UL and DL+UL compressed mode for DPCH

Table B.1: Parameters for DL compressed mode

TGL	DL Frame Type	Spreading Factor	Idle length [ms]	Transmission time Reduction method	Idle frame Combining
3	A	512 – 4	1.73 – 1.99	Puncturing, Spreading factor division by 2 or Higher layer scheduling	(S) (D) =(1,2) or (2,1)
	B		1.60 – 1.86		
4	A		2.40 – 2.66		(S) (D) =(1,3), (2,2) or (3,1)
	B		2.27 – 2.53		
5	A		3.07 – 3.33		(S) (D) = (1,4), (2,3), (3, 2) or (4,1)
	B		2.93 – 3.19		
7	A		4.40 – 4.66		(S) (D)=(1,6), (2,5), (3,4), (4,3), (5,2) or (6,1)
	B		4.27 – 4.53		
10	A		6.40 – 6.66		(D)=(3,7), (4,6), (5,5), (6,4) or (7,3)
	B		6.27 – 6.53		
14	A		9.07 – 9.33		(D) =(7,7)
	B		8.93 – 9.19		

Table B.2: Parameters for UL compressed mode

TGL	Spreading Factor	Idle length [ms]	Transmission time Reduction method	Idle frame Combining
3	256 – 4	2.00	Spreading factor division by 2 or Higher layer scheduling	(S) (D) =(1,2) or (2,1)
4		2.67		(S) (D) =(1,3), (2,2) or (3,1)
5		3.33		(S) (D) = (1,4), (2,3), (3, 2) or (4,1)
7		4.67		(S) (D)=(1,6), (2,5), (3,4), (4,3), (5,2) or (6,1)
10		6.67		(D)=(3,7), (4,6), (5,5), (6,4) or (7,3)
14		9.33		(D) =(7,7)

Table B.3: Parameters for combined UL/DL compressed mode

<table>
<tr><th>TGL</th><th>DL Frame Type</th><th>Spreading Factor</th><th>Idle length [ms]</th><th>Transmission time Reduction method</th><th>Idle frame Combining</th></tr>
<tr><td>3</td><td rowspan="6">A or B</td><td rowspan="6">DL:
512 – 4

UL:
256 – 4</td><td>1.47 – 1.73</td><td rowspan="6">DL:
Puncturing, Spreading factor division by 2 or Higher layer scheduling

UL:
Spreading factor division by 2 or Higher layer scheduling</td><td>(S)
(D) =(1,2) or (2,1)</td></tr>
<tr><td>4</td><td>2.13 – 2.39</td><td>(S)
(D) =(1,3), (2,2) or (3,1)</td></tr>
<tr><td>5</td><td>2.80 – 3.06</td><td>(S)
(D) = (1,4), (2,3), (3, 2) or (4,1)</td></tr>
<tr><td>7</td><td>4.13 – 4.39</td><td>(S)
(D)=(1,6), (2,5), (3,4), (4,3), (5,2) or (6,1)</td></tr>
<tr><td>10</td><td>6.13 – 6.39</td><td>(D)=(3,7), (4,6), (5,5), (6,4) or (7,3)</td></tr>
<tr><td>14</td><td>8.80 – 9.06</td><td>(D) =(7,7)</td></tr>
</table>

(S): Single-frame method as shown in figure 14 (1).

(D): Double-frame method as shown in figure 14 (2). (x,y) indicates x: the number of idle slots in the first frame, y: the number of idle slots in the second frame.

NOTE: Compressed mode by spreading factor reduction is not supported when SF=4 is used in normal mode

3GPP TSG-RAN WG1 Meeting #40
Scottsdale, USA, Feb 14th- 18th

Tdoc R1-050081 ⌘

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CHANGE REQUEST

⌘	**25.213**	**CR**	**070**	⌘ **rev**	**1**	⌘ Current version:	**6.1.0** ⌘

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

Title:	⌘	Introduction of F-DPCH		
Source:	⌘	RAN WG1		
Work item code:	⌘	RANimp-RABSE-CodeOptFDD	***Date:*** ⌘	07/02/2005
Category:	⌘	**B**	***Release:*** ⌘	Rel-6
		Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

Reason for change:	⌘	This CR introduces Fractional DPCH in the specifications
Summary of change:	⌘	Relevant sections are updated: - abbreviations - spreading - channelisation codes - scrambling codes
Consequences if not approved:	⌘	

Clauses affected:	⌘	3.2, 5.1, 5.2.1				
		Y	**N**			
Other specs	⌘	**Y**		Other core specifications	⌘	25.211, 25.212, 25.214, 25.215, 25.302, 25.331, 25.423, 25.433, 25.101, 25.133
affected:				Test specifications		
				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.

3.2 Abbreviations

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

16QAM	16 Quadrature Amplitude Modulation
AICH	Acquisition Indicator Channel
AP	Access Preamble
BCH	Broadcast Control Channel
CCPCH	Common Control Physical Channel
CD	Collision Detection
CPCH	Common Packet Channel
CPICH	Common Pilot Channel
DCH	Dedicated Channel
DPCH	Dedicated Physical Channel
DPCCH	Dedicated Physical Control Channel
DPDCH	Dedicated Physical Data Channel
E-AGCH	E-DCH Absolute Grant Channel
E-DPCCH	E-DCH Dedicated Physical Control Channel
E-DPDCH	E-DCH Dedicated Physical Data Channel
E-HICH	E-DCH Hybrid ARQ Indicator Channel
E-RGCH	E-DCH Relative Grant Channel
FDD	Frequency Division Duplex
F-DPCH	Fractional Dedicated Physical Channel
HS-DPCCH	Dedicated Physical Control Channel (uplink) for HS-DSCH
HS-DSCH	High Speed Downlink Shared Channel
HS-PDSCH	High Speed Physical Downlink Shared Channel
HS-SCCH	Shared Control Physical Channel for HS-DSCH
Mcps	Mega Chip Per Second
MICH	MBMS Indication Channel
OVSF	Orthogonal Variable Spreading Factor (codes)
PDSCH	Physical Dedicated Shared Channel
PICH	Page Indication Channel
PRACH	Physical Random Access Channel
PSC	Primary Synchronisation Code
RACH	Random Access Channel
SCH	Synchronisation Channel
SSC	Secondary Synchronisation Code
SF	Spreading Factor
UE	User Equipment

4 Uplink spreading and modulation

4.1 Overview

Spreading is applied to the physical channels. It 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.

With the channelisation, data symbols on so-called I- and Q-branches are independently multiplied with an OVSF code. With the scrambling operation, the resultant signals on the I- and Q-branches are further multiplied by complex-valued scrambling code, where I and Q denote real and imaginary parts, respectively.

5 Downlink spreading and modulation

5.1 Spreading

Figure 8 illustrates the spreading operation for all physical channel except SCH. The spreading operation includes a modulation mapper stage successively followed by a channelisation stage, an IQ combining stage and a scrambling stage. All the downlink physical channels are then combined as specified in sub subclause 5.1.5.

The non-spread downlink physical channels, except SCH, AICH, AP-ICH CD/CA-ICH, E-HICH and E-RGCH consist of a sequence of 3-valued digits taking the values 0, 1 and "DTX". Note that "DTX" is only applicable to those downlink physical channels that support DTX transmission.

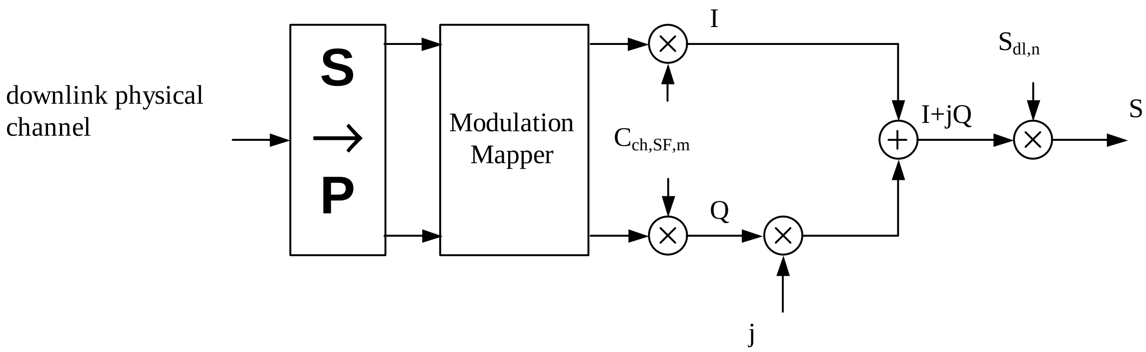

Figure 8: Spreading for all downlink physical channels except SCH

NOTE: Although subclause 5.1 has been reorganized in this release, the spreading operation as specified for the DL channels in the previous release remains unchanged.

5.1.1 Modulation mapper

Table 3A defines which of the IQ mapping specified in subclauses 5.1.1.1 and 5.1.1.2 may be used for the physical channel being processed.

Table 3A: IQ mapping

Physical channel	IQ mapping
HS-PDSCH	QPSK or 16QAM
All other channels (except the SCH)	QPSK

5.1.1.1 QPSK

For all channels, except AICH, AP-AICH, CD/CA-ICH, E-HICH and E-RGCH, the input digits shall be mapped to real-valued symbols as follows: the binary value "0" is mapped to the real value +1, the binary value "1" is mapped to the real value –1 and "DTX" is mapped to the real value 0.

For the indicator channels using signatures (AICH, AP-AICH, CD/CA-ICH), the real-valued input symbols depend on the exact combination of the indicators to be transmitted as specified in [2] subclauses 5.3.3.7, 5.3.3.8 and 5.3.3.9.For the E-HICH and the E-RGCH the input is a real valued symbol sequence as specified in [2]

Each pair of two consecutive real-valued symbols is first converted from serial to parallel and mapped to an I and Q branch. The definition of the modulation mapper is such that even and odd numbered symbols are mapped to the I and Q branch respectively. For all QPSK channels except the indicator channels using signatures, symbol number zero is defined as the first symbol in each frame or sub-frame. For the indicator channels using signatures, symbol number zero is defined as the first symbol in each access slot.

5.2 Code generation and allocation

5.2.1 Channelisation codes

The channelisation codes of figure 8 are the same codes as used in the uplink, namely Orthogonal Variable Spreading Factor (OVSF) codes that preserve the orthogonality between downlink channels of different rates and spreading factors. The OVSF codes are defined in figure 4 in subclause 4.3.1.

The channelisation code for the Primary CPICH is fixed to $C_{ch,256,0}$ and the channelisation code for the Primary CCPCH is fixed to $C_{ch,256,1}$.The channelisation codes for all other physical channels are assigned by UTRAN.

With the spreading factor 512 a specific restriction is applied. When the code word $C_{ch,512,n}$, with n=0,2,4….510, is used in soft handover, then the code word $C_{ch,512,n+1}$ is not allocated in the cells where timing adjustment is to be used. Respectively if $C_{ch,512,n}$, with n=1,3,5….511 is used, then the code word $C_{ch,512,n-1}$ is not allocated in the cells where timing adjustment is to be used. This restriction shall not apply in cases where timing adjustments in soft handover are not used with spreading factor 512.

When compressed mode is implemented by reducing the spreading factor by 2, the OVSF code used for compressed frames is:

- $C_{ch,SF/2,\lfloor n/2 \rfloor}$ if ordinary scrambling code is used.
- $C_{ch,SF/2,n \bmod SF/2}$ if alternative scrambling code is used (see subclause 5.2.2);

where $C_{ch,SF,n}$ is the channelisation code used for non-compressed frames.

For F-DPCH, the spreading factor is always 256.

In case the OVSF code on the PDSCH varies from frame to frame, the OVSF codes shall be allocated in such a way that the OVSF code(s) below the smallest spreading factor will be from the branch of the code tree pointed by the code with smallest spreading factor used for the connection which is called PDSCH root channelisation code. This means that all the codes for this UE for the PDSCH connection can be generated according to the OVSF code generation principle from the PDSCH root channelisation code i.e. the code with smallest spreading factor used by the UE on PDSCH.

In case of mapping the DSCH to multiple parallel PDSCHs, the same rule applies, but all of the branches identified by the multiple codes, corresponding to the smallest spreading factor, may be used for higher spreading factor allocation i.e. the multiple codes with smallest spreading factor can be considered as PDSCH root channelisation codes.

For HS-PDSCH, the spreading factor is always 16.

For HS-SCCH, the spreading factor is always 128.

Channelisation-code-set information over HS-SCCH is mapped in following manner: the OVSF codes shall be allocated in such a way that they are positioned in sequence in the code tree. That is, for P multicodes at offset O the following codes are allocated:

$C_{ch,16,O} \ldots C_{ch,16,O+P-1}$

The number of multicodes and the corresponding offset for HS-PDSCHs mapped from a given HS-DSCH is signalled by HS-SCCH.

For E-HICH and for E-RGCH, the spreading factor shall always be 128. In each cell, the E-RGCH and E-HICH assigned to a UE shall be configured with the same channelisation code.

For E-AGCH, the spreading factor shall always be 256.

5.2.2 Scrambling code

A total of 2^{18}-1 = 262,143 scrambling codes, numbered 0…262,142 can be generated. However not all the scrambling codes are used. The scrambling codes are divided into 512 sets each of a primary scrambling code and 15 secondary scrambling codes.

The primary scrambling codes consist of scrambling codes n=16*i where i=0…511. The i:th set of secondary scrambling codes consists of scrambling codes 16*i+k, where k=1…15.

There is a one-to-one mapping between each primary scrambling code and 15 secondary scrambling codes in a set such that i:th primary scrambling code corresponds to i:th set of secondary scrambling codes.

Hence, according to the above, scrambling codes k = 0, 1, …, 8191 are used. Each of these codes are associated with a left alternative scrambling code and a right alternative scrambling code, that may be used for compressed frames. The left alternative scrambling code corresponding to scrambling code k is scrambling code number k + 8192, while the right alternative scrambling code corresponding to scrambling code k is scrambling code number k + 16384. The alternative scrambling codes can be used for compressed frames. In this case, the left alternative scrambling code is used if n<SF/2 and the right alternative scrambling code is used if n≥SF/2, where $c_{ch,SF,n}$ is the channelisation code used for non-compressed frames. The usage of alternative scrambling code for compressed frames is signalled by higher layers for each physical channel respectively.

In case F-DPCH is configured in the downlink, the same scrambling code and OVSF code shall be used in F-DPCH compressed frames and normal frames.

The set of primary scrambling codes is further divided into 64 scrambling code groups, each consisting of 8 primary scrambling codes. The j:th scrambling code group consists of primary scrambling codes 16*8*j+16*k, where j=0..63 and k=0..7.

Each cell is allocated one and only one primary scrambling code. The primary CCPCH, primary CPICH, PICH, MICH, AICH, AP-AICH, CD/CA-ICH, CSICH and S-CCPCH carrying PCH shall always be transmitted using the primary scrambling code. The other downlink physical channels may be transmitted with either the primary scrambling code or a secondary scrambling code from the set associated with the primary scrambling code of the cell.

The mixture of primary scrambling code and no more than one secondary scrambling code for one CCTrCH is allowable. In compressed mode during compressed frames, these can be changed to the associated left or right scrambling codes as described above, i.e. in these frames, the total number of different scrambling codes may exceed two.

In the case of the CCTrCH of type DSCH, all the PDSCH channelisation codes that a single UE may receive shall be under a single scrambling code (either the primary or a secondary scrambling code). In the case of CCTrCH of type of HS-DSCH then all the HS-PDSCH channelisation codes and HS-SCCH that a single UE may receive shall be under a single scrambling code (either the primary or a secondary scrambling code).

In each cell, the E-RGCH, E-HICH and E-AGCH assigned to a UE shall be configured with same scrambling code.

The scrambling code sequences are constructed by combining two real sequences into a complex sequence. Each of the two real sequences are constructed as the position wise modulo 2 sum of 38400 chip segments of two binary *m*-sequences generated by means of two generator polynomials of degree 18. The resulting sequences thus constitute segments of a set of Gold sequences. The scrambling codes are repeated for every 10 ms radio frame. Let *x* and *y* be the two sequences respectively. The *x* sequence is constructed using the primitive (over GF(2)) polynomial $1+X^7+X^{18}$. The y sequence is constructed using the polynomial $1+X^5+X^7+ X^{10}+X^{18}$.

The sequence depending on the chosen scrambling code number *n* is denoted z_n, in the sequel. Furthermore, let $x(i)$, $y(i)$ and $z_n(i)$ denote the *i*:th symbol of the sequence *x*, *y*, and z_n, respectively.

The *m*-sequences *x*and *y* are constructed as:

Initial conditions:

- x is constructed with x (0)=1, x(1)= x(2)=...= x (16)= x (17)=0.
- y(0)=y(1)= … =y(16)= y(17)=1.

Recursive definition of subsequent symbols:

- x(i+18) =x(i+7) + x(i) modulo 2, i=0,…,2^{18}-20.
- y(i+18) = y(i+10)+y(i+7)+y(i+5)+y(i) modulo 2, i=0,…, 2^{18}-20.

The n:th Gold code sequence z_n, $n=0,1,2,\ldots,2^{18}-2$, is then defined as:

- $z_n(i) = x((i+n) \text{ modulo } (2^{18} - 1)) + y(i) \text{ modulo } 2, i=0,\ldots, 2^{18}-2$.

These binary sequences are converted to real valued sequences Z_n by the following transformation:

$$Z_n(i) = \begin{cases} +1 & if \;\; z_n(i) = 0 \\ -1 & if \;\; z_n(i) = 1 \end{cases} \quad for \quad i = 0,1,\ldots,2^{18}-2.$$

Finally, the n:th complex scrambling code sequence $S_{dl,n}$ is defined as:

- $S_{dl,n}(i) = Z_n(i) + j\,Z_n((i+131072) \text{ modulo } (2^{18}-1))$, i=0,1,…,38399.

Note that the pattern from phase 0 up to the phase of 38399 is repeated.

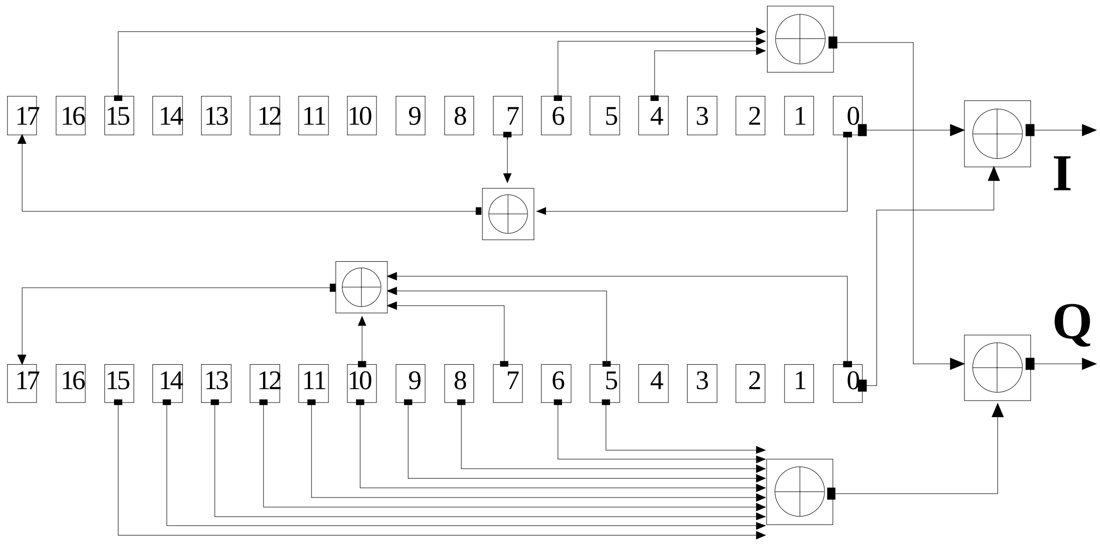

Figure 10: Configuration of downlink scrambling code generator

3GPP TSG-RAN WG1 Meeting #40
Scottsdale, USA, 14th- 18th February 2005

Tdoc R1-050179 ⌘

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CHANGE REQUEST

⌘	**25.214**	**CR**	**368**	⌘ **rev**	**1**	⌘ Current version:	**6.4.0** ⌘

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

Title:	⌘	Introduction of F-DPCH without pilot field		
Source:	⌘	RAN WG1		
Work item code:	⌘	RANimp-RABSE-CodeOptFDD	***Date:*** ⌘	08/02/2005
Category:	⌘	**B** *Use one of the following categories:* ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.	***Release:*** ⌘	Rel-6 *Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

Reason for change:	⌘	This CR introduces Fractional DPCH without pilot field into the specifications
Summary of change:	⌘	Relevant sections are updated: - abbreviations - synchronisation primitives - radio link establishment and physical layer reconfiguration of dedicated channels - synchronisation procedure A and B - transmission timing adjustments -out-of-synchronisation handling - TPC command generation during RL initialisation - UL power control in compressed mode - UL power control during power control preamble - DL power control (DPCCH/DPDCH/F-DPCH) - DL power control in compressed mode - HS-DSCH operation in compressed mode
Consequences if not approved:	⌘	

Clauses affected:	⌘	3, 4.3, 4.3.1.2, 4.3.2.1, 4.3.2.3, 4.3.2.4, 4.3.4, 5.1.2.2.1.1, 5.1.2.3, 5.1.2.4, 5.2.1, 5.2.1.1, 5.2.1.2.1.1 (new section), 5.2.1.2.2, 5.2.1.3, 6A.3				
		Y	**N**			
Other specs affected:	⌘	**Y**		Other core specifications	⌘	25.211, 25.212, 25.213, 25.215, 25.302, 25.331, 25.423, 25.433, 25.101, 25.133
				Test specifications		
				O&M Specifications		

Other comments: ⌘	

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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.

3.2 Abbreviations

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

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

4 Synchronisation procedures

4.1 Cell search

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

4.2 Common physical channel synchronisation

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

4.2.1 P-CCPCH radio frame timing

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

4.2.2 S-CCPCH soft combining timing

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

4.3 DPCCH/DPDCH/F-DPCH synchronisation

4.3.1 Synchronisation primitives

4.3.1.1 General

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

4.3.1.2 Downlink synchronisation primitives

Layer 1 in the UE shall every radio frame check synchronisation status of the downlink dedicated channels, including F-DPCH if one is configured. Synchronisation status is indicated to higher layers using the CPHY-Sync-IND and CPHY-Out-of-Sync-IND primitives.

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

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

- The UE estimates the DPCCH or F-DPCH 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 DPCCH quality measurements have been collected. Q_{in} is defined implicitly by the relevant tests in [7].

In case F-DPCH is configured in the downlink, the quality criterion shall be estimated on TPC fields of the F-DPCH frame received from the serving HS-DSCH cell.

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

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

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

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

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

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

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

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

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

4.3.1.3 Uplink synchronisation primitives

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

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

4.3.2 Radio link establishment and physical layer reconfiguration for dedicated channels

4.3.2.1 General

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

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

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

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

For existing radio links, the reconfiguration of downlink phase reference from P-CPICH or S-CPICH to dedicated pilots is not supported. For all other physical layer reconfigurations not listed above, the UE and UTRAN shall not perform any of the synchronisation procedures listed above.

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

4.3.2.2 Node B radio link set state machine

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

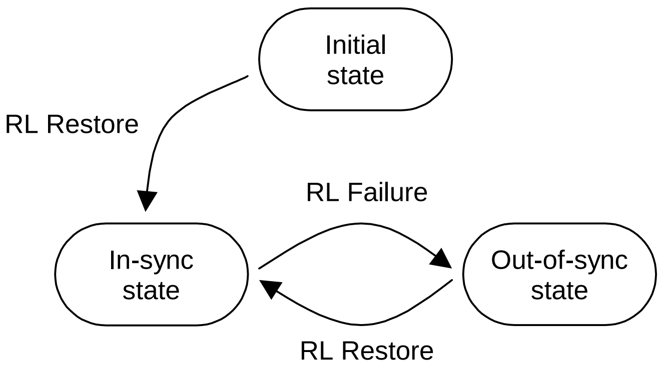


Figure 1: Node B radio link set states and transitions

4.3.2.3 Synchronisation procedure A

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

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

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

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

d) The UE shall not transmit on uplink until higher layers consider the downlink physical channel established. If no activation time for uplink DPCCH has been signalled to the UE or if the UE attempts to re-establish the DPCH after an inter-RAT, intra- or inter-frequency hard-handover failure [5], uplink DPCCH transmission shall start when higher layers consider the downlink physical channel established. If an activation time has been given, uplink DPCCH transmission shall not start before the downlink physical channel has been established and the activation time has been reached. Physical channel establishment and activation time are defined in [5]. The initial uplink DPCCH transmit power is set by higher layers [5]. In case the UE attempts to re-establish the DPCH after an inter-RAT, intra- or inter-frequency hard-handover failure [5] the initial uplink DPCCH power shall be the same as the one used immediately preceding the inter-RAT, intra- or inter-frequency hard-handover attempt. In case of physical layer reconfiguration the uplink DPCCH power is kept unchanged between before and after the reconfiguration except for inner loop power control adjustments. A power control preamble shall be applied as indicated by higher layers. The transmission of the uplink DPCCH power control preamble shall start N_{pcp} radio frames prior to the start of uplink DPDCH transmission, where N_{pcp} is a higher layer parameter set by UTRAN [5]; in case the UE attempts to re-establish the DPCH after an inter-RAT, intra- or inter-frequency hard-handover failure [5] the UE shall use the value of N_{pcp} as specified in [5] for this case. Note that the transmission start delay between DPCCH and DPDCH may be cancelled using a power control preamble of 0 length. The starting time for transmission of DPDCHs shall also satisfy the constraints on adding transport channels to a CCTrCH, as defined in [2] sub-clause 4.2.14, independently of whether there are any bits mapped to the DPDCHs. During the uplink DPCCH power control preamble, independently of the selected TFC, no transmission is done on the DPDCH.

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

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

4.3.2.4 Synchronisation procedure B

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

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

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

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

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

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

4.3.3 Radio link monitoring

4.3.3.1 Downlink radio link failure

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

4.3.3.2 Uplink radio link failure/restore

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

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

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

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

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

4.3.4 Transmission timing adjustments

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

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

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

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

5 Power control

5.1 Uplink power control

5.1.1 PRACH

5.1.1.1 General

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

5.1.1.2 Setting of PRACH control and data part power difference

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

- β_c is the gain factor for the control part (similar to DPCCH);
- β_d is the gain factor for the data part (similar to DPDCH);
- no inner loop power control is performed.

5.1.2 DPCCH/DPDCH

5.1.2.1 General

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

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

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

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

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

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

5.1.2.2 Ordinary transmit power control

5.1.2.2.1 General

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

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

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

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

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

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

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

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

5.1.2.2.1.1 Out of synchronisation handling

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

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

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

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

5.1.2.2.1.2 TPC command generation on downlink during RL initialisation

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

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

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

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

else

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

The TPC pattern shall terminate once uplink synchronisation is achieved.

5.1.2.2.2 Algorithm 1 for processing TPC commands

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

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

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

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

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

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

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

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

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

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

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

The function γ shall fulfil the following criteria:

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

5.1.2.2.3 Algorithm 2 for processing TPC commands

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

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

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

The value of TPC_cmd shall be derived as follows:

- For the first 4 slots of a set, TPC_cmd = 0.
- For the fifth slot of a set, the UE uses hard decisions on each of the 5 received TPC commands as follows:
  - If all 5 hard decisions within a set are 1 then TPC_cmd = 1 in the 5^{th} slot.
  - If all 5 hard decisions within a set are 0 then TPC_cmd = -1 in the 5^{th} slot.
  - Otherwise, TPC_cmd = 0 in the 5^{th} slot.

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

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

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

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

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

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

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

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

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

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

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

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

- TPC_cmd is set to -1 if any of TPC_temp_1 to TPC_temp_N are equal to -1.
- Otherwise, TPC_cmd is set to 1 if $\frac{1}{N}\sum_{i=1}^{N} TPC\_temp_i > 0.5$.
- Otherwise, TPC_cmd is set to 0.

5.1.2.3 Transmit power control in compressed mode

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

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

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

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

where ΔSIR1_coding and ΔSIR2_coding are computed from uplink parameters DeltaSIR1, DeltaSIR2, DeltaSIRafter1, DeltaSIRafter2 signalled by higher layers as:

- ΔSIR1_coding = DeltaSIR1 if the start of the first transmission gap in the transmission gap pattern is within the current uplink frame.
- ΔSIR1_coding = DeltaSIRafter1 if the current uplink frame just follows a frame containing the start of the first transmission gap in the transmission gap pattern.
- ΔSIR2_coding = DeltaSIR2 if the start of the second transmission gap in the transmission gap pattern is within the current uplink frame.
- ΔSIR2_coding = DeltaSIRafter2 if the current uplink frame just follows a frame containing the start of the second transmission gap in the transmission gap pattern.
- ΔSIR1_coding = 0 dB and ΔSIR2_coding = 0 dB in all other cases.

ΔSIR_{PILOT} is defined as: $\Delta SIR_{PILOT} = 10Log_{10} (N_{pilot,N}/N_{pilot,curr\_frame})$, where $N_{pilot,curr\_frame}$ is the number of pilot bits per slot in the current uplink frame, and $N_{pilot,N}$ is the number of pilot bits per slot in a normal uplink frame without a transmission gap.

In the case of several compressed mode pattern sequences being used simultaneously, ΔSIR1_coding and ΔSIR2_coding offsets are computed for each compressed mode pattern and all ΔSIR1_coding and ΔSIR2_coding offsets are summed together.

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

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

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

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

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

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

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

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

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

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

Table 1: Initial Transmit Power modes during compressed mode

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

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

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

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

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

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

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

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

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

Table 2: Recovery Period Power control modes during compressed mode

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

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

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

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

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

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

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

5.1.2.4 Transmit power control in the uplink DPCCH power control preamble

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

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

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

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

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

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

5.2 Downlink power control

The transmit power of the downlink channels is determined by the network. In general the ratio of the transmit power between different downlink channels is not specified and may change with time. However, regulations exist as described in the following subclauses.

Higher layer power settings shall be interpreted as setting of the total power, i.e. the sum of the power from the two antennas in case of transmit diversity.

5.2.1 DPCCH/DPDCH/F-DPCH

5.2.1.1 General

The downlink transmit power control procedure controls simultaneously the power of a DPCCH and its corresponding DPDCHs. The power control loop adjusts the power of the DPCCH and DPDCHs with the same amount, i.e. the relative power difference between the DPCCH and DPDCHs is not changed. In case of F-DPCH, the power control loop adjusts the F-DPCH power.

For DPCH, ~~T~~the relative transmit power offset between DPCCH fields and DPDCHs is determined by the network. The TFCI, TPC and pilot fields of the DPCCH are offset relative to the DPDCHs power by PO1, PO2 and PO3 dB respectively. The power offsets may vary in time. UTRAN may use the SSDT operation as specified in section 5.2.2 to determine what power offset to use for TFCI in hard split mode with respect to the associated downlink DPDCH. The method for controlling the power offsets within UTRAN is specified in [6]. The power offsets PO1, PO2 and PO3 do not apply to F-DPCH.

5.2.1.2 Ordinary transmit power control

5.2.1.2.1 UE behaviour

The UE shall generate TPC commands to control the network transmit power and send them in the TPC field of the uplink DPCCH. An example on how to derive the TPC commands in given in Annex B.2.

The UE shall check the downlink power control mode (DPC_MODE) before generating the TPC command:

- if DPC_MODE = 0 : the UE sends a unique TPC command in each slot and the TPC command generated is transmitted in the first available TPC field in the uplink DPCCH;
- if DPC_MODE = 1 : the UE repeats the same TPC command over 3 slots and the new TPC command is transmitted such that there is a new command at the beginning of the frame.

The DPC_MODE parameter is a UE specific parameter controlled by the UTRAN.

The UE shall not make any assumptions on how the downlink power is set by UTRAN, in order to not prohibit usage of other UTRAN power control algorithms than what is defined in subclause 5.2.1.2.2.

5.2.1.2.1.1 F-DPCH quality target control

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

5.2.1.2.2 UTRAN behaviour

Upon receiving the TPC commands UTRAN shall adjust its downlink DPCCH/DPDCH or F-DPCH power accordingly. For DPC_MODE = 0, UTRAN shall estimate the transmitted TPC command TPC_{est} to be 0 or 1, and shall update the power every slot. If DPC_MODE = 1, UTRAN shall estimate the transmitted TPC command TPC_{est} over three slots to be 0 or 1, and shall update the power every three slots.

After estimating the *k*:th TPC command, UTRAN shall adjust the current downlink power $P(k\text{-}1)$ [dB] to a new power $P(k)$ [dB] according to the following formula:

$P(k) = P(k - 1) + P_{TPC}(k) + P_{bal}(k)$,

where $P_{TPC}(k)$ is the *k*:th power adjustment due to the inner loop power control, and $P_{bal}(k)$ [dB] is a correction according to the downlink power control procedure for balancing radio link powers towards a common reference power. The power balancing procedure and control of the procedure is described in [6].

$P_{TPC}(k)$ is calculated according to the following.

If the value of *Limited Power Increase Used* parameter is 'Not used', then

$$\mathrm{P_{TPC}}(k) = \begin{cases} +\Delta_{\mathrm{TPC}} & \text{if } \mathrm{TPC_{est}}(k) = 1 \\ -\Delta_{\mathrm{TPC}} & \text{if } \mathrm{TPC_{est}}(k) = 0 \end{cases} \text{, [dB].} \qquad (1)$$

If the value of *Limited Power Increase Used* parameter is 'Used', then the *k*:th inner loop power adjustment shall be calculated as:

$$P_{TPC}(k) = \begin{cases} +\Delta_{TPC} & \text{if } \mathrm{TPC_{est}}(k) = 1 \text{ and } \Delta_{sum}(k) + \Delta_{TPC} < \text{Power\_Raise\_Limit} \\ 0 & \text{if } \mathrm{TPC_{est}}(k) = 1 \text{ and } \Delta_{sum}(k) + \Delta_{TPC} \geq \text{Power\_Raise\_Limit} \\ -\Delta_{TPC} & \text{if } \mathrm{TPC_{est}}(k) = 0 \end{cases} \text{, [dB]} \qquad (2)$$

where

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

is the temporary sum of the last *DL_Power_Averaging_Window_Size* inner loop power adjustments (in dB).

For the first (*DL_Power_Averaging_Window_Size* – 1) adjustments after the activation of the limited power increase method, formula (1) shall be used instead of formula (2). *Power_Raise_Limit* and *DL_Power_Averaging_Window_Size* are parameters configured in the UTRAN.

The power control step size Δ_{TPC} can take four values: 0.5, 1, 1.5 or 2 dB. It is mandatory for UTRAN to support Δ_{TPC} of 1 dB, while support of other step sizes is optional.

In addition to the above described formulas on how the downlink power is updated, the restrictions below apply.

In case of congestion (commanded power not available), UTRAN may disregard the TPC commands from the UE.

The average power of transmitted DPDCH symbols over one timeslot shall not exceed Maximum_DL_Power (dB), nor shall it be below Minimum_DL_Power (dB). Transmitted DPDCH symbol means here a complex QPSK symbol before spreading which does not contain DTX. Maximum_DL_Power (dB) and Minimum_DL_Power (dB) are power limits for one channelisation code, relative to the primary CPICH power [6].

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

5.2.1.3 Power control in compressed mode

The aim of downlink power control in uplink or/and downlink compressed mode is to recover as fast as possible a signal-to-interference ratio (SIR) close to the target SIR after each transmission gap.

The UE behaviour is the same in compressed mode as in normal mode, described in subclause 5.2.1.2, except that the target SIR for a DPCH is offset by higher layer signalling. However due to transmission gaps in uplink compressed frames there may be incomplete sets of TPC commands when DPC_MODE=1.

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

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

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

During compressed mode except during downlink transmission gaps, UTRAN shall estimate the *k*:th TPC command and adjust the current downlink power $P(k-1)$ [dB] to a new power $P(k)$ [dB] according to the following formula:

$P(k) = P(k - 1) + P_{TPC}(k) + P_{SIR}(k) + P_{bal}(k)$,

where $P_{TPC}(k)$ is the *k*:th power adjustment due to the inner loop power control, $P_{SIR}(k)$ is the k-th power adjustment due to the downlink target SIR variation, and $P_{bal}(k)$ [dB] is a correction according to the downlink power control procedure for balancing radio link powers towards a common reference power. The power balancing procedure and control of the procedure is described in [6].

Due to transmission gaps in uplink compressed frames, there may be missing TPC commands in the uplink.

For DPC_MODE = 0 if no uplink TPC command is received, $P_{TPC}(k)$ derived by the Node B shall be set to zero. Otherwise, $P_{TPC}(k)$ is calculated the same way as in normal mode (see sub-clause 5.2.1.2.2) but with a step size Δ_{STEP} instead of Δ_{TPC}.

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

The power control step size $\Delta_{STEP} = \Delta_{RP-TPC}$ during RPL slots after each transmission gap and $\Delta_{STEP} = \Delta_{TPC}$ otherwise, where:

- RPL is the recovery period length and is expressed as a number of slots. RPL is equal to the minimum value out of the transmission gap length and 7 slots. If a transmission gap is scheduled to start before RPL slots have elapsed, then the recovery period shall end at the start of the gap, and the value of RPL shall be reduced accordingly.

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

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

For DPCH, ~~T~~the power offset $P_{SIR}(k) = \delta P_{curr} - \delta P_{prev}$, where δP_{curr} and δP_{prev} are respectively the value of δP in the current slot and the most recently transmitted slot and δP is computed as follows:

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

where n is the number of different TTI lengths amongst TTIs of all TrChs of the CCTrCh, where ΔP1_coding and ΔP2_coding are computed from uplink parameters DeltaSIR1, DeltaSIR2, DeltaSIRafter1, DeltaSIRafter2 signaled by higher layers as:

- ΔP1_coding = DeltaSIR1 if the start of the first transmission gap in the transmission gap pattern is within the current frame.

- ΔP1coding = DeltaSIRafter1 if the current frame just follows a frame containing the start of the first transmission gap in the transmission gap pattern.

- ΔP2_coding = DeltaSIR2 if the start of the second transmission gap in the transmission gap pattern is within the current frame.

- ΔP2_coding = DeltaSIRafter2 if the current frame just follows a frame containing the start of the second transmission gap in the transmission gap pattern.

- ΔP1_coding = 0 dB and ΔP2_coding = 0 dB in all other cases.

and ΔPi_compression is defined by :

- ΔPi_compression = 3 dB for downlink frames compressed by reducing the spreading factor by 2.
- ΔPi_compression = 10 log $(15*F_i / (15*F_i - TGL_i))$ if there is a transmission gap created by puncturing method within the current TTI of length F_i frames, where TGL_i is the gap length in number of slots (either from one gap or a sum of gaps) in the current TTI of length F_i frames.
- ΔPi_compression = 0 dB in all other cases.

In case several compressed mode patterns are used simultaneously, a δP offset is computed for each compressed mode pattern and the sum of all δP offsets is applied to the frame.

For all time slots except those in transmissions gaps, the average power of transmitted DPDCH symbols over one timeslot shall not exceed Maximum_DL_Power (dB) by more than δP_{curr}, nor shall it be below Minimum_DL_Power (dB). Transmitted DPDCH symbol means here a complex QPSK symbol before spreading which does not contain DTX. Maximum_DL_Power (dB) and Minimum_DL_Power (dB) are power limits for one channelisation code, relative to the primary CPICH power [6].

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

5.2.1.4 Site selection diversity transmit power control

5.2.1.4.1 General

Site selection diversity transmit power control (SSDT) is another macro diversity method in soft handover mode. This method is optional in UTRAN.

Operation is summarised as follows. The UE selects one of the cells from its active set to be 'primary', all other cells are classed as 'non primary'. The main objective is to transmit on the downlink from the primary cell, thus reducing the interference caused by multiple transmissions in a soft handover mode. A second objective is to achieve fast site selection without network intervention, thus maintaining the advantage of the soft handover. In order to select a primary cell, each cell is assigned a temporary identification (ID) and UE periodically informs a primary cell ID to the connecting cells. The non-primary cells selected by UE switch off the transmission power. The primary cell ID is delivered by UE to the active cells via uplink FBI field. SSDT activation, SSDT termination and ID assignment are all carried out by higher layer signalling.

SSDT is only supported when the P-CPICH is used as the downlink phase reference and closed loop mode transmit diversity is not used simultaneously. Simultaneous operation of SSDT and HS-SCCH or F-DPCH reception is not supported.

UTRAN may also command UE to use SSDT signalling in the uplink although cells would transmit the downlink as without SSDT active. In case SSDT is used in the uplink direction only, the processing in the UE for the radio links received in the downlink is as with macro diversity in non-SSDT case. The downlink operation mode for SSDT is set by higher layers. UTRAN may use the SSDT information for the PDSCH power control as specified in section 5.2.2 and for the TFCI power control in hard split mode. SSDT signaling in the uplink is only supported when the P-CPICH is used as the downlink phase reference and closed loop mode transmit diversity is not used simultaneously. Simultaneous operation of SSDT signalling in the uplink and HS-SCCH or F-DPCH reception is not supported.

NOTE: This feature of SSDT limited to uplink only applies to terminals that are DSCH capable.

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

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

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

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

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

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

Annex B (Informative): Power control

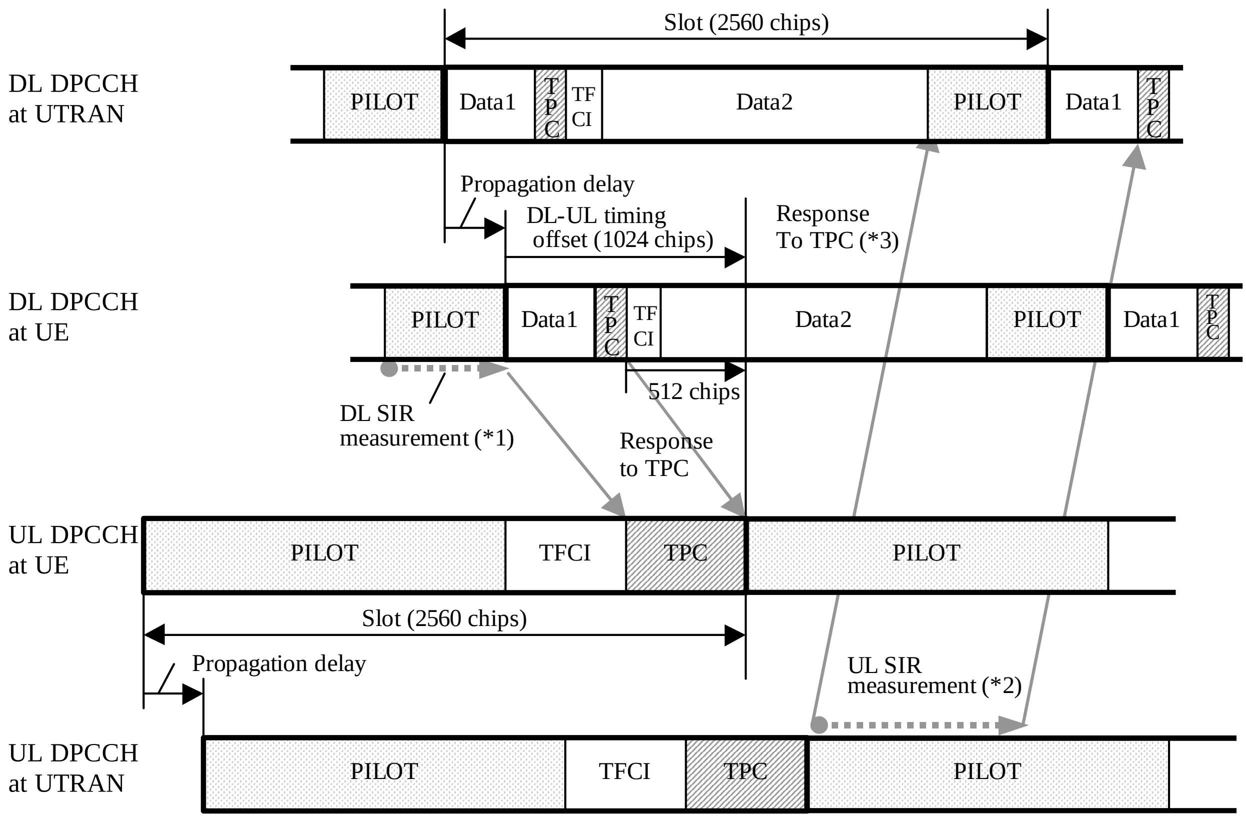
B.1 Downlink power control timing

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

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

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

Figure B.1 illustrates an example of transmitter power control timings.



1,2 The SIR measurement periods illustrated here are examples. Other ways of measurement are allowed to achieve accurate SIR estimation.

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

Figure B.1: Transmitter power control timing

B.2 Example of implementation in the UE

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

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

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

When the UE is in soft handover and SSDT is not activated, the UE should estimate SIR_{est} from the downlink signals of all cells in the active set.

When SSDT is activated, the UE should estimate SIR_{est} from the downlink signals of the primary cell as described in 5.2.1.4.2. If the state of the cells (primary or non-primary) in the active set is changed and the UE sends the last portion of the coded ID in uplink slot j, the UE should change the basis for the estimation of SIR_{est} at the beginning of downlink slot $(j+1+T_{os})$ mod 15, where T_{os} is defined as a constant of 2 time slots.

3GPP TSG-RAN WG1 Meeting #40
Scottsdale, USA, 14th- 18th February 2005

Tdoc R1-050133 ⌘

CR-Form-v7

CHANGE REQUEST

⌘	**25.215**	**CR** **155**	⌘ **rev**	**-**	⌘ Current version:	**6.1.0** ⌘

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

Title: ⌘	Introduction of F-DPCH without pilot field		
Source: ⌘	RAN WG1		
Work item code: ⌘	RANimp-RABSE-CodeOptFDD	***Date:*** ⌘	08/02/2005
Category: ⌘	**B**	***Release:*** ⌘	Rel-6
	Use <u>one</u> of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use <u>one</u> of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

Reason for change: ⌘	This CR introduces Fractional DPCH without pilot field into the specifications
Summary of change: ⌘	Relevant UE and UTRAN measurements are updated: • UE : UE Rx-Tx time difference • UTRAN : Transmitted Code Power, Round-Trip-Time
Consequences if not approved: ⌘	

Clauses affected: ⌘	3.2, 5.1.10, 5.2.5, 5.2.8				
	Y	**N**			
Other specs affected: ⌘	**Y**		Other core specifications	⌘	25.211, 25.212, 25.213, 25.214, 25.302, 25.331, 25.423, 25.433, 25.101, 25.133
			Test specifications		
			O&M Specifications		
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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.

3 Definitions and Abbreviations

3.1 Definitions

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

cell portion: A geographical part of a cell for which a Node B measurement can be reported to the RNC. A cell portion is semi-static, and identical for both the UL and the DL. Within a cell, a cell portion is uniquely identified by a cell portion ID.

Note 1: a cell portion is not necessarily analogous to actual beams used for transmission and/or reception of e.g. a DPCH at the Node B.
Note 2: RNC may associate physical channels with cell portions.

3.2 Abbreviations

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

BER	Bit Error Rate
BLER	Block Error Rate
Ec/No	Received energy per chip divided by the power density in the band
F-DPCH	Fractional Dedicated Physical Channel
ISCP	Interference Signal Code Power
RL	Radio Link
RSCP	Received Signal Code Power
RSSI	Received Signal Strength Indicator
SIR	Signal to Interference Ratio

5.1.10 UE Rx-Tx time difference

Definition	The difference in time between the UE uplink DPCCH frame transmission and the first detected path (in time), of the downlink DPCH or F-DPCH frame from the measured radio link. Type 1 and Type 2 are defined. For Type 1, the reference Rx path shall be the first detected path (in time) amongst the paths (from the measured radio link) used in the demodulation process. For Type 2, the reference Rx path shall be the first detected path (in time) amongst all paths (from the measured radio link) detected by the UE. The reference path used for the measurement may therefore be different for Type 1 and Type 2. The reference point for the UE Rx-Tx time difference shall be the antenna connector of the UE. Measurement shall be made for each cell included in the active set.
Applicable for	CELL_DCH intra

5.2.5 Transmitted code power

Definition	Transmitted code power, is the transmitted power on one channelisation code on one given scrambling code on one given carrier. For DPCH, ~~M~~measurement shall be possible on the DPCCH-field of any dedicated radio link transmitted from the UTRAN access point and shall reflect the power on the pilot bits of the DPCCH-field. For F-DPCH, measurement shall be possible on the TPC-field and shall reflect the power on the TPC bits. When measuring the transmitted code power in compressed mode all slots shall be included in the measurement, e.g. also the slots in the transmission gap shall be included in the measurement. The reference point for the transmitted code power measurement shall be the Tx antenna connector. In case of Tx diversity the transmitted code power for each branch shall be measured and summed together in [W].

5.2.6 Transport channel BER

Definition	The transport channel BER is an estimation of the average bit error rate (BER) of the DPDCH data of a Radio Link Set. The transport channel (TrCH) BER is measured from the data considering only non-punctured bits at the input of the channel decoder in Node B. It shall be possible to report an estimate of the transport channel BER for a TrCH after the end of each TTI of the TrCH. The reported TrCH BER shall be an estimate of the BER during the latest TTI for that TrCH.

5.2.7 Physical channel BER

Definition	The Physical channel BER is an estimation of the average bit error rate (BER) on the DPCCH of a Radio Link Set. An estimate of the Physical channel BER shall be possible to be reported after the end of each TTI of any of the transferred TrCHs. The reported physical channel BER shall be an estimate of the BER averaged over the latest TTI of the respective TrCH.

5.2.8 Round trip time

Definition	Round trip time (RTT), is defined as RTT = $T_{RX} – T_{TX}$, where T_{TX} = The time of transmission of the beginning of a downlink DPCH or F-DPCH frame to a UE. The reference point for T_{TX} shall be the Tx antenna connector. T_{RX} = The time of reception of the beginning (the first detected path, in time) of the corresponding uplink DPCCH frame from the UE. The reference point for T_{RX} shall be the Rx antenna connector. Measurement shall be possible on DPCH or F-DPCH for each RL transmitted from an UTRAN access point and DPDCH for each RL received in the same UTRAN access point.