TSG-RAN Meeting #8 ***RP-000271***
Düsseldorf, Germany, 21-23 June 2000

Title: **Agreed CRs to TS 25.221**

Source: **TSG-RAN WG1**

Agenda item: **5.1.3**

No.	Doc #	Spec	CR	Rev	Subject	Cat	Current_v	New_v
1	R1-000629	25.221	018	1	Removal of the reference to ODMA	D	3.2.0	3.3.0
2	R1-000463	25.221	019	-	Editorial changes in transport channels section	D	3.2.0	3.3.0
3	R1-000583	25.221	020	1	TPC transmission for TDD	F	3.2.0	3.3.0
4	R1-000628	25.221	021	-	Editorial modification of 25.221	D	3.2.0	3.3.0
5	R1-000651	25.221	023	-	Clarifications on TxDiversity for UTRA TDD	D	3.2.0	3.3.0
6	R1-000654	25.221	024	-	Clarifications on PCH and PICH in UTRA TDD	F	3.2.0	3.3.0

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00-0629*
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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25.221 CR 018r1 Current Version: 3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: TSG RAN #8	for approval	X	strategic		(for SMG
list expected approval meeting # here ↑	for information		non-strategic		use only)

Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: (U)SIM [ ] ME [ ] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: TSG RAN WG1 **Date:** 10, May, 2000

Subject: Removal of the reference to ODMA

Work item: TS 25.221

Category:				**Release:**		
	F	Correction			Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature			Release 97	
shall be marked	C	Functional modification of feature			Release 98	
with an X)	D	Editorial modification	X		Release 99	X
					Release 00	

Reason for change: The references to ODMA is removed from the TDD specification since ODMA is not supported for R99.

Clauses affected: Contents, 5.2, 5.3.3, 6, 6.1, 6.2.5

Other specs affected:			
	Other 3G core specifications		→ List of CRs:
	Other GSM core specifications		→ List of CRs:
	MS test specifications		→ List of CRs:
	BSS test specifications		→ List of CRs:
	O&M specifications		→ List of CRs:

Other comments:

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Contents

Foreword

This Technical Specification has been produced by the 3GPP.

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

Version 3.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 Indicates TSG approved document under change control.

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

z the third digit is incremented when editorial only changes have been incorporated in the specification;

1 Scope

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

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

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

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

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

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

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

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

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

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

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

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

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

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

[13] 3G TS 25.401: "UTRAN Overall Description"

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

3 Abbreviations

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

BCH	Broadcast Channel
CCPCH	Common Control Physical Channel
CCTrCH	Coded Composite Transport Channel
CDMA	Code Division Multiple Access
DPCH	Dedicated Physical Channel
DSCH	Downlink Shared Channel
FACH	Forward Access Channel
FDD	Frequency Division Duplex
FEC	Forward Error Correction
GP	Guard Period
GSM	Global System for Mobile Communication
NRT	Non-Real Time
OVSF	Orthogonal Variable Spreading Factor
P-CCPCH	Primary CCPCH
PCH	Paging Channel

PDSCH	Physical Downlink Shared Channel
PDU	Protocol Data Unit
PICH	Page Indicator Channel
PRACH	Physical Random Access Channel
PUSCH	Physical Uplink Shared Channel
RACH	Random Access Channel
RLC	Radio Link Control
RF	Radio Frame
RT	Real Time
S-CCPCH	Secondary CCPCH
SCH	Synchronisation Channel
SFN	Cell System Frame Number
TCH	Traffic Channel
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
USCH	Uplink Shared Channel

4 Transport channels

4.1 Transport channels

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

- common channels (where there is a need for in-band identification of the UEs when particular UEs are addressed) and
- dedicated channels (where the UEs are identified by the physical channel)

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

4.1.1 Dedicated transport channels

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

4.1.2 Common transport channels

Common transport channels are:

1) Broadcast Channel (BCH)

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

2) Paging Channel (PCH)

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

3) Forward Access Channel(s) (FACH)

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

4) Random Access Channel(s) (RACH)

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

5) Uplink Shared Channel (USCH)

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

6) Downlink Shared Channel (DSCH)

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

5 Physical channels

All physical channels take three-layer structure with respect to timeslots, radio frames and system frame numbering (SFN), see [14]. Depending on the resource allocation, the configuration of radio frames or timeslots becomes different. All physical channels need guard symbols in every timeslot. The time slots are used in the sense of a TDMA component to separate different user signals in the time and the code domain. The physical channel signal format is presented in figure 1.
A physical channel in TDD is a burst, which is transmitted in a particular timeslot within allocated Radio Frames. The allocation can be continuous, i.e. the time slot in every frame is allocated to the physical channel or discontinuous, i.e. the time slot in a subset of all frames is allocated only. A burst is the combination of a data part, a midamble and a guard period. The duration of a burst is one time slot. Several bursts can be transmitted at the same time from one transmitter. In this case, the data part must use different OVSF channelisation codes, but the same scrambling code. The midamble part has to use the same basic midamble code, but can use different midambles.

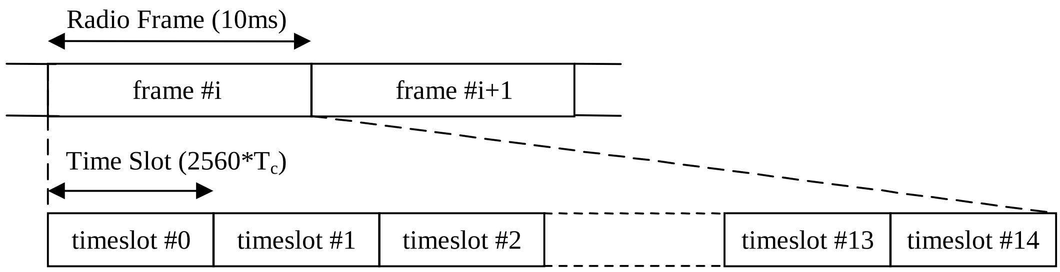


Figure 1: Physical channel signal format

The data part of the burst is spread with a combination of channelisation code and scrambling code. The channelisation code is a OVSF code, that can have a spreading factor of 1, 2, 4, 8, or 16. The data rate of the physical channel is depending on the used spreading factor of the used OVSF code.
The midamble part of the burst can contain two different types of midambles: a short one of length 256 chips, or a long one of 512 chips. The data rate of the physical channel is depending on the used midamble length.
So a physical channel is defined by frequency, timeslot, channelisation code, burst type and Radio Frame allocation The scrambling code and the basic midamble code are broadcast and may be constant within a cell. When a physical channel is established, a start frame is given. The physical channels can either be of infinite duration, or a duration for the allocation can be defined.

5.1 Frame structure

The TDMA frame has a duration of 10 ms and is subdivided into 15 time slots (TS) of $2560{*}T_c$ duration each. A time slot corresponds to 2560 chips. The physical content of the time slots are the bursts of corresponding length as described in section 5.2.2.
Each 10 ms frame consists of 15 time slots, each allocated to either the uplink or the downlink (figure 2). With such a flexibility , the TDD mode can be adapted to different environments and

deployment scenarios. In any configuration at least one time slot has to be allocated for the downlink and at least one time slot has to be allocated for the uplink.

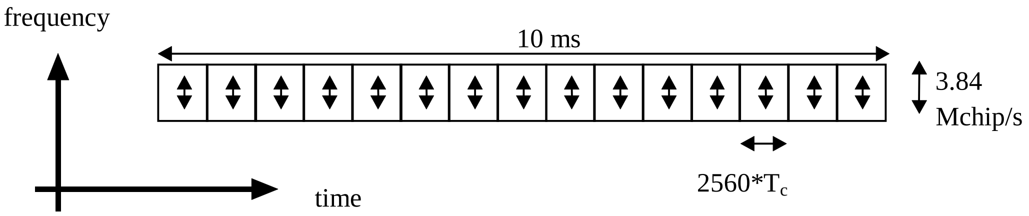
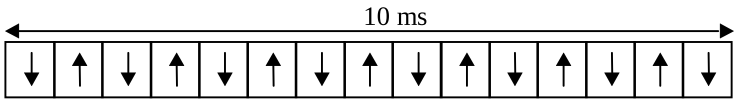
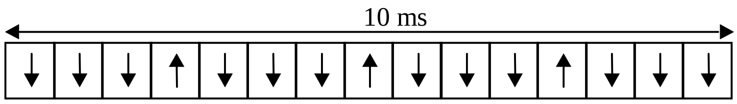


Figure 2: The TDD frame structure

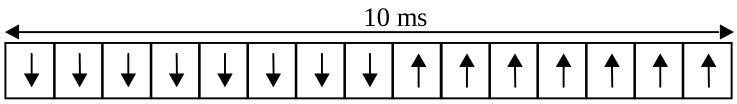
Examples for multiple and single switching point configurations as well as for symmetric and asymmetric UL/DL allocations are given in figure 3.



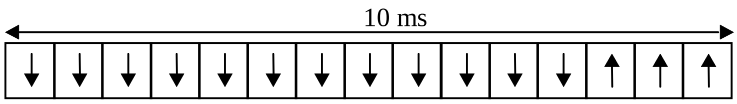
Multiple-switching-point configuration (symmetric DL/UL allocation)



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



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



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

Figure 3: TDD frame structure examples

5.2 Dedicated physical channel (DPCH)

The DCH ~~or in case of ODMA networks the ODCH~~ as described in section 4.1.1 ~~are~~ is mapped onto the dedicated physical channel.

5.2.1 Spreading

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

5.2.1.1 Spreading for Downlink Physical Channels

Downlink physical channels shall use SF =16. Multiple parallel physical channels can be used to support higher data rates. These parallel physical channels shall be transmitted using different channelisation codes, see [8]. These codes with SF =16 are generated as described in [8]. Operation with a single code with spreading factor 1 is possible for the downlink physical channels.

5.2.1.2 Spreading for Uplink Physical Channels

The range of spreading factor that may be used for uplink physical channels shall range from 16 down to 1.
For multicode transmission a UE shall use a maximum of two physical channels per timeslot simultaneously. These two parallel physical channels shall be transmitted using different channelisation codes, see [8].

5.2.2 Burst Types

Two types of bursts for dedicated physical channels are defined: The burst type 1 and the burst type 2. Both consist of two data symbol fields, a midamble and a guard period. The bursts type 1 has a longer midamble of 512 chips than the burst type 2 with a midamble of 256 chips. Sample sets of midambles are given in section 5.2.3.1.
Because of the longer midamble, the burst type 1 is suited for the uplink, where up to 16 different channel impulse responses can be estimated. The burst type 2 can be used for the downlink and, if the bursts within a time slot are allocated to less than four users, also for the uplink.
Thus the burst type 1 can be used for

- uplink, independent of the number of active users in one time slot
- downlink, independent of the number of active users in one time slot

The burst type 2 can be used for

- uplink, if the bursts within a time slot are allocated to less than four users
- downlink, independent of the number of active users in one time slot

The data fields of the burst type 1 are 976 chips long, whereas the data fields length of the burst type 2 are 1104 chips long. The corresponding number of symbols depends on the spreading factor, as indicated in table 1 below. The guard period for the burst type 1and type 2 is 96 chip periods long.
The bursts type 1 and type 2 are shown in Figure 4 and Figure 5. The contents of the burst fields are described in table 2 and table 3.

Table 1: number of symbols per data field in bursts 1 and 2

Spreading factor (Q)	Number of symbols (N) per data field in Burst 1	Number of symbols (N) per data field in Burst 2
1	976	1104
2	488	552
4	244	276
8	122	138
16	61	69

Table 2: The contents of the burst type 1 fields

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

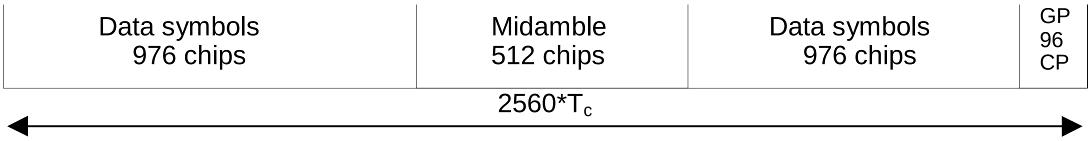


Figure 4: **Burst structure of the burst type 1. GP denotes the guard period and CP the chip periods**

Table 3: The contents of the burst type 2 fields

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

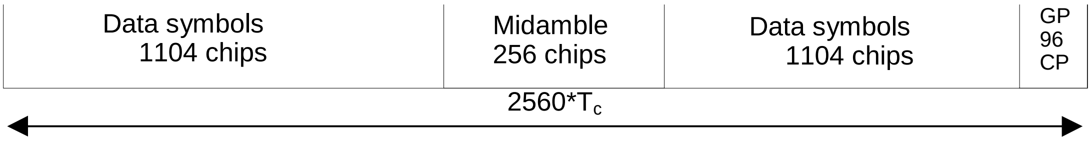


Figure 5: **Burst structure of the burst type 2. GP denotes the guard period and CP the chip periods**

The two different bursts defined here are well-suited for the different applications mentioned above. It may be possible to further optimise the burst structure for specific applications, for instance for unlicensed operation.

5.2.2.1 Transmission of TFCI

Both burst types 1 and 2 provide the possibility for transmission of TFCI both in up- and downlink. The transmission of TFCI is negotiated at call setup and can be re-negotiated during the call. For each CCTrCH it is indicated by higher layer signalling, which TFCI format is applied. Additionally for each allocated timeslot it is signalled individually whether that timeslot carries the TFCI or not.If a time slot contains the TFCI, then it is always transmitted using the first allocated channelisation code in the timeslot, according to the order in the higher layer allocation message. The transmission of TFCI is done in the data parts of the respective physical channel, this means TFCI and data bits are subject to the same spreading procedure as depicted in [8]. Hence the midamble structure and length is not changed. The TFCI information is to be transmitted directly adjacent to the midamble, possibly after the TPC. Figure 6 shows the position of the TFCI in a traffic burst, if no TPC is transmitted. Figure 7 shows the position of the TFCI in a traffic burst, if TPC is transmitted.

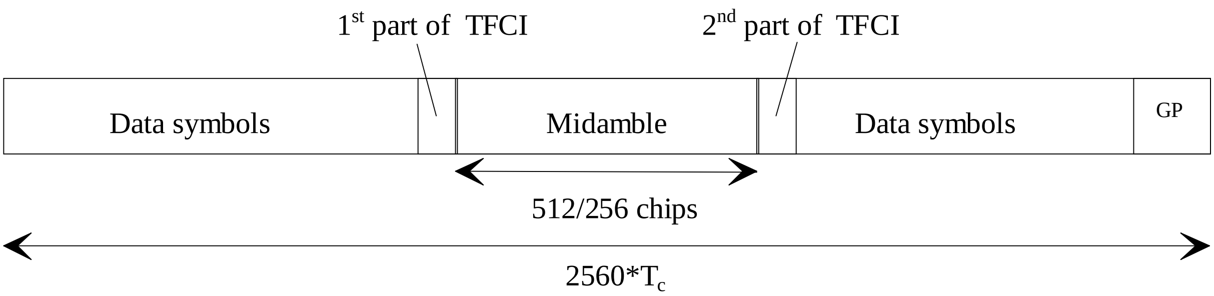


Figure 6: Position of TFCI information in the traffic burst in case of no TPC

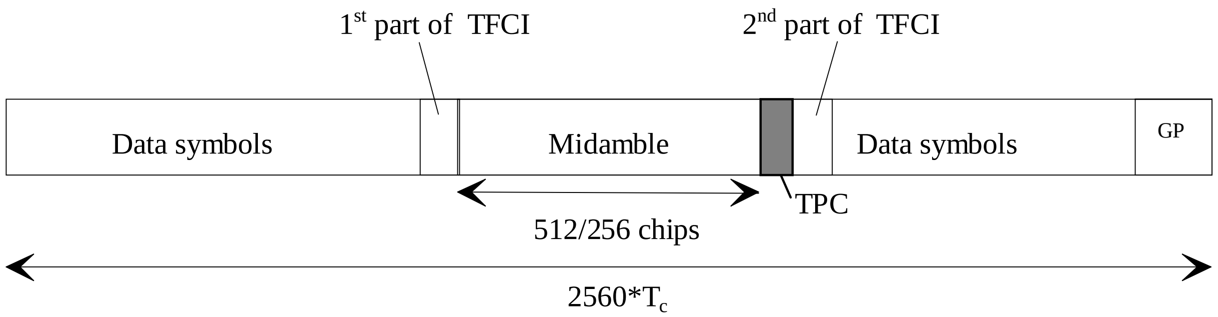


Figure 7: Position of TFCI information in the traffic burst in case of TPC

Two examples of TFCI transmission in the case of multiple DPCHs used for a connection are given in the Figure 8 and Figure 9 below. Combinations of the two schemes shown are also applicable. It should be noted that the SF can vary for the DPCHs not carrying TFCI information.

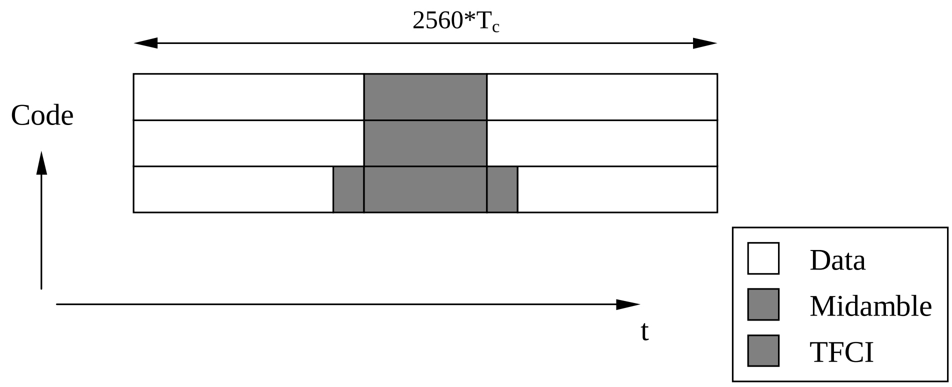


Figure 8: Example of TFCI transmission with physical channels multiplexed in code domain

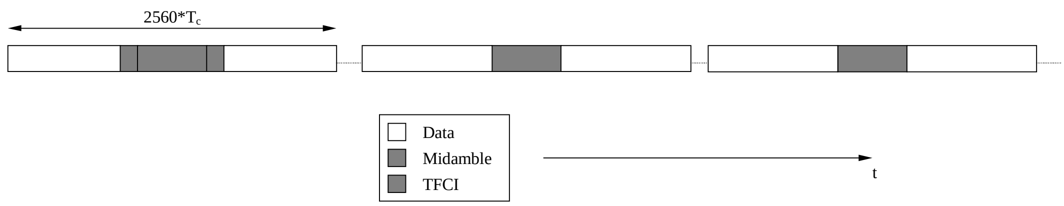


Figure 9: Example of TFCI transmission with physical channels multiplexed in time domain

5.2.2.2 Transmission of TPC

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

The transmission of TPC is negotiated at call setup and can be re-negotiated during the call. If applied, transmission of TPC is done in the data parts of the traffic burst. Hence the midamble structure and length is not changed. The TPC information is to be transmitted directly after the midamble. Figure 10 shows the position of the TPC in a traffic burst.

For every user the TPC information is to be transmitted once per frame. If the TPC is applied, then it is always transmitted using the first allocated channelisation code and the first allocated timeslot, according to the order in the higher layer allocation message. The TPC is spread with the same spreading factor (SF) and spreading code as the data parts of the respective physical channel.

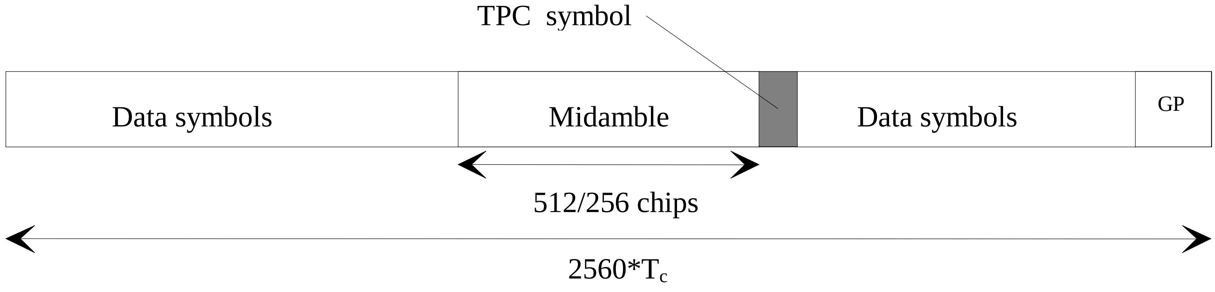


Figure 10: Position of TPC information in the traffic burst

5.2.2.3 Timeslot formats

5.2.2.3.1 Downlink timeslot formats

The downlink timeslot format depends on the spreading factor, midamble length and on the number of the TFCI bits, as depicted in the table 4a.

Table 4a: Time slot formats for the Downlink

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

5.2.2.3.2 Uplink timeslot formats

The uplink timeslot format depends on the spreading factor, midamble length, the TPC presence and on the number of the TFCI bits. In the case that TPC is used, different amount of bits are mapped to the two data fields. The timeslot formats are depicted in the table 4b.

Table 4b: Timeslot formats for the Uplink

Slot Format #	Spreading Factor	Midamble length (chips)	N_{TFCI} (bits)	N_{TPC} (bits)	Bits/slot	$N_{Data/Slot}$ (bits)	$N_{data/data\ field(1)}$ (bits)	$N_{data/data\ field(2)}$ (bits)
0	16	512	0	0	244	244	122	122
1	16	512	4	0	244	240	120	120
2	16	512	8	0	244	236	118	118
3	16	512	16	0	244	228	114	114
4	16	512	32	0	244	212	106	106
5	16	512	0	2	244	242	122	120
6	16	512	4	2	244	238	120	118
7	16	512	8	2	244	234	118	116
8	16	512	16	2	244	226	114	112
9	16	512	32	2	244	210	106	104
10	16	256	0	0	276	276	138	138
11	16	256	4	0	276	272	136	136
12	16	256	8	0	276	268	134	134
13	16	256	16	0	276	260	130	130
14	16	256	32	0	276	244	122	122
15	16	256	0	2	276	274	138	136
16	16	256	4	2	276	270	136	134
17	16	256	8	2	276	266	134	132
18	16	256	16	2	276	258	130	128
19	16	256	32	2	276	242	122	120
20	8	512	0	0	488	488	244	244
21	8	512	4	0	488	484	242	242
22	8	512	8	0	488	480	240	240
23	8	512	16	0	488	472	236	236
24	8	512	32	0	488	456	228	228
25	8	512	0	2	488	486	244	242
26	8	512	4	2	488	482	242	240
27	8	512	8	2	488	478	240	238
28	8	512	16	2	488	470	236	234
29	8	512	32	2	488	454	228	226
30	8	256	0	0	552	552	276	276
31	8	256	4	0	552	548	274	274
32	8	256	8	0	552	544	272	272
33	8	256	16	0	552	536	268	268
34	8	256	32	0	552	520	260	260
35	8	256	0	2	552	550	276	274
36	8	256	4	2	552	546	274	272
37	8	256	8	2	552	542	272	270
38	8	256	16	2	552	534	268	266
39	8	256	32	2	552	518	260	258
40	4	512	0	0	976	976	488	488
41	4	512	4	0	976	972	486	486
42	4	512	8	0	976	968	484	484
43	4	512	16	0	976	960	480	480
44	4	512	32	0	976	944	472	472
45	4	512	0	2	976	974	488	486
46	4	512	4	2	976	970	486	484
47	4	512	8	2	976	966	484	482

Slot Format #	Spreading Factor	Midamble length (chips)	N_{TFCI} (bits)	N_{TPC} (bits)	Bits/slot	$N_{Data/Slot}$ (bits)	$N_{data/data\ field(1)}$ (bits)	$N_{data/data\ field(2)}$ (bits)
48	4	512	16	2	976	958	480	478
49	4	512	32	2	976	942	472	470
50	4	256	0	0	1104	1104	552	552
51	4	256	4	0	1104	1100	550	550
52	4	256	8	0	1104	1096	548	548
53	4	256	16	0	1104	1088	544	544
54	4	256	32	0	1104	1072	536	536
55	4	256	0	2	1104	1102	552	550
56	4	256	4	2	1104	1098	550	548
57	4	256	8	2	1104	1094	548	546
58	4	256	16	2	1104	1086	544	542
59	4	256	32	2	1104	1070	536	534
60	2	512	0	0	1952	1952	976	976
61	2	512	4	0	1952	1948	974	974
62	2	512	8	0	1952	1944	972	972
63	2	512	16	0	1952	1936	968	968
64	2	512	32	0	1952	1920	960	960
65	2	512	0	2	1952	1950	976	974
66	2	512	4	2	1952	1946	974	972
67	2	512	8	2	1952	1942	972	970
68	2	512	16	2	1952	1934	968	966
69	2	512	32	2	1952	1918	960	958
70	2	256	0	0	2208	2208	1104	1104
71	2	256	4	0	2208	2204	1102	1102
72	2	256	8	0	2208	2200	1100	1100
73	2	256	16	0	2208	2192	1096	1096
74	2	256	32	0	2208	2176	1088	1088
75	2	256	0	2	2208	2206	1104	1102
76	2	256	4	2	2208	2202	1102	1100
77	2	256	8	2	2208	2198	1100	1098
78	2	256	16	2	2208	2190	1096	1094
79	2	256	32	2	2208	2174	1088	1086
80	1	512	0	0	3904	3904	1952	1952
81	1	512	4	0	3904	3900	1950	1950
82	1	512	8	0	3904	3896	1948	1948
83	1	512	16	0	3904	3888	1944	1944
84	1	512	32	0	3904	3872	1936	1936
85	1	512	0	2	3904	3902	1952	1950
86	1	512	4	2	3904	3898	1950	1948
87	1	512	8	2	3904	3894	1948	1946
88	1	512	16	2	3904	3886	1944	1942
89	1	512	32	2	3904	3870	1936	1934
90	1	256	0	0	4416	4416	2208	2208
91	1	256	4	0	4416	4412	2206	2206
92	1	256	8	0	4416	4408	2204	2204
93	1	256	16	0	4416	4400	2200	2200
94	1	256	32	0	4416	4384	2192	2192
95	1	256	0	2	4416	4414	2208	2206
96	1	256	4	2	4416	4410	2206	2204
97	1	256	8	2	4416	4406	2204	2202

Slot Format #	Spreading Factor	Midamble length (chips)	N_{TFCI} (bits)	N_{TPC} (bits)	Bits/slot	$N_{Data/Slot}$ (bits)	$N_{data/data\ field(1)}$ (bits)	$N_{data/data\ field(2)}$ (bits)
98	1	256	16	2	4416	4398	2200	2198
99	1	256	32	2	4416	4282	2192	2190

5.2.2.3.3 ACH timeslot formats

For the RACH the timeslot format is only spreading factor dependent. Burst type 1 midamble is always used. The two data fields contain a different number of bits.

Table 4c: Timeslot formats for the RACH

Slot Format #	Spreading Factor	Midamble length (chips)	Bits/slot	$N_{Data/Slot}$ (bits)	$N_{data/data\ field(1)}$ (bits)	$N_{data/data\ field(2)}$ (bits)
0	16	512	232	232	122	110
1	8	512	464	464	244	220

5.2.3 Training sequences for spread bursts

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

The basic midamble codes in Annex A.1 and A.2 are listed in hexadecimal notation. The binary form of the basic midamble code shall be derived according to table 5 below.

Table 5: Mapping of 4 binary elements m_i on a single hexadecimal digit

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

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

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

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

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

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

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

Hence, the elements $\underline{m}_i$ of the complex basic midamble code are alternating real and imaginary.
To derive the required training sequences, this vector $\underline{\mathbf{m}}_\mathrm{P}$ is periodically extended to the size:

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

Notes on equation (4):

- K’, W and P taken from Annex A.1 or A.2 according to burst type and thus to length of midamble L_m
- K=2K’
- $\lfloor x \rfloor$ denotes the largest integer smaller or equal to x

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

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

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

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

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

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

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

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

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

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

Whether intermediate shifts are allowed in a cell is broadcast on the BCH.
The midamble sequences derived according to equations (7) to (9) have complex values and are not subject to spreading or scrambling process, i.e. the elements $\underline{m}_i^{(k)}$ represent complex chips for usage in the pulse shaping process at modulation.
The term ’a midamble code set’ or ’a midamble code family’ denotes K specific midamble codes $\underline{\mathbf{m}}^{(k)}$; k=1,...,K, based on a single basic midamble code $\mathbf{m}_\mathrm{P}$ according to (1).

5.2.3.1 Midamble Transmit Power

If in the downlink all users in one time slot have a common midamble, the transmit power of this common midamble is such that there is no power offset between the data part and the midamble part of the transmit signal within the time slot.

In the case of user specific midambles, the transmit power of the user specific midamble is such that there is no power offset between the data parts and the midamble part for this user within one slot.

5.2.4 Beamforming and Transmit Diversity

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

5.3 Common physical channels

5.3.1 Primary common control physical channel (P-CCPCH)

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

5.3.1.1 P-CCPCH Spreading

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

5.3.1.2 P-CCPCH Burst Types

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

5.3.1.3 P-CCPCH Training sequences

The training sequences, i.e. midambles, as described in section 5.2.3 are used for the P-CCPCH. For those timeslots in which the P-CCPCH is transmitted, the midambles $m^{(1)}$, $m^{(2)}$, $m^{(9)}$ and $m^{(10)}$ are reserved for P-CCPCH in order to support Block STTD antenna diversity and the beacon function, see 5.3.1.4 and 5.4. The use of midambles depends on whether Block STTD is applied to P-CCPCH, see 5.3.1.4.

5.3.1.4 Block STTD antenna diversity for P-CCPCH

Block STTD antenna diversity can be optionally applied for the P-CCPCH. Its support is mandatory for the UE. Two possibilities exist :

- If no antenna diversity is applied to P-CCPCH, $m^{(1)}$ is used and $m^{(2)}$ is left unused.
- If Block STTD antenna diversity is applied to P-CCPCH, $m^{(1)}$ is used for the first antenna and $m^{(2)}$ is used for the diversity antenna.

5.3.2 Secondary common control physical channel (S-CCPCH)

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

5.3.2.1 S-CCPCH Spreading

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

5.2.3.2 S-CCPCH Burst Types

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

5.2.3.3 S-CCPCH Training sequences

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

5.3.3 The physical random access channel (PRACH)

The RACH ~~or in case of ODMA networks the ORACH~~ as described in section 4.1.2 ~~are~~ is mapped onto one or more uplink physical random access channels (PRACH). In such a way the capacity of RACH ~~and ORACH~~ can be flexibly scaled depending on the operators need.
This description of the physical properties of the PRACH also applies to bursts carrying other signaling or user traffic if they are scheduled on a time slot which is (partly) allocated to the RACH. ~~or ORACH~~.

5.3.3.1 PRACH Spreading

The uplink PRACH uses either spreading factor SF=16 or SF=8 as described in section 5.2.1.1. The set of admissible spreading codes for use on the PRACH and the associated spreading factors are broadcast on the BCH (within the RACH configuration parameters on the BCH).

5.3.3.2 PRACH Burst Types

The mobile stations send the uplink access bursts randomly in the PRACH. The PRACH burst consists of two data symbol fields, a midamble and a guard period. The second data symbol field is shorter than the first symbol data field by 96 chips in order to provide additional guard time at the end of the PRACH time slot.
The precise number of collision groups depends on the spreading codes (i.e. the selected RACH configuration. The access burst is depicted in figure 9, the contents of the access burst fields are listed in table 6 and table 7.

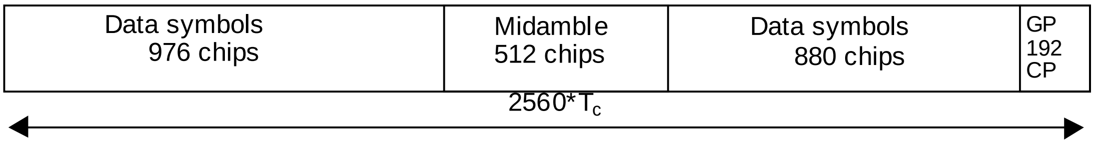


Figure 11: PRACH burst, GP denotes the guard period

Table 6: number of symbols per data field in PRACH burst

Spreading factor (Q)	Number of symbols in data field 1	Number of symbols in data field 2
8	122	110
16	61	55

Table 7: The contents of the PRACH burst field

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

5.3.3.3 PRACH Training sequences

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

For cells with large radius additional midambles may be derived from the time-inverted Basic Midamble Sequence. Thus, the second Basic Midamble Code m_2 is the time inverted version of Basic Midamble Code m_1.
In this way, a joint channel estimation for the channel impulse responses of all active users within one time slot can be performed by a maximum of two cyclic correlations (in cells with small radius, a single cyclic correlator suffices). The different user specific channel impulse response estimates are obtained sequentially in time at the output of the cyclic correlators.

5.3.3.4 Association between Training Sequences and Channelisation Codes

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

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

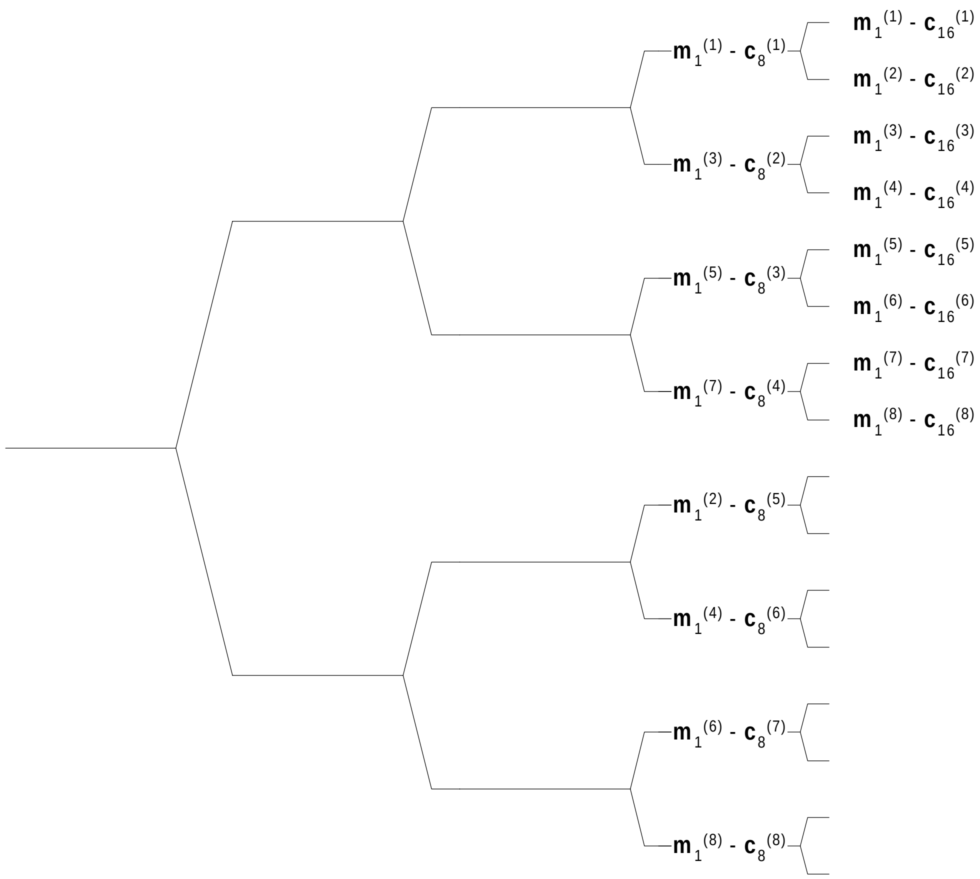


Figure 12: Association of Midambles to Channelisation Codes in the OVSF tree for all *k*

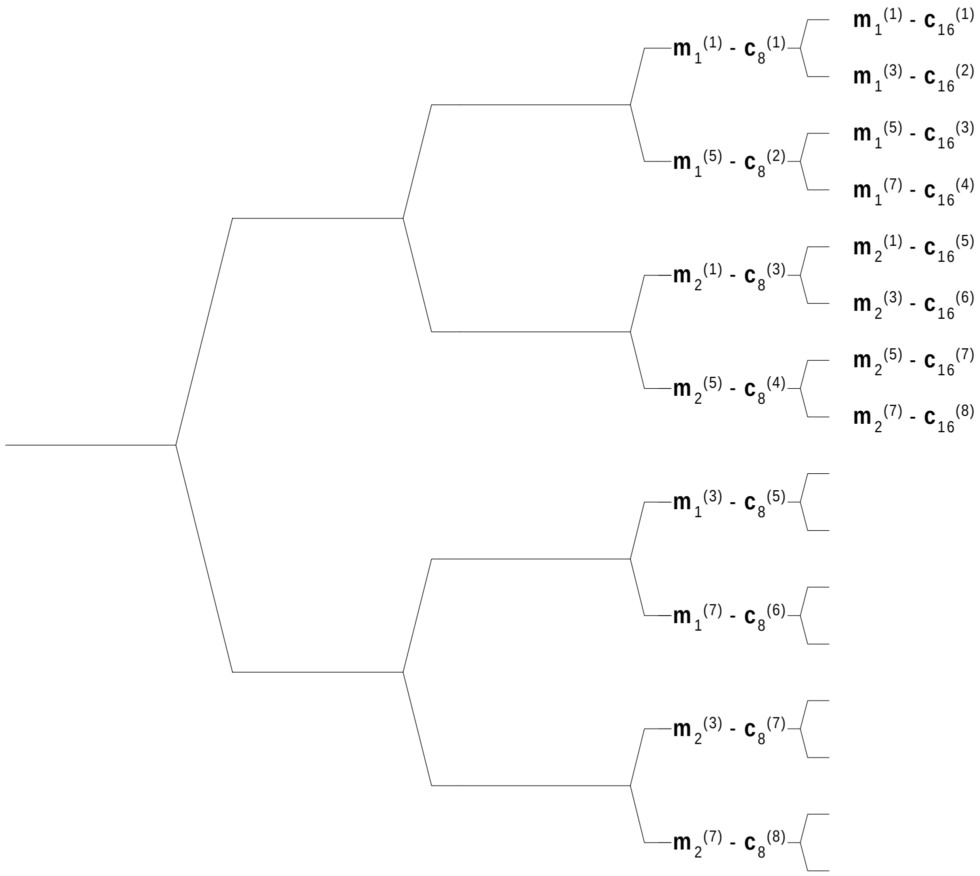


Figure 13: Association of Midambles to Channelisation Codes in the OVSF tree for odd *k*

5.3.4 The synchronisation channel (SCH)

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

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

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

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

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

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

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

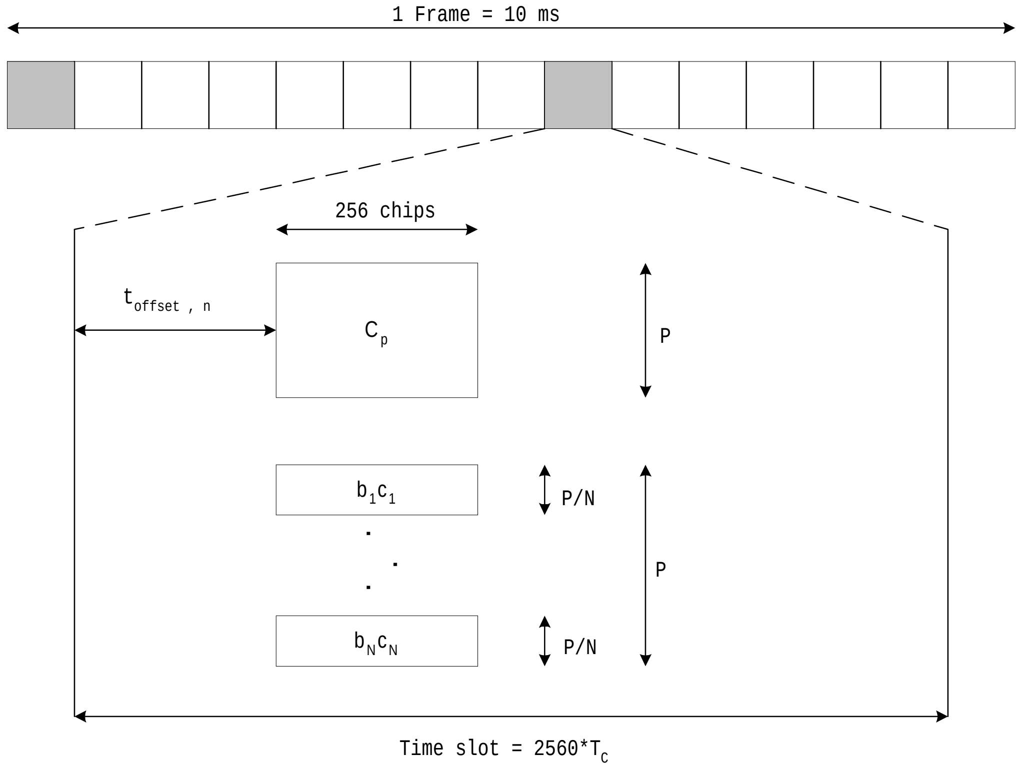


Figure 14: Scheme for Synchronisation channel SCH consisting of one primary sequence C_p and N=3 parallel secondary sequences in slot k and k+8

(example for k=0 in Case 2)

As depicted in figure 14, the SCH consists of a primary and three secondary code sequences with 256 chips length. The primary and secondary code sequences are defined in [8] chapter 7 'Synchronisation codes'.
Due to mobile to mobile interference, it is mandatory for public TDD systems to keep synchronisation between base stations. As a consequence of this, a capture effect concerning SCH can arise. The time offset t_{offset} enables the system to overcome the capture effect.
The time offset t_{offset} is one of 32 values, depending on the cell parameter, thus on the code group of the cell, cf. 'table 7 Mapping scheme for Cell Parameters, Code Groups, Scrambling Codes, Midambles and t_{offset}' in [8]. Note that the cell parameter will change from frame to frame, cf. 'Table 6 Alignment of cell parameter cycling and system frame number' in [8], but the cell will belong to only one code group and thus have one time offset t_{offset}.The exact value for t_{offset}, regarding column 'Associated t_{offset}' in table 7 in [8] is given by:

$$t_{offset,n} = n \cdot T_c \left\lfloor \frac{2560-96-256}{31} \right\rfloor$$
$$= n \cdot 71T_c \;; \quad n = 0,\dots,31$$

Please note that $\lfloor x \rfloor$ denotes the largest integer number less or equal to x and that T_c denotes the chip duration.

5.3.5 Physical Uplink Shared Channel (PUSCH)

For Physical Uplink Shared Channel (PUSCH) the burst structure of DPCH as described in section 5.2 shall be used. User specific physical layer parameters like power control, timing advance or directive antenna settings are derived from the associated channel (FACH or DCH). PUSCH provides the possibility for transmission of TFCI in uplink.

5.3.6 Physical Downlink Shared Channel (PDSCH)

For Physical Downlink Shared Channel (PDSCH) the burst structure of DPCH as described in section 5.2 shall be used. User specific physical layer parameters like power control or directive antenna settings are derived from the associated channel (FACH or DCH). PDSCH provides the possibility for transmission of TFCI in downlink.
To indicate to the UE that there is data to decode on the DSCH, three signalling methods are available:

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

When the midamble based method is used, the UE shall decode the PDSCH if the PDSCH was transmitted with the midamble assigned to the UE by UTRAN, see 5.5.1.1.2. For this method no other physical channels may use the same time slot as the PDSCH and only one UE may share the PDSCH time slot at the same time.

5.3.7 The Page Indicator Channel (PICH)

The Page Indicator Channel (PICH) is a physical channel used to carry the Page Indicators (PI). The PICH substitutes one or more paging sub-channels that are mapped on a S-CCPCH, see 6.2.2. The page indicator indicates a paging message for one or more UEs that are associated with it. PICH is always transmitted at the same reference power level as the P-CCPCH.
The page indicators of length L_{PI}=2, L_{PI}=4 or L_{PI}=8 symbols are transmitted in a normal burst (type 1 or 2) as seen in figure 15. The number of page indicators N_{PI} per time slot is given by the number L_{PI} of symbols for the page indicators and the burst type. In table 8 this number is shown for the different possibilities of burst types and PI lengths.

Table 8 Number N_{PI} of PI per time slot for the different burst types and PI lengths L_{PI}

	L_{PI}=2	L_{PI}=4	L_{PI}=8
Burst Type 1	61	30	15
Burst Type 2	69	34	17

The same burst type is used for the PICH in every cell. In case of L_{PI}=4 or L_{PI}=8, one symbol in each data part adjacent to the midamble is left over. These symbols are filled by dummy bits that are transmitted with the same power as the PI. Figure 15 shows examples for the transmission of page indicators in the different burst types for L_{PI}=4.

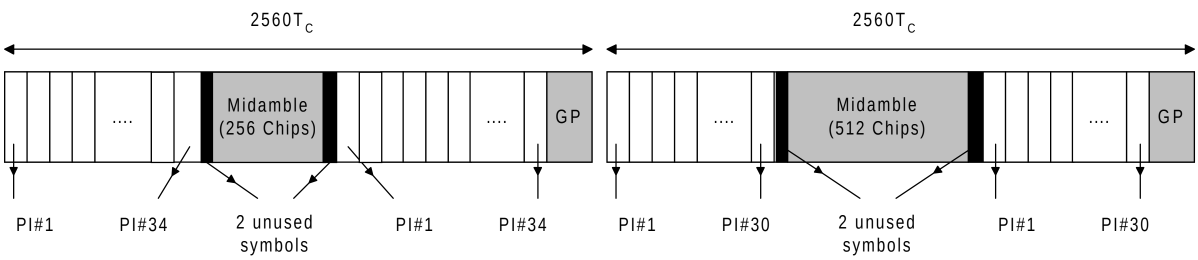


Figure 15: Example of PI Transmission in PICH bursts of different types for L_{PI}=4

5.4 Beacon function of physical channels

For the purpose of measurements, a beacon function shall be provided by particular physical channels.

5.4.1 Location of physical channels with beacon function

The location of the physical channels with beacon function is determined by the SCH and depends on the SCH allocation case, see 5.3.4:

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

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

Note that by this definition the P-CCPCH always provides the beacon function.

5.4.2 Physical characteristics of the beacon function

The physical channels providing the beacon function

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

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

- If no Block STTD antenna diversity is applied to P-CCPCH, all the reference power of any physical channel providing the beacon function is allocated to $m^{(1)}$.
- If Block STTD antenna diversity is applied to P-CCPCH, for any physical channel providing the beacon function midambles $m^{(1)}$ and $m^{(2)}$ are each allocated half of the reference power. Midamble $m^{(1)}$ is used for the first antenna and $m^{(2)}$ is used for the diversity antenna. Block STTD encoding is used for the data in P-CCPCH, see [9]; for all other physical channels identical data sequences are transmitted on both antennas.

5.5 Midamble Allocation for Physical Channels

In general, midambles are part of the physical channel configuration which is performed by higher layers.
Optionally, if no midamble is allocated by higher layers, a default midamble allocation shall be used. This default midamble allocation is given by a fixed association between midambles and channelisation codes, see annex A.3, and shall be applied individually to all channelisation codes within one time slot. Different associations apply for different burst types and cell configurations with respect to the maximum number of midambles.

5.5.1 Midamble Allocation for DL Physical Channels

Physical channels providing the beacon function shall always use the reserved midambles, see 5.4. For all other DL physical channels the midamble allocation is signalled or given by default.

5.5.1.1 Midamble Allocation by signalling

Either a common or a UE specific midamble shall be signalled to the UE as a part of the physical channel configuration. Common or UE specific midambles may be applied only if the conditions in Sections 5.5.1.1.1 and Section 5.5.1.1.2 hold respectively. If the midamble is not signalled as a part of the physical channel configuration, midamble allocation by default shall be used.

5.5.1.1.1 Common Midamble

A common midamble may be assigned to all physical channels in one time slot, if

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

or

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

5.5.1.1.2 UE specific Midamble

An individual midamble may be assigned to each of the UEs in one time slot, if

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

or

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

5.5.1.2 Midamble Allocation by default

If no midamble is allocated by signalling, the UE shall derive the midamble from the associated channelisation code and shall use an individual midamble for each channelisation code. For each association between midambles and channelisation codes in annex A.3, there is one primary channelisation code associated to each midamble. A set of secondary channelisation codes is associated to each primary channelisation code. All the secondary channelisation codes within a set use the same midamble as the primary channelisation code to which they are associated.
Higher layers shall allocate the channelisation codes in a particular order. Primary channelisation codes shall be allocated prior to associated secondary channelisation codes. If midambles are reserved for the beacon function, all primary and secondary channelisation codes that are associated with the reserved midambles shall not be used.
Primary and its associated secondary channelisation codes shall not be allocated to different UE's.
In the case that secondary channelisation codes are used, secondary channelisation codes of one set shall be allocated in ascending order, with respect to their numbering.

5.5.2 Midamble Allocation for UL Physical Channels

If the midamble is part of the physical channel configuration, an individual midamble shall be assigned to all UE's in one time slot.
If no midamble is allocated by higher layers, the UE shall derive the midamble from the assigned channelisation code as for DL physical channels. If the UE changes the SF according to the data rate, it shall always vary the channelisation code along the lower branch of the OVSF tree.

6 Mapping of transport channels to physical channels

This section describes the way in which transport channels are mapped onto physical resources, see figure 16.

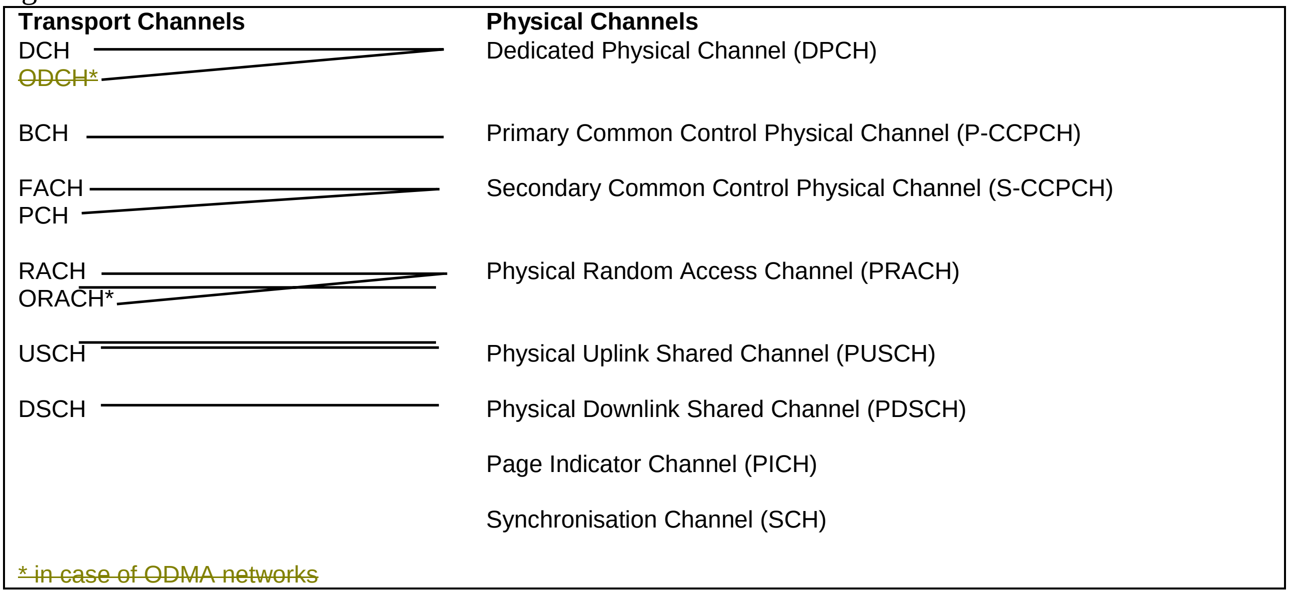


Figure 16: Transport channel to physical channel mapping

6.1 Dedicated Transport Channels

A dedicated transport channel is mapped onto one or more physical channels. An interleaving period is associated with each allocation. The frame is subdivided into slots that are available for uplink and downlink information transfer. The mapping of transport blocks on physical channels is described in TS25.222 ("multiplexing and channel coding").

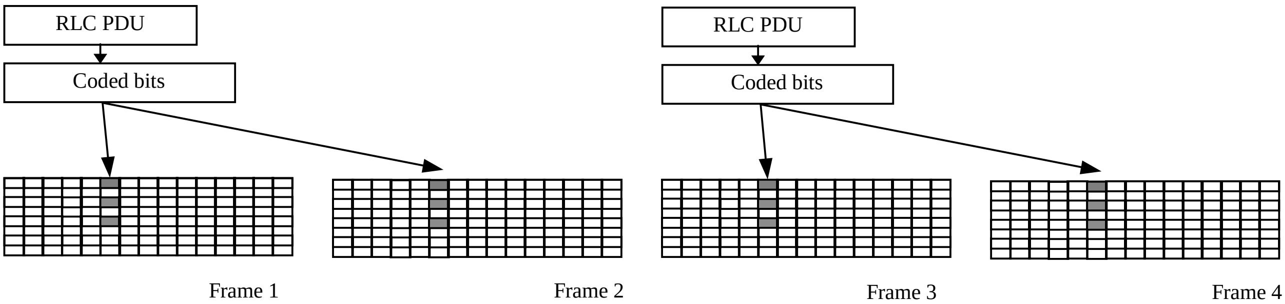


Figure 19: Mapping of PDU onto the physical bearer

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

~~An ODCH is also mapped onto one or more sets of slots and codes within a TDD frame as shown in figure 4. The actual transmission mode (i.e. combination of slots, codes, TX power, interleaving depth etc.) chosen for a relay link will be negotiated between nodes prior to transmission. Several of these transmission mode parameters can be adapted during transmission due to changes in propagation and data traffic.~~

6.2 Common Transport Channels

6.2.1 The Broadcast Channel (BCH)

The BCH is mapped onto the P-CCPCH. The secondary SCH indicates in which timeslot a mobile can find the P-CCPCH containing BCH. If the broadcast information requires more resources than provided by the P-CCPCH, the BCH in P-CCPCH will comprise a pointer to additional S-CCPCH resources for FACH in which this additional broadcast information shall be sent.

6.2.2 The Paging Channel (PCH)

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

To allow an efficient DRX, the PCH is divided into several paging sub-channels within the allocated multiframe structure. Examples of multiframe structures are given in the Annex B of this document. Each paging sub-channel is mapped onto 2 consecutive frames that are allocated to the PCH on the same S-CCPCH. Layer 3 information to a particular paging group is transmitted only in the associated paging sub-channel. The assignment of UEs to paging groups is independent of the assignment of UEs to page indicators.

6.2.3 The Forward Channel (FACH)

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

6.2.4 The Random Access Channel (RACH)

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

~~6.2.5 Common Transport Channels for ODMA networks~~

~~The ORACH is used to transfer short probes or short protocol data units (PDU) between one or more nodes for routing and resource allocation control.~~

~~To limit the transmission time of short probe PDUs on the ORACH then this data should be transmitted as one burst on one code. That is, one probe burst should be transmitted on one 2560*~~$\cancel{T_c}$ ~~timeslot (which as described in section 5.1 would be configured as an ORACH slot).~~

~~Since the ORACH is a common control channel used to transfer probes between one or more nodes a common fixed spreading factor should be adopted~~.

6.2.~~6~~5 The Uplink Shared Channel (USCH)

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

6.2.~~7~~6 The Downlink Shared Channel (DSCH)

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

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Document *R1-00-0463*
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

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25.221 CR 019 Current Version: 3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: TSG RAN #8	for approval	X	strategic		(for SMG
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Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: (U)SIM [ ] ME [ ] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: TSG RAN WG1 **Date:** 28, March 2000

Subject: Editorial changes in Transport Channels section

Work item: TS 25.221

Category:				**Release:**		
	F	Correction			Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature			Release 97	
shall be marked	C	Functional modification of feature			Release 98	
with an X)	D	Editorial modification	X		Release 99	X
					Release 00	

Reason for change: Alignment with FDD specification 25.211

Clauses affected: 4.

Other specs affected:			
	Other 3G core specifications		→ List of CRs:
	Other GSM core specifications		→ List of CRs:
	MS test specifications		→ List of CRs:
	BSS test specifications		→ List of CRs:
	O&M specifications		→ List of CRs:

Other comments:

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4 Transport channels

~~4.1 Transport channels~~

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

- Dedicated Channels , using inherent addressing of UE
- ~~c~~Common ~~c~~Channels ~~(where there is a need for in-band identification of the UEs when particular UEs are addressed) and~~ , using explicit addressing of UE if addressing is needed
- ~~dedicated channels (where the UEs are identified by the physical channel)~~

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

4.1.~~1~~ Dedicated transport channels

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

4.~~1.2~~2 Common transport channels

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

4.2.1 BCH - Broadcast Channel

~~1) Broadcast Channel (BCH)~~

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

4.2.2 FACH – Forward Access Channel

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

4.2.3 PCH – Paging Channel

~~2) Paging Channel (PCH)~~

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

~~3) Forward Access Channel(s) (FACH)~~

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

~~4) Random Access Channel(s) (RACH)~~

4.2.4 RACH – Random Access Channel

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

~~6) Uplink Shared Channel (USCH)~~

4.2.~~5~~5 USCH – Uplink Shared Channel

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

~~7) Downlink Shared Channel (DSCH)~~

4.2.~~6~~6 DSCH – Downlink Shared Channel

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

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25.221	**CR**	**020r1**	Current Version:	3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to:	TSG RAN#8	for approval	X	strategic		(for SMG use only)
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Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: TSG RAN WG1 **Date:** 2000-04-04

Subject: TPC transmission for TDD

Work item:

Category:				**Release:**		
	F	Correction	X		Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature			Release 97	
shall be marked	C	Functional modification of feature			Release 98	
with an X)	D	Editorial modification			Release 99	X
					Release 00	

Reason for change: WG1 description has to be aligned with higher layer descriptions, TPC transmission should be mandatory for PUSCH and uplink DPCH

Clauses affected: 5.2.2.1, 5.2.2.2, 5.2.2.3

Other specs affected:				
	Other 3G core specifications		→ List of CRs:	
	Other GSM core specifications		→ List of CRs:	
	MS test specifications		→ List of CRs:	
	BSS test specifications		→ List of CRs:	
	O&M specifications		→ List of CRs:	

Other comments:

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5.2 Dedicated Physical Channel (DPCH)

5.2.2.1 Transmission of TFCI

Both burst types 1 and 2 provide the possibility for transmission of TFCI both in up- and downlink.

The transmission of TFCI is negotiated at call setup and can be re-negotiated during the call. For each CCTrCH it is indicated by higher layer signalling, which TFCI format is applied. Additionally for each allocated timeslot it is signalled individually whether that timeslot carries the TFCI or not.If a time slot contains the TFCI, then it is always transmitted using the first allocated channelisation code in the timeslot, according to the order in the higher layer allocation message.

The transmission of TFCI is done in the data parts of the respective physical channel, this means TFCI and data bits are subject to the same spreading procedure as depicted in [8]. Hence the midamble structure and length is not changed. The TFCI information is to be transmitted directly adjacent to the midamble, possibly after the TPC. Figure 6 shows the position of the TFCI in a traffic burst in downlink~~, if no TPC is transmitted~~. Figure 7 shows the position of the TFCI in a traffic burst in uplink~~, if TPC is transmitted~~.

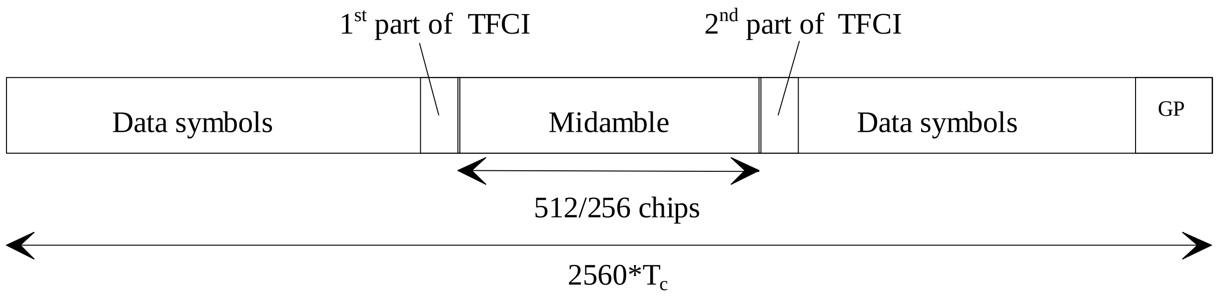

Figure 6: Position of TFCI information in the traffic burst in case of downlink~~no TPC~~

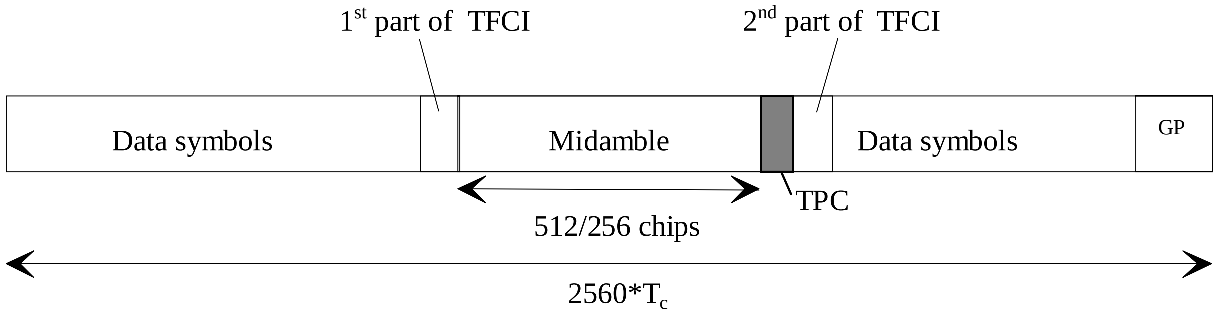

Figure 7: Position of TFCI information in the traffic burst in case of uplink ~~TPC~~

Two examples of TFCI transmission in the case of multiple DPCHs used for a connection are given in the Figure 8 and Figure 9 below. Combinations of the two schemes shown are also applicable. It should be noted that the SF can vary for the DPCHs not carrying TFCI information.

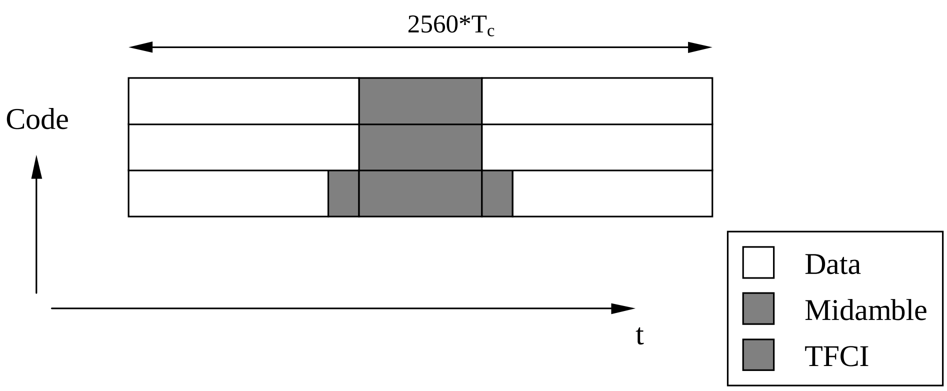

Figure 8: Example of TFCI transmission with physical channels multiplexed in code domain

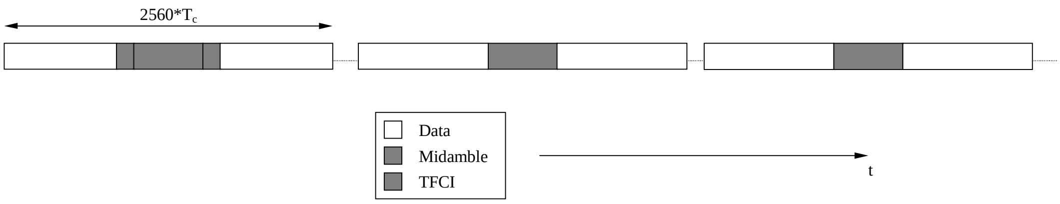

Figure 9: Example of TFCI transmission with physical channels multiplexed in time domain

5.2.2.2 Transmission of TPC

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

~~The transmission of TPC is negotiated at call setup and can be re-negotiated during the call. If applied,~~The transmission of TPC is done in the data parts of the traffic burst. Hence the midamble structure and length is not changed. The TPC information is to be transmitted directly after the midamble. Figure 10 shows the position of the TPC in a traffic burst.

For every user the TPC information shall~~is to~~ be transmitted at least once per transmitted frame. If TFCI is applied for a CCTrCH, TPC shall be transmitted with the same channelization codes and in the same timeslots as TFCI. ~~If the TPC is applied, then iIt~~If no TFCI is applied for a CCTrCH, TPC shall be~~is always~~ transmitted using the first allocated channelisation code and the first allocated timeslot, according to the order in the higher layer allocation message. The TPC is spread with the same spreading factor (SF) and spreading code as the data parts of the respective physical channel.

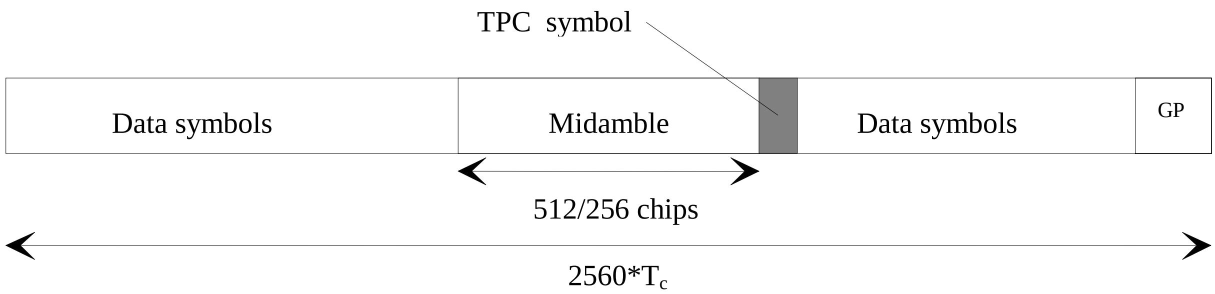

Figure 10: Position of TPC information in the traffic burst

5.2.2.3 Timeslot formats

5.2.2.3.1 Downlink timeslot formats

The downlink timeslot format depends on the spreading factor, midamble length and on the number of the TFCI bits, as depicted in the table 4a.

Table 4a: Time slot formats for the Downlink

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

5.2.2.3.2 Uplink timeslot formats

The uplink timeslot format depends on the spreading factor, midamble length~~, the TPC presence~~ and on the number of the TFCI bits. Due to TPC ~~In the case that TPC is used~~, different amount of bits are mapped to the two data fields. The timeslot formats are depicted in the table 4b.

Table 4b: Timeslot formats for the Uplink

Slot Format #	Spreading Factor	Midamble length (chips)	N_{TFCI} (bits)	N_{TPC} (bits)	Bits/slot	$N_{Data/Slot}$ (bits)	$N_{data/data field(1)}$ (bits)	$N_{data/data field(2)}$ (bits)
0	16	512	0	0	244	244	122	122
~~1~~	~~16~~	~~512~~	~~4~~	~~0~~	~~244~~	~~240~~	~~120~~	~~120~~
~~2~~	~~16~~	~~512~~	~~8~~	~~0~~	~~244~~	~~236~~	~~118~~	~~118~~
~~3~~	~~16~~	~~512~~	~~16~~	~~0~~	~~244~~	~~228~~	~~114~~	~~114~~
~~4~~	~~16~~	~~512~~	~~32~~	~~0~~	~~244~~	~~212~~	~~106~~	~~106~~
5	16	512	0	2	244	242	122	120
6	16	512	4	2	244	238	120	118
7	16	512	8	2	244	234	118	116
8	16	512	16	2	244	226	114	112
9	16	512	32	2	244	210	106	104
10	16	256	0	0	276	276	138	138
~~11~~	~~16~~	~~256~~	~~4~~	~~0~~	~~276~~	~~272~~	~~136~~	~~136~~
~~12~~	~~16~~	~~256~~	~~8~~	~~0~~	~~276~~	~~268~~	~~134~~	~~134~~
~~13~~	~~16~~	~~256~~	~~16~~	~~0~~	~~276~~	~~260~~	~~130~~	~~130~~
~~14~~	~~16~~	~~256~~	~~32~~	~~0~~	~~276~~	~~244~~	~~122~~	~~122~~
15	16	256	0	2	276	274	138	136
16	16	256	4	2	276	270	136	134
17	16	256	8	2	276	266	134	132
18	16	256	16	2	276	258	130	128
19	16	256	32	2	276	242	122	120
20	8	512	0	0	488	488	244	244
~~21~~	~~8~~	~~512~~	~~4~~	~~0~~	~~488~~	~~484~~	~~242~~	~~242~~
~~22~~	~~8~~	~~512~~	~~8~~	~~0~~	~~488~~	~~480~~	~~240~~	~~240~~
~~23~~	~~8~~	~~512~~	~~16~~	~~0~~	~~488~~	~~472~~	~~236~~	~~236~~
~~24~~	~~8~~	~~512~~	~~32~~	~~0~~	~~488~~	~~456~~	~~228~~	~~228~~
25	8	512	0	2	488	486	244	242
26	8	512	4	2	488	482	242	240
27	8	512	8	2	488	478	240	238
28	8	512	16	2	488	470	236	234
29	8	512	32	2	488	454	228	226
30	8	256	0	0	552	552	276	276
~~31~~	~~8~~	~~256~~	~~4~~	~~0~~	~~552~~	~~548~~	~~274~~	~~274~~
~~32~~	~~8~~	~~256~~	~~8~~	~~0~~	~~552~~	~~544~~	~~272~~	~~272~~
~~33~~	~~8~~	~~256~~	~~16~~	~~0~~	~~552~~	~~536~~	~~268~~	~~268~~
~~34~~	~~8~~	~~256~~	~~32~~	~~0~~	~~552~~	~~520~~	~~260~~	~~260~~
35	8	256	0	2	552	550	276	274
36	8	256	4	2	552	546	274	272
37	8	256	8	2	552	542	272	270
38	8	256	16	2	552	534	268	266
39	8	256	32	2	552	518	260	258
40	4	512	0	0	976	976	488	488
~~41~~	~~4~~	~~512~~	~~4~~	~~0~~	~~976~~	~~972~~	~~486~~	~~486~~
~~42~~	~~4~~	~~512~~	~~8~~	~~0~~	~~976~~	~~968~~	~~484~~	~~484~~
~~43~~	~~4~~	~~512~~	~~16~~	~~0~~	~~976~~	~~960~~	~~480~~	~~480~~
~~44~~	~~4~~	~~512~~	~~32~~	~~0~~	~~976~~	~~944~~	~~472~~	~~472~~
45	4	512	0	2	976	974	488	486
46	4	512	4	2	976	970	486	484
47	4	512	8	2	976	966	484	482

Slot Format #	Spreading Factor	Midamble length (chips)	N_{TFCI} (bits)	N_{TPC} (bits)	Bits/slot	$N_{Data/Slot}$ (bits)	$N_{data/data\ field(1)}$ (bits)	$N_{data/data\ field(2)}$ (bits)
48	4	512	16	2	976	958	480	478
49	4	512	32	2	976	942	472	470
50	4	256	0	0	1104	1104	552	552
~~51~~	~~4~~	~~256~~	~~4~~	~~0~~	~~1104~~	~~1100~~	~~550~~	~~550~~
~~52~~	~~4~~	~~256~~	~~8~~	~~0~~	~~1104~~	~~1096~~	~~548~~	~~548~~
~~53~~	~~4~~	~~256~~	~~16~~	~~0~~	~~1104~~	~~1088~~	~~544~~	~~544~~
~~54~~	~~4~~	~~256~~	~~32~~	~~0~~	~~1104~~	~~1072~~	~~536~~	~~536~~
55	4	256	0	2	1104	1102	552	550
56	4	256	4	2	1104	1098	550	548
57	4	256	8	2	1104	1094	548	546
58	4	256	16	2	1104	1086	544	542
59	4	256	32	2	1104	1070	536	534
60	2	512	0	0	1952	1952	976	976
~~61~~	~~2~~	~~512~~	~~4~~	~~0~~	~~1952~~	~~1948~~	~~974~~	~~974~~
~~62~~	~~2~~	~~512~~	~~8~~	~~0~~	~~1952~~	~~1944~~	~~972~~	~~972~~
~~63~~	~~2~~	~~512~~	~~16~~	~~0~~	~~1952~~	~~1936~~	~~968~~	~~968~~
~~64~~	~~2~~	~~512~~	~~32~~	~~0~~	~~1952~~	~~1920~~	~~960~~	~~960~~
65	2	512	0	2	1952	1950	976	974
66	2	512	4	2	1952	1946	974	972
67	2	512	8	2	1952	1942	972	970
68	2	512	16	2	1952	1934	968	966
69	2	512	32	2	1952	1918	960	958
70	2	256	0	0	2208	2208	1104	1104
~~71~~	~~2~~	~~256~~	~~4~~	~~0~~	~~2208~~	~~2204~~	~~1102~~	~~1102~~
~~72~~	~~2~~	~~256~~	~~8~~	~~0~~	~~2208~~	~~2200~~	~~1100~~	~~1100~~
~~73~~	~~2~~	~~256~~	~~16~~	~~0~~	~~2208~~	~~2192~~	~~1096~~	~~1096~~
~~74~~	~~2~~	~~256~~	~~32~~	~~0~~	~~2208~~	~~2176~~	~~1088~~	~~1088~~
75	2	256	0	2	2208	2206	1104	1102
76	2	256	4	2	2208	2202	1102	1100
77	2	256	8	2	2208	2198	1100	1098
78	2	256	16	2	2208	2190	1096	1094
79	2	256	32	2	2208	2174	1088	1086
80	1	512	0	0	3904	3904	1952	1952
~~81~~	~~1~~	~~512~~	~~4~~	~~0~~	~~3904~~	~~3900~~	~~1950~~	~~1950~~
~~82~~	~~1~~	~~512~~	~~8~~	~~0~~	~~3904~~	~~3896~~	~~1948~~	~~1948~~
~~83~~	~~1~~	~~512~~	~~16~~	~~0~~	~~3904~~	~~3888~~	~~1944~~	~~1944~~
~~84~~	~~1~~	~~512~~	~~32~~	~~0~~	~~3904~~	~~3872~~	~~1936~~	~~1936~~
85	1	512	0	2	3904	3902	1952	1950
86	1	512	4	2	3904	3898	1950	1948
87	1	512	8	2	3904	3894	1948	1946
88	1	512	16	2	3904	3886	1944	1942
89	1	512	32	2	3904	3870	1936	1934
90	1	256	0	0	4416	4416	2208	2208
~~91~~	~~1~~	~~256~~	~~4~~	~~0~~	~~4416~~	~~4412~~	~~2206~~	~~2206~~
~~92~~	~~1~~	~~256~~	~~8~~	~~0~~	~~4416~~	~~4408~~	~~2204~~	~~2204~~
~~93~~	~~1~~	~~256~~	~~16~~	~~0~~	~~4416~~	~~4400~~	~~2200~~	~~2200~~
~~94~~	~~1~~	~~256~~	~~32~~	~~0~~	~~4416~~	~~4384~~	~~2192~~	~~2192~~
95	1	256	0	2	4416	4414	2208	2206
96	1	256	4	2	4416	4410	2206	2204
97	1	256	8	2	4416	4406	2204	2202

Slot Format #	**Spreading Factor**	**Midamble length (chips)**	**N_{TFCI} (bits)**	**N_{TPC} (bits)**	**Bits/slot**	**$N_{Data/Slot}$ (bits)**	**$N_{data/data field(1)}$ (bits)**	**$N_{data/data field(2)}$ (bits)**
98	1	256	16	2	4416	4398	2200	2198
99	1	256	32	2	4416	43~~2~~82	2192	2190

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e.g. for 3GPP use the format TP-99xxx
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25.221 CR 021 Current Version: 3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: TSG RAN #8	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑	for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: (U)SIM [ ] ME [ ] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: TSG RAN WG1 **Date:** 10, May 2000

Subject: Editorial modification of 25.221

Work item: TS 25.221

Category: *(only one category shall be marked with an X)*

F	Correction		**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature			Release 98	
D	Editorial modification	X		Release 99	X
				Release 00	

Reason for change:

Clauses affected: Contents, 5.2.2.3.3 (removed), 5.2.3, 5.3.3.2.2 (new), 5.3.4

Other specs affected:

Other 3G core specifications		→ List of CRs:	
Other GSM core specifications		→ List of CRs:	
MS test specifications		→ List of CRs:	
BSS test specifications		→ List of CRs:	
O&M specifications		→ List of CRs:	

Other comments:

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<--------- double-click here for help and instructions on how to create a CR.

Contents

Foreword

This Technical Specification has been produced by the 3GPP.

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

Version 3.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 Indicates TSG approved document under change control.

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

z the third digit is incremented when editorial only changes have been incorporated in the specification;

1 Scope

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

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

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

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

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

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

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

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

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

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

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

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

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

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

[13] 3G TS 25.401: "UTRAN Overall Description"

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

3 Abbreviations

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

BCH Broadcast Channel
CCPCH Common Control Physical Channel
CCTrCH Coded Composite Transport Channel
CDMA Code Division Multiple Access
DPCH Dedicated Physical Channel

DSCH	Downlink Shared Channel
FACH	Forward Access Channel
FDD	Frequency Division Duplex
FEC	Forward Error Correction
GP	Guard Period
GSM	Global System for Mobile Communication
NRT	Non-Real Time
OVSF	Orthogonal Variable Spreading Factor
P-CCPCH	Primary CCPCH
PCH	Paging Channel
PDSCH	Physical Downlink Shared Channel
PDU	Protocol Data Unit
PICH	Page Indicator Channel
PRACH	Physical Random Access Channel
PUSCH	Physical Uplink Shared Channel
RACH	Random Access Channel
RLC	Radio Link Control
RF	Radio Frame
RT	Real Time
S-CCPCH	Secondary CCPCH
SCH	Synchronisation Channel
SFN	Cell System Frame Number
TCH	Traffic Channel
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
USCH	Uplink Shared Channel

4 Transport channels

4.1 Transport channels

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

- common channels (where there is a need for in-band identification of the UEs when particular UEs are addressed) and

- dedicated channels (where the UEs are identified by the physical channel)

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

4.1.1 Dedicated transport channels

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

4.1.2 Common transport channels

Common transport channels are:

1) Broadcast Channel (BCH)

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

2) Paging Channel (PCH)

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

3) Forward Access Channel(s) (FACH)

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

4) Random Access Channel(s) (RACH)

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

5) Uplink Shared Channel (USCH)

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

6) Downlink Shared Channel (DSCH)

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

5 Physical channels

All physical channels take three-layer structure with respect to timeslots, radio frames and system frame numbering (SFN), see [14]. Depending on the resource allocation, the configuration of radio frames or timeslots becomes different. All physical channels need guard symbols in every timeslot. The time slots are used in the sense of a TDMA component to separate different user signals in the time and the code domain. The physical channel signal format is presented in figure 1.
A physical channel in TDD is a burst, which is transmitted in a particular timeslot within allocated Radio Frames. The allocation can be continuous, i.e. the time slot in every frame is allocated to the physical channel or discontinuous, i.e. the time slot in a subset of all frames is allocated only. A burst is the combination of a data part, a midamble and a guard period. The duration of a burst is one time slot. Several bursts can be transmitted at the same time from one transmitter. In this case, the data part must use different OVSF channelisation codes, but the same scrambling code. The midamble part has to use the same basic midamble code, but can use different midambles.

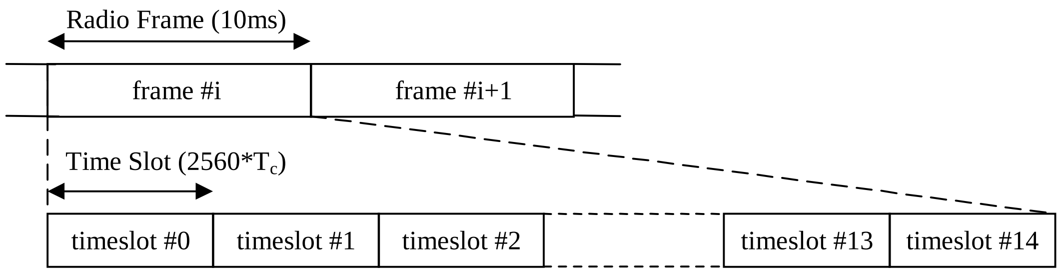


Figure 1: Physical channel signal format

The data part of the burst is spread with a combination of channelisation code and scrambling code. The channelisation code is a OVSF code, that can have a spreading factor of 1, 2, 4, 8, or 16. The data rate of the physical channel is depending on the used spreading factor of the used OVSF code.
The midamble part of the burst can contain two different types of midambles: a short one of length 256 chips, or a long one of 512 chips. The data rate of the physical channel is depending on the used midamble length.
So a physical channel is defined by frequency, timeslot, channelisation code, burst type and Radio Frame allocation The scrambling code and the basic midamble code are broadcast and may be constant within a cell. When a physical channel is established, a start frame is given. The physical channels can either be of infinite duration, or a duration for the allocation can be defined.

5.1 Frame structure

The TDMA frame has a duration of 10 ms and is subdivided into 15 time slots (TS) of 2560*T_c duration each. A time slot corresponds to 2560 chips. The physical content of the time slots are the bursts of corresponding length as described in section 5.2.2.
Each 10 ms frame consists of 15 time slots, each allocated to either the uplink or the downlink (figure 2). With such a flexibility , the TDD mode can be adapted to different environments and deployment scenarios. In any configuration at least one time slot has to be allocated for the downlink and at least one time slot has to be allocated for the uplink.

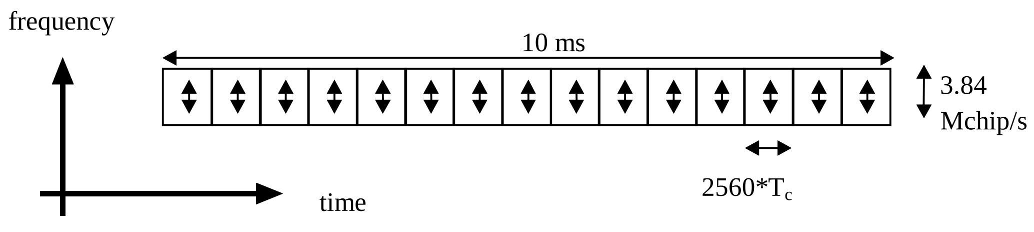
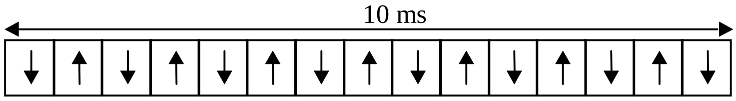
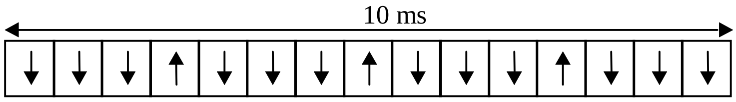


Figure 2: The TDD frame structure

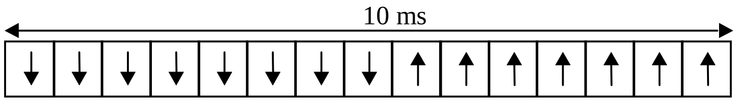
Examples for multiple and single switching point configurations as well as for symmetric and asymmetric UL/DL allocations are given in figure 3.



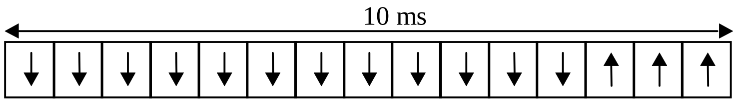
Multiple-switching-point configuration (symmetric DL/UL allocation)



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



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



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

Figure 3: TDD frame structure examples

5.2 Dedicated physical channel (DPCH)

The DCH or in case of ODMA networks the ODCH as described in section 4.1.1 are mapped onto the dedicated physical channel.

5.2.1 Spreading

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

5.2.1.1 Spreading for Downlink Physical Channels

Downlink physical channels shall use SF =16. Multiple parallel physical channels can be used to support higher data rates. These parallel physical channels shall be transmitted using different channelisation codes, see [8]. These codes with SF =16 are generated as described in [8].
Operation with a single code with spreading factor 1 is possible for the downlink physical channels.

5.2.1.2 Spreading for Uplink Physical Channels

The range of spreading factor that may be used for uplink physical channels shall range from 16 down to 1.
For multicode transmission a UE shall use a maximum of two physical channels per timeslot simultaneously. These two parallel physical channels shall be transmitted using different channelisation codes, see [8].

5.2.2 Burst Types

Two types of bursts for dedicated physical channels are defined: The burst type 1 and the burst type 2. Both consist of two data symbol fields, a midamble and a guard period. The bursts type 1 has a longer midamble of 512 chips than the burst type 2 with a midamble of 256 chips. Sample sets of midambles are given in section 5.2.3.1.
Because of the longer midamble, the burst type 1 is suited for the uplink, where up to 16 different channel impulse responses can be estimated. The burst type 2 can be used for the downlink and, if the bursts within a time slot are allocated to less than four users, also for the uplink.
Thus the burst type 1 can be used for

- uplink, independent of the number of active users in one time slot
- downlink, independent of the number of active users in one time slot

The burst type 2 can be used for

- uplink, if the bursts within a time slot are allocated to less than four users
- downlink, independent of the number of active users in one time slot

The data fields of the burst type 1 are 976 chips long, whereas the data fields length of the burst type 2 are 1104 chips long. The corresponding number of symbols depends on the spreading factor, as indicated in table 1 below. The guard period for the burst type 1and type 2 is 96 chip periods long.
The bursts type 1 and type 2 are shown in Figure 4 and Figure 5. The contents of the burst fields are described in table 2 and table 3.

Table 1: number of symbols per data field in bursts 1 and 2

Spreading factor (Q)	Number of symbols (N) per data field in Burst 1	Number of symbols (N) per data field in Burst 2
1	976	1104
2	488	552
4	244	276
8	122	138
16	61	69

Table 2: The contents of the burst type 1 fields

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

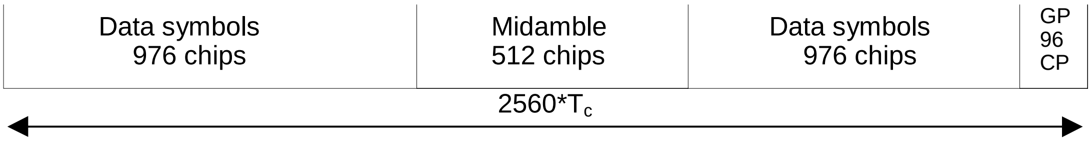


Figure 4: **Burst structure of the burst type 1. GP denotes the guard period and CP the chip periods**

Table 3: The contents of the burst type 2 fields

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

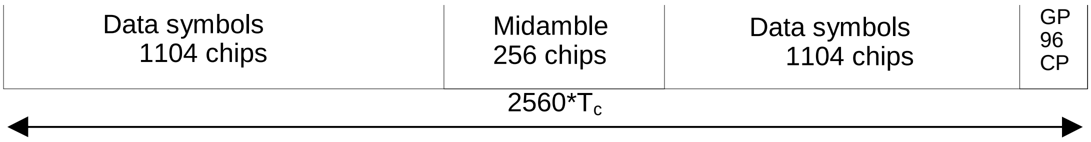


Figure 5: **Burst structure of the burst type 2. GP denotes the guard period and CP the chip periods**

The two different bursts defined here are well-suited for the different applications mentioned above. It may be possible to further optimise the burst structure for specific applications, for instance for unlicensed operation.

5.2.2.1 Transmission of TFCI

Both burst types 1 and 2 provide the possibility for transmission of TFCI both in up- and downlink.
The transmission of TFCI is negotiated at call setup and can be re-negotiated during the call. For each CCTrCH it is indicated by higher layer signalling, which TFCI format is applied. Additionally for each allocated timeslot it is signalled individually whether that timeslot carries the TFCI or not.If a time slot contains the TFCI, then it is always transmitted using the first allocated channelisation code in the timeslot, according to the order in the higher layer allocation message.
The transmission of TFCI is done in the data parts of the respective physical channel, this means TFCI and data bits are subject to the same spreading procedure as depicted in [8]. Hence the midamble structure and length is not changed. The TFCI information is to be transmitted directly adjacent to the midamble, possibly after the TPC. Figure 6 shows the position of the TFCI in a traffic burst, if no TPC is transmitted. Figure 7 shows the position of the TFCI in a traffic burst, if TPC is transmitted.

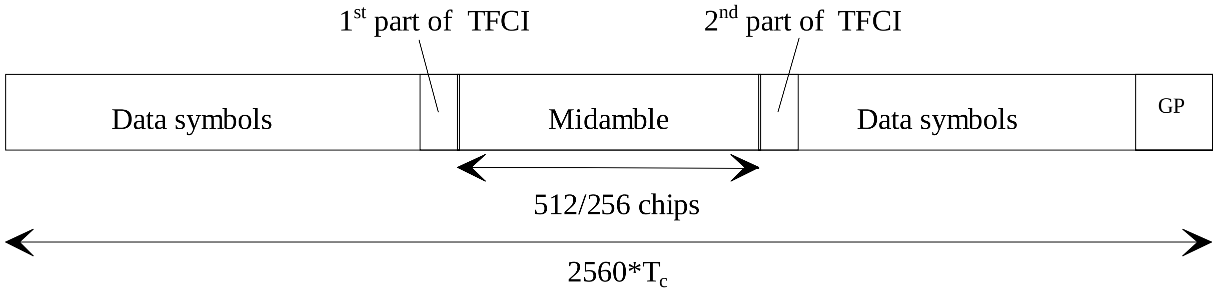


Figure 6: Position of TFCI information in the traffic burst in case of no TPC

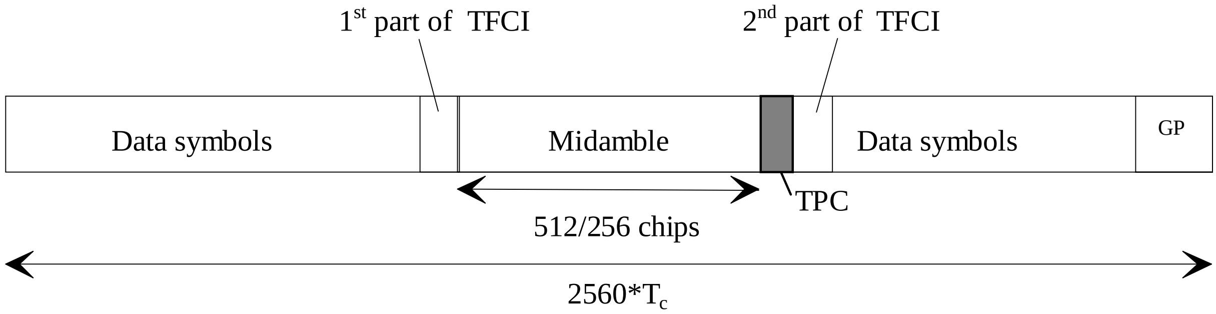


Figure 7: Position of TFCI information in the traffic burst in case of TPC

Two examples of TFCI transmission in the case of multiple DPCHs used for a connection are given in the Figure 8 and Figure 9 below. Combinations of the two schemes shown are also applicable. It should be noted that the SF can vary for the DPCHs not carrying TFCI information.

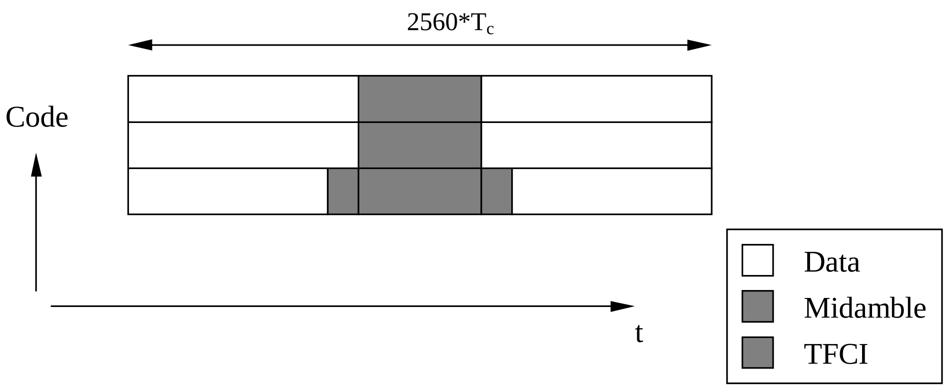


Figure 8: Example of TFCI transmission with physical channels multiplexed in code domain

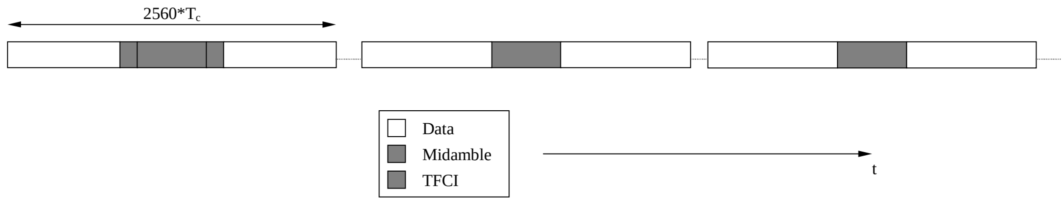


Figure 9: Example of TFCI transmission with physical channels multiplexed in time domain

5.2.2.2 Transmission of TPC

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

The transmission of TPC is negotiated at call setup and can be re-negotiated during the call. If applied, transmission of TPC is done in the data parts of the traffic burst. Hence the midamble structure and length is not changed. The TPC information is to be transmitted directly after the midamble. Figure 10 shows the position of the TPC in a traffic burst.

For every user the TPC information is to be transmitted once per frame. If the TPC is applied, then it is always transmitted using the first allocated channelisation code and the first allocated timeslot, according to the order in the higher layer allocation message. The TPC is spread with the same spreading factor (SF) and spreading code as the data parts of the respective physical channel.

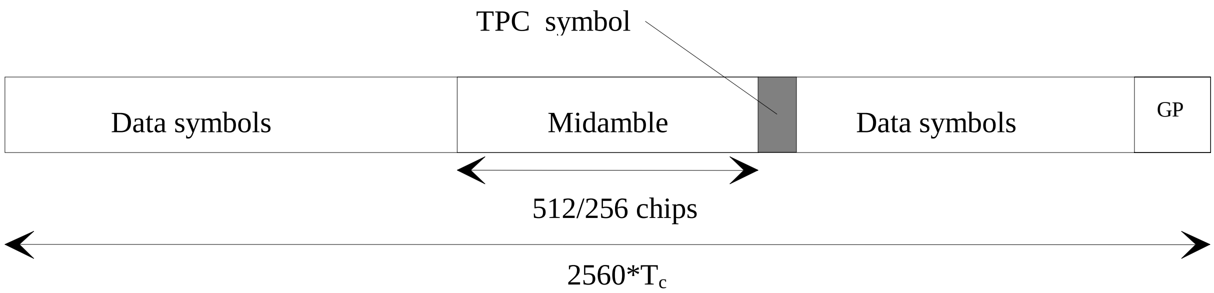


Figure 10: Position of TPC information in the traffic burst

5.2.2.3 Timeslot formats

5.2.2.3.1 Downlink timeslot formats

The downlink timeslot format depends on the spreading factor, midamble length and on the number of the TFCI bits, as depicted in the table 4a.

Table 4a: Time slot formats for the Downlink

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

5.2.2.3.2 Uplink timeslot formats

The uplink timeslot format depends on the spreading factor, midamble length, the TPC presence and on the number of the TFCI bits. In the case that TPC is used, different amount of bits are mapped to the two data fields. The timeslot formats are depicted in the table 4b.

Table 4b: Timeslot formats for the Uplink

Slot Format #	Spreading Factor	Midamble length (chips)	N_{TFCI} (bits)	N_{TPC} (bits)	Bits/slot	$N_{Data/Slot}$ (bits)	$N_{data/data\ field(1)}$ (bits)	$N_{data/data\ field(2)}$ (bits)
0	16	512	0	0	244	244	122	122
1	16	512	4	0	244	240	120	120
2	16	512	8	0	244	236	118	118
3	16	512	16	0	244	228	114	114
4	16	512	32	0	244	212	106	106
5	16	512	0	2	244	242	122	120
6	16	512	4	2	244	238	120	118
7	16	512	8	2	244	234	118	116
8	16	512	16	2	244	226	114	112
9	16	512	32	2	244	210	106	104
10	16	256	0	0	276	276	138	138
11	16	256	4	0	276	272	136	136
12	16	256	8	0	276	268	134	134
13	16	256	16	0	276	260	130	130
14	16	256	32	0	276	244	122	122
15	16	256	0	2	276	274	138	136
16	16	256	4	2	276	270	136	134
17	16	256	8	2	276	266	134	132
18	16	256	16	2	276	258	130	128
19	16	256	32	2	276	242	122	120
20	8	512	0	0	488	488	244	244
21	8	512	4	0	488	484	242	242
22	8	512	8	0	488	480	240	240
23	8	512	16	0	488	472	236	236
24	8	512	32	0	488	456	228	228
25	8	512	0	2	488	486	244	242
26	8	512	4	2	488	482	242	240
27	8	512	8	2	488	478	240	238
28	8	512	16	2	488	470	236	234
29	8	512	32	2	488	454	228	226
30	8	256	0	0	552	552	276	276
31	8	256	4	0	552	548	274	274
32	8	256	8	0	552	544	272	272
33	8	256	16	0	552	536	268	268
34	8	256	32	0	552	520	260	260
35	8	256	0	2	552	550	276	274
36	8	256	4	2	552	546	274	272
37	8	256	8	2	552	542	272	270
38	8	256	16	2	552	534	268	266
39	8	256	32	2	552	518	260	258
40	4	512	0	0	976	976	488	488
41	4	512	4	0	976	972	486	486
42	4	512	8	0	976	968	484	484

Slot Format #	Spreading Factor	Midamble length (chips)	N_{TFCI} (bits)	N_{TPC} (bits)	Bits/slot	$N_{Data/Slot}$ (bits)	$N_{data/data\ field(1)}$ (bits)	$N_{data/data\ field(2)}$ (bits)
43	4	512	16	0	976	960	480	480
44	4	512	32	0	976	944	472	472
45	4	512	0	2	976	974	488	486
46	4	512	4	2	976	970	486	484
47	4	512	8	2	976	966	484	482
48	4	512	16	2	976	958	480	478
49	4	512	32	2	976	942	472	470
50	4	256	0	0	1104	1104	552	552
51	4	256	4	0	1104	1100	550	550
52	4	256	8	0	1104	1096	548	548
53	4	256	16	0	1104	1088	544	544
54	4	256	32	0	1104	1072	536	536
55	4	256	0	2	1104	1102	552	550
56	4	256	4	2	1104	1098	550	548
57	4	256	8	2	1104	1094	548	546
58	4	256	16	2	1104	1086	544	542
59	4	256	32	2	1104	1070	536	534
60	2	512	0	0	1952	1952	976	976
61	2	512	4	0	1952	1948	974	974
62	2	512	8	0	1952	1944	972	972
63	2	512	16	0	1952	1936	968	968
64	2	512	32	0	1952	1920	960	960
65	2	512	0	2	1952	1950	976	974
66	2	512	4	2	1952	1946	974	972
67	2	512	8	2	1952	1942	972	970
68	2	512	16	2	1952	1934	968	966
69	2	512	32	2	1952	1918	960	958
70	2	256	0	0	2208	2208	1104	1104
71	2	256	4	0	2208	2204	1102	1102
72	2	256	8	0	2208	2200	1100	1100
73	2	256	16	0	2208	2192	1096	1096
74	2	256	32	0	2208	2176	1088	1088
75	2	256	0	2	2208	2206	1104	1102
76	2	256	4	2	2208	2202	1102	1100
77	2	256	8	2	2208	2198	1100	1098
78	2	256	16	2	2208	2190	1096	1094
79	2	256	32	2	2208	2174	1088	1086
80	1	512	0	0	3904	3904	1952	1952
81	1	512	4	0	3904	3900	1950	1950
82	1	512	8	0	3904	3896	1948	1948
83	1	512	16	0	3904	3888	1944	1944
84	1	512	32	0	3904	3872	1936	1936
85	1	512	0	2	3904	3902	1952	1950
86	1	512	4	2	3904	3898	1950	1948
87	1	512	8	2	3904	3894	1948	1946

Slot Format #	Spreading Factor	Midamble length (chips)	N_{TFCI} (bits)	N_{TPC} (bits)	Bits/slot	$N_{Data/Slot}$ (bits)	$N_{data/data field(1)}$ (bits)	$N_{data/data field(2)}$ (bits)
88	1	512	16	2	3904	3886	1944	1942
89	1	512	32	2	3904	3870	1936	1934
90	1	256	0	0	4416	4416	2208	2208
91	1	256	4	0	4416	4412	2206	2206
92	1	256	8	0	4416	4408	2204	2204
93	1	256	16	0	4416	4400	2200	2200
94	1	256	32	0	4416	4384	2192	2192
95	1	256	0	2	4416	4414	2208	2206
96	1	256	4	2	4416	4410	2206	2204
97	1	256	8	2	4416	4406	2204	2202
98	1	256	16	2	4416	4398	2200	2198
99	1	256	32	2	4416	4282	2192	2190

~~5.2.2.3.3 RACH timeslot formats~~

~~For the RACH the timeslot format is only spreading factor dependent. Burst type 1 midamble is always used. The two data fields contain a different number of bits.~~

~~Table 4c: Timeslot formats for the RACH~~

~~Slot Format #~~	~~Spreading Factor~~	~~Midamble length (chips)~~	~~Bits/slot~~	~~$N_{Data/Slot}$ (bits)~~	~~$N_{data/data field(1)}$ (bits)~~	~~$N_{data/data field(2)}$ (bits)~~
~~0~~	~~16~~	~~512~~	~~232~~	~~232~~	~~122~~	~~110~~
~~1~~	~~8~~	~~512~~	~~464~~	~~464~~	~~244~~	~~220~~

5.2.3 Training sequences for spread bursts

In this section, the training sequences for usage as midambles in burst type 1 and burst type 2 (see section 5.2.2) are defined. The training sequences, i.e. midambles, of different users active in the same cell and same time slot are cyclically shifted versions of one single basic midamble code. The applicable basic midamble codes are given in Annex A.1 and A.2. As different basic midamble codes are required for different burst formats, the Annex A.1 shows the basic midamble codes $\mathbf{m}_{PL}$ for burst type 1 and Annex and A.2 shows $\mathbf{m}_{PS}$ for burst type 2. It should be noted that the different burst types must not be mixed in the same timeslot of one cell.
The basic midamble codes in Annex A.1 and A.2 are listed in hexadecimal notation. The binary form of the basic midamble code shall be derived according to table 5 below.

Table 5: Mapping of 4 binary elements m_i on a single hexadecimal digit

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

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

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

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

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

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

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

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

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

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

Notes on equation (4):

- K', W and P taken from Annex A.1 or A.2 according to burst type and thus to length of midamble L_m
- K=2K'
- $\lfloor x \rfloor$ denotes the largest integer smaller or equal to x

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

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

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

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

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

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

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

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

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

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

Whether intermediate shifts are allowed in a cell is broadcast on the BCH.
The midamble sequences derived according to equations (7) to (9) have complex values and are not subject to ~~spreading s~~channelisation or scrambling process, i.e. the elements $\underline{m}_i^{(k)}$ represent complex chips for usage in the pulse shaping process at modulation.
The term 'a midamble code set' or 'a midamble code family' denotes K specific midamble codes $\underline{\mathbf{m}}^{(k)}$; k=1,...,K, based on a single basic midamble code $\mathbf{m}_P$ according to (1).

5.2.3.1 Midamble Transmit Power

If in the downlink all users in one time slot have a common midamble, the transmit power of this common midamble is such that there is no power offset between the data part and the midamble part of the transmit signal within the time slot.
In the case of user specific midambles, the transmit power of the user specific midamble is such that there is no power offset between the data parts and the midamble part for this user within one slot.

5.2.4 Beamforming and Transmit Diversity

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

5.3 Common physical channels

5.3.1 Primary common control physical channel (P-CCPCH)

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

5.3.1.1 P-CCPCH Spreading

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

5.3.1.2 P-CCPCH Burst Types

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

5.3.1.3 P-CCPCH Training sequences

The training sequences, i.e. midambles, as described in section 5.2.3 are used for the P-CCPCH. For those timeslots in which the P-CCPCH is transmitted, the midambles $m^{(1)}$, $m^{(2)}$, $m^{(9)}$ and $m^{(10)}$ are reserved for P-CCPCH in order to support Block STTD antenna diversity and the beacon function, see 5.3.1.4 and 5.4. The use of midambles depends on whether Block STTD is applied to P-CCPCH, see 5.3.1.4.

5.3.1.4 Block STTD antenna diversity for P-CCPCH

Block STTD antenna diversity can be optionally applied for the P-CCPCH. Its support is mandatory for the UE. Two possibilities exist :

- If no antenna diversity is applied to P-CCPCH, $m^{(1)}$ is used and $m^{(2)}$ is left unused.
- If Block STTD antenna diversity is applied to P-CCPCH, $m^{(1)}$ is used for the first antenna and $m^{(2)}$ is used for the diversity antenna.

5.3.2 Secondary common control physical channel (S-CCPCH)

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

5.3.2.1 S-CCPCH Spreading

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

5.2.3.2 S-CCPCH Burst Types

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

5.2.3.3 S-CCPCH Training sequences

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

5.3.3 The physical random access channel (PRACH)

The RACH or in case of ODMA networks the ORACH as described in section 4.1.2 are mapped onto one or more uplink physical random access channels (PRACH). In such a

way the capacity of RACH and ORACH can be flexibly scaled depending on the operators need.
This description of the physical properties of the PRACH also applies to bursts carrying other signaling or user traffic if they are scheduled on a time slot which is (partly) allocated to the RACH or ORACH.

5.3.3.1 PRACH Spreading

The uplink PRACH uses either spreading factor SF=16 or SF=8 as described in section 5.2.1.1. The set of admissible spreading codes for use on the PRACH and the associated spreading factors are broadcast on the BCH (within the RACH configuration parameters on the BCH).

5.3.3.2 PRACH Burst Types

The mobile stations send the uplink access bursts randomly in the PRACH. The PRACH burst consists of two data symbol fields, a midamble and a guard period. The second data symbol field is shorter than the first symbol data field by 96 chips in order to provide additional guard time at the end of the PRACH time slot.
The precise number of collision groups depends on the spreading codes (i.e. the selected RACH configuration. The access burst is depicted in figure 9, the contents of the access burst fields are listed in table 6 and table 7.

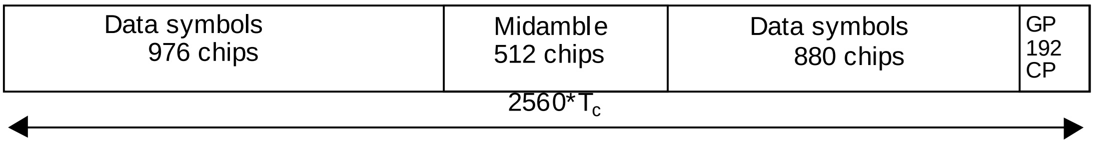


Figure 11: PRACH burst, GP denotes the guard period

Table 6: number of symbols per data field in PRACH burst

Spreading factor (Q)	Number of symbols in data field 1	Number of symbols in data field 2
8	122	110
16	61	55

Table 7: The contents of the PRACH burst field

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

5.3.3.3 PRACH Training sequences

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

or *uneven* k=1,3,5,...≤K' (for cells with large radius). Different cells use different periodic basic codes, i.e. different midamble sets.
For cells with large radius additional midambles may be derived from the time-inverted Basic Midamble Sequence. Thus, the second Basic Midamble Code m_2 is the time inverted version of Basic Midamble Code m_1.
In this way, a joint channel estimation for the channel impulse responses of all active users within one time slot can be performed by a maximum of two cyclic correlations (in cells with small radius, a single cyclic correlator suffices). The different user specific channel impulse response estimates are obtained sequentially in time at the output of the cyclic correlators.

5.3.3.4 RACH timeslot formats

For the RACH the timeslot format is only spreading factor dependent. Burst type 1 midamble is always used. The two data fields contain a different number of bits.

Table 4c: Timeslot formats for the RACH

Slot Format #	Spreading Factor	Midamble length (chips)	Bits/slot	$N_{Data/Slot}$ (bits)	$N_{data/data\ field(1)}$ (bits)	$N_{data/data\ field(2)}$ (bits)
0	16	512	232	232	122	110
1	8	512	464	464	244	220

5.3.3.45 Association between Training Sequences and Channelisation Codes

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

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

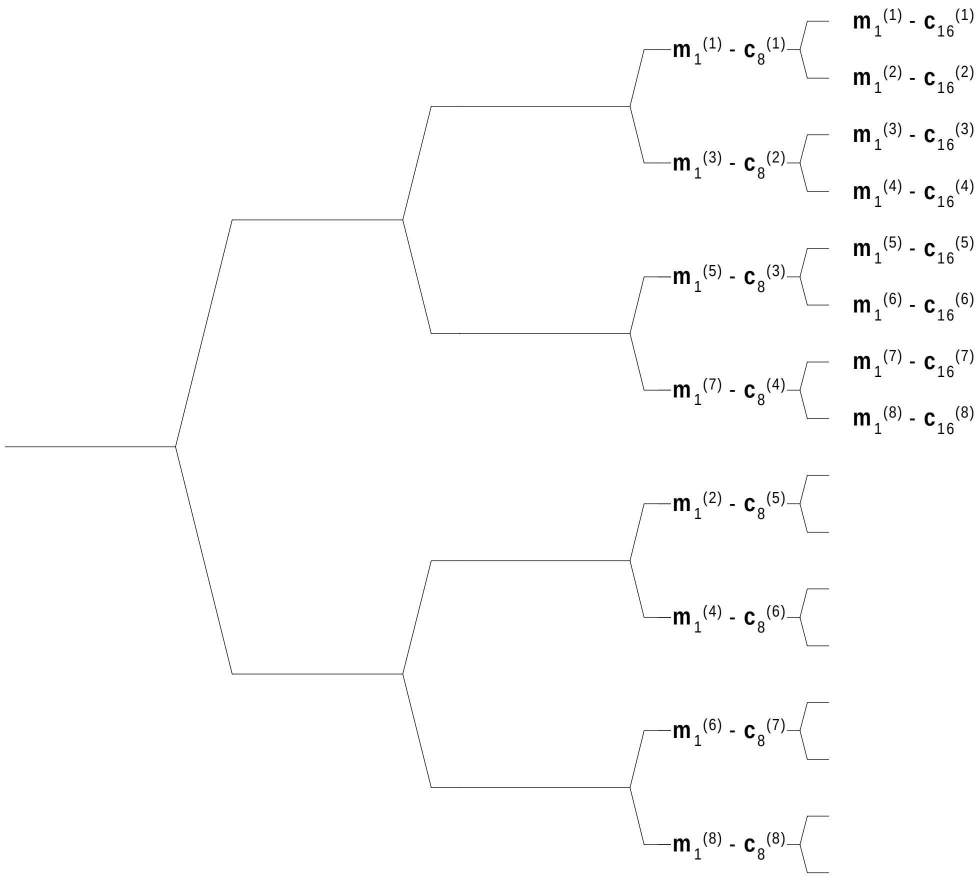


Figure 12: Association of Midambles to Channelisation Codes in the OVSF tree for all *k*

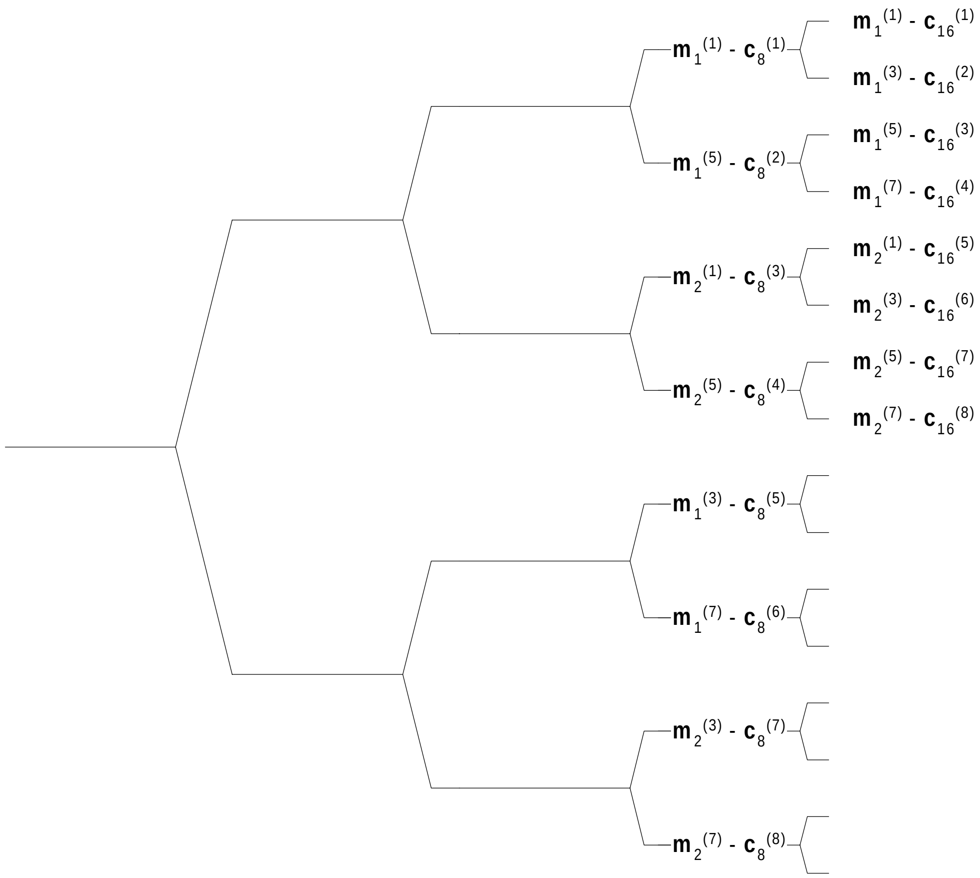


Figure 13: Association of Midambles to Channelisation Codes in the OVSF tree for odd *k*

5.3.4 The synchronisation channel (SCH)

In TDD mode code group of a cell can be derived from the synchronisation channel. In order not to limit the uplink/downlink asymmetry the SCH is mapped on one or two downlink slots per frame only.
There are two cases of SCH and P-CCPCH allocation as follows:

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

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

The position of SCH (value of k) in frame can change on a long term basis in any case.
Due to this SCH scheme, the position of P-CCPCH is known from the SCH.
Figure 14 is an example for transmission of SCH, k=0, of Case 2.

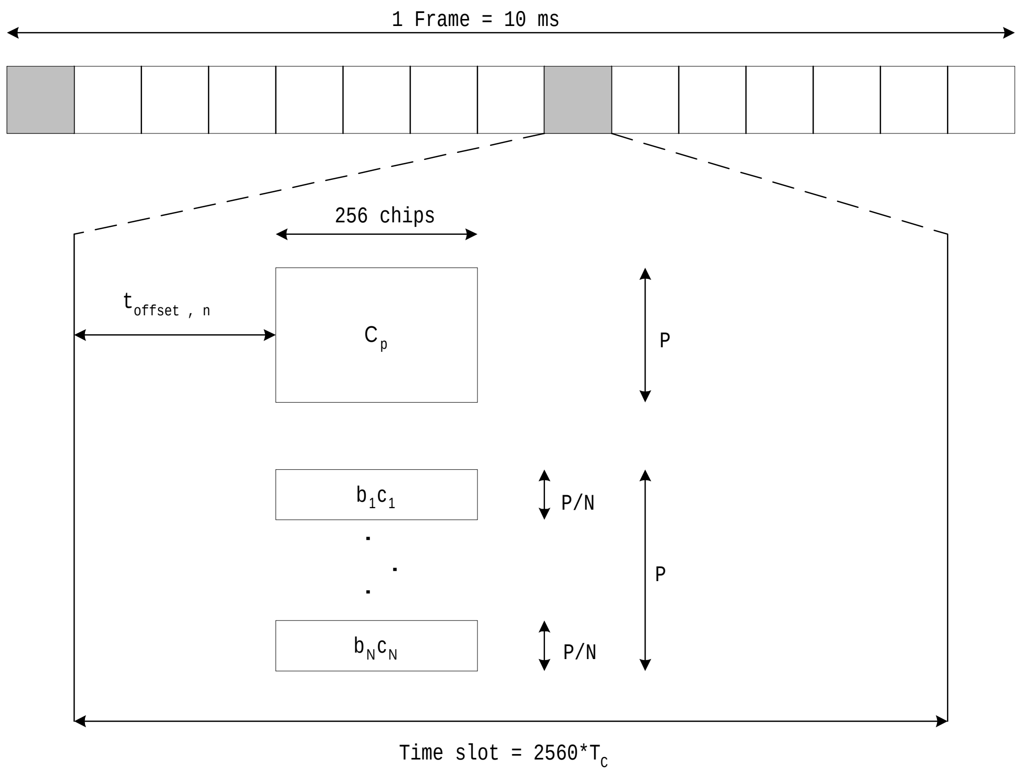


Figure 14: Scheme for Synchronisation channel SCH consisting of one primary sequence C_p and N=3 parallel secondary sequences in slot k and k+8

(example for k=0 in Case 2)

As depicted in figure 14, the SCH consists of a primary and three secondary code sequences with 256 chips length. The primary and secondary code sequences are defined in [8] chapter 7 'Synchronisation codes'.

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

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

$$t_{offset,n} = n \cdot T_c \left\lfloor \frac{2560-96-256}{31} \right\rfloor$$
$$= n \cdot 71T_c\ ; \quad n = 0,\ldots,31$$

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e.g. for 3GPP use the format TP-99xxx
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25.221	**CR**	**023**	Current Version:	3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

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Form: CR cover sheet, version 2 for 3GPP and SMG   The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: *(at least one should be marked with an X)*	(U)SIM		ME	X	UTRAN / Radio	X	Core Network	

Source:	TSG RAN WG1	**Date:**	2000-05-12
Subject:	Clarifications on TxDiversity for UTRA TDD		
Work item:			

Category:	F	Correction		**Release:**	Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature			Release 97	
shall be marked	C	Functional modification of feature			Release 98	
with an X)	D	Editorial modification	X		Release 99	X
					Release 00	

Reason for change:

- Clarification which TxDiversity scheme may be applied to which physical channel
- Removal of inconsistency regarding midamble allocation

Clauses affected: 5.2.4, 5.3.1.3, 5.3.1.4, 5.4, 5.5

Other specs affected:	Other 3G core specifications		→ List of CRs:	
	Other GSM core specifications		→ List of CRs:	
	MS test specifications		→ List of CRs:	
	BSS test specifications		→ List of CRs:	
	O&M specifications		→ List of CRs:	

Other comments:

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5.2.4 Beamforming~~ and Transmit Diversity~~

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

5.3.1.3 P-CCPCH Training sequences

The training sequences, i.e. midambles, as described in subclause 5.2.3 are used for the P-CCPCH. For those timeslots in which the P-CCPCH is transmitted, the midambles $m^{(1)}$, $m^{(2)}$, $m^{(9)}$ and $m^{(10)}$ are reserved for P-CCPCH in order to support Block STTD antenna diversity and the beacon function, see 5.~~3.1.~~4 and 5.~~4~~5. The use of midambles depends on whether Block STTD is applied to the P-CCPCH~~, see 5.3.1.4.~~:

- If no antenna diversity is applied to P-CCPCH, $m^{(1)}$ is used and $m^{(2)}$ is left unused;
- If Block STTD antenna diversity is applied to P-CCPCH, $m^{(1)}$ is used for the first antenna and $m^{(2)}$ is used for the diversity antenna.

The midambles $m^{(9)}$ and $m^{(10)}$ are always left unused in the P-CCPCH time slots.

~~5.3.1.4 Block STTD antenna diversity for P-CCPCH~~

~~Block STTD antenna diversity can be optionally applied for the P-CCPCH. Its support is mandatory for the UE. Two possibilities exist:~~

- ~~If no antenna diversity is applied to P-CCPCH, $m^{(1)}$ is used and $m^{(2)}$ is left unused;~~
- ~~If Block STTD antenna diversity is applied to P-CCPCH, $m^{(1)}$ is used for the first antenna and $m^{(2)}$ is used for the diversity antenna.~~

5.4 Transmit Diversity for DL Physical Channels

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

Table 9: Application of Tx diversity schemes on downlink physical channel types "X" – can be applied, "–" – must not be applied

Physical channel type	Open loop TxDiversity		Closed loop TxDiversity
	TSTD	Block STTD	
P-CCPCH	–	X	–
SCH	X	–	–
DPCH	–	–	X

5.~~4~~5 Beacon function of physical channels

For the purpose of measurements, a beacon function shall be provided by particular physical channels.

5.~~4~~5.1 Location of physical channels with beacon function

The location of the physical channels with beacon function is determined by the SCH and depends on the SCH allocation case, see 5.3.4:

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

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

Note that by this definition the P-CCPCH always provides the beacon function.

5.~~4~~5.2 Physical characteristics of the beacon function

The physical channels providing the beacon function:

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

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

- If no Block STTD antenna diversity is applied to P-CCPCH, all the reference power of any physical channel providing the beacon function is allocated to $m^{(1)}$.
- If Block STTD antenna diversity is applied to P-CCPCH, for any physical channel providing the beacon function midambles $m^{(1)}$ and $m^{(2)}$ are each allocated half of the reference power. Midamble $m^{(1)}$ is used for the first antenna and $m^{(2)}$ is used for the diversity antenna. Block STTD encoding is used for the data in P-CCPCH, see [9]; for all other physical channels identical data sequences are transmitted on both antennas.

5.6~~5~~ Midamble Allocation for Physical Channels

In general, midambles are part of the physical channel configuration which is performed by higher layers.

Optionally, if no midamble is allocated by higher layers, a default midamble allocation shall be used. This default midamble allocation is given by a fixed association between midambles and channelisation codes, see clause A.3, and shall be applied individually to all channelisation codes within one time slot. Different associations apply for different burst types and cell configurations with respect to the maximum number of midambles.

5.~~5~~6.1 Midamble Allocation for DL Physical Channels

Physical channels providing the beacon function shall always use the reserved midambles, see 5.5~~4~~. For all other DL physical channels the midamble allocation is signalled or given by default.

5.~~5~~6.1.1 Midamble Allocation by signalling

Either a common or a UE specific midamble shall be signalled to the UE as a part of the physical channel configuration. Common or UE specific midambles may be applied only if the conditions in subclauses 5.~~5~~6.1.1.1 and subclause 5.~~5~~6.1.1.2 hold respectively. If the midamble is not signalled as a part of the physical channel configuration, midamble allocation by default shall be used.

5.~~5~~6.1.1.1 Common Midamble

A common midamble may be assigned to all physical channels in one time slot, if:

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

or

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

5.~~5~~6.1.1.2 UE specific Midamble

An individual midamble may be assigned to each of the UEs in one time slot, if:

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

or

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

5.6~~5~~.1.2 Midamble Allocation by default

If no midamble is allocated by signalling, the UE shall derive the midamble from the associated channelisation code and shall use an individual midamble for each channelisation code. For each association between midambles and channelisation codes in annex A.3, there is one primary channelisation code associated to each midamble. A set of secondary channelisation codes is associated to each primary channelisation code. All the secondary channelisation codes within a set use the same midamble as the primary channelisation code to which they are associated.

Higher layers shall allocate the channelisation codes in a particular order. Primary channelisation codes shall be allocated prior to associated secondary channelisation codes. If midambles are reserved for the beacon function, all primary and secondary channelisation codes that are associated with the reserved midambles shall not be used.

Primary and its associated secondary channelisation codes shall not be allocated to different UE's.

In the case that secondary channelisation codes are used, secondary channelisation codes of one set shall be allocated in ascending order, with respect to their numbering.

5.6~~5~~.2 Midamble Allocation for UL Physical Channels

If the midamble is part of the physical channel configuration, an individual midamble shall be assigned to all UE's in one time slot.

If no midamble is allocated by higher layers, the UE shall derive the midamble from the assigned channelisation code as for DL physical channels. If the UE changes the SF according to the data rate, it shall always vary the channelisation code along the lower branch of the OVSF tree.

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Document *R1-00-0654*

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25.221 CR 024 Current Version: 3.2.0

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Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: TSG RAN WG1 **Date:** 2000-05-12

Subject: Clarifications on PCH and PICH in UTRA TDD

Work item:

Category:
(only one category shall be marked with an X)

F	Correction	X	
A	Corresponds to a correction in an earlier release		
B	Addition of feature		
C	Functional modification of feature		
D	Editorial modification		

Release:

Phase 2	
Release 96	
Release 97	
Release 98	
Release 99	X
Release 00	

Reason for change: The current description of the PICH and PCH is insufficient.

Clauses affected: 2, 5.3.7, 6.2.2

Other specs affected:

Other 3G core specifications		→ List of CRs:
Other GSM core specifications		→ List of CRs:
MS test specifications		→ List of CRs:
BSS test specifications		→ List of CRs:
O&M specifications		→ List of CRs:

Other comments:

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2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5.3.7 The Page Indicator Channel (PICH)

The Page Indicator Channel (PICH) is a physical channel used to carry the Page Indicators (PI). ~~The PICH substitutes one or more paging sub-channels that are mapped on a S-CCPCH, see 6.2.2. The page indicator indicates a paging message for one or more UEs that are associated with it.~~ The PICH is always transmitted at the same reference power level as the P-CCPCH.

Figure 15 depicts the structure of a PICH burst and the numbering of the bits within the burst. The same burst type is used for the PICH in every cell. N_{PIB} bits in a normal burst of type 1 or 2 are used to carry the PI, where N_{PIB} depends on the burst type: N_{PIB}=240 for burst type 1 and N_{PIB}=272 for burst type 2. The bits b_{NPIB},..., b_{NPIB+3} adjacent to the midamble are reserved for possible future use. They shall be set to 0 and transmitted with the same power as the PI carrying bits.

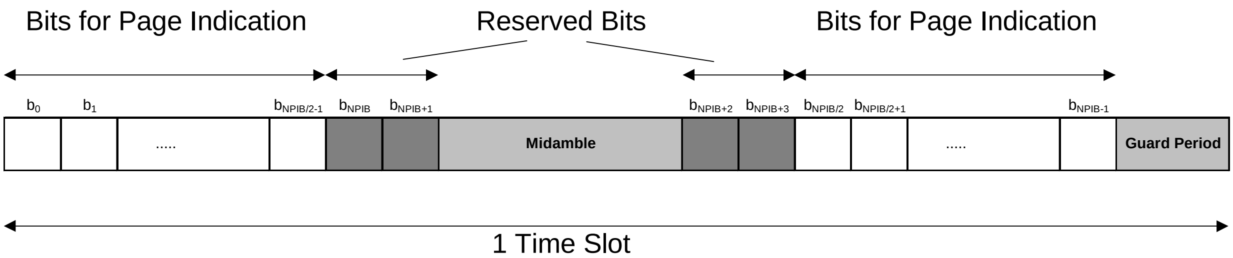


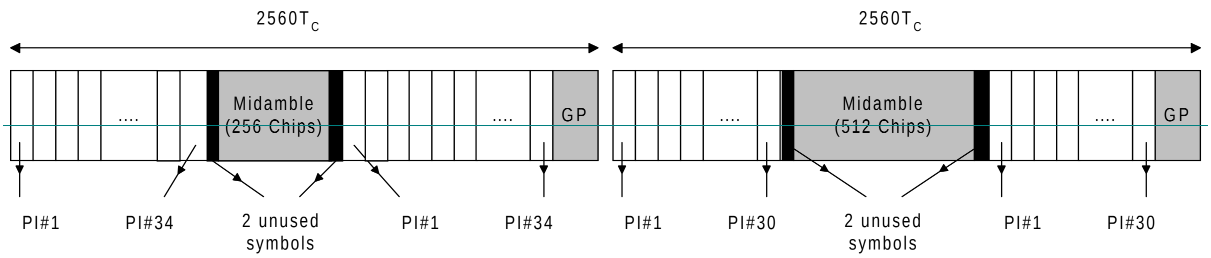
Figure 15: Transmission and Numbering of PI carrying Bits in a PICH burst

N_{PI} ~~The~~ page indicators of length L_{PI}=4~~2~~, L_{PI}=8~~4~~ or L_{PI}=16~~8~~ bits~~symbols~~ are transmitted in one time slot.~~a normal burst (type 1 or 2) as seen in figure 15.~~ The number of page indicators N_{PI} per time slot is given by the number L_{PI} of bits~~symbols~~ for the page indicators and the burst type. In table 8 this number is shown for the different possibilities of burst types and PI lengths.

Table 8: Number N_{PI} of PI per time slot for the different burst types and PI lengths L_{PI}

	L_{PI}=4~~2~~	L_{PI}=~~4~~8	L_{PI}=16~~8~~
Burst Type 1	N_{PI}=60~~1~~	N_{PI}=30	N_{PI}=15
Burst Type 2	N_{PI}=68~~9~~	N_{PI}=34	N_{PI}=17

~~The same burst type is used for the PICH in every cell. In case of L_{PI}=4 or L_{PI}=8, one symbol in each data part adjacent to the midamble is left over. These symbols are filled by dummy bits that are transmitted with the same power as the PI. Figure 15 shows examples for the transmission of page indicators in the different burst types for L_{PI}=4.~~



~~**Figure 15: Example of PI Transmission in PICH bursts of different types for L_{PI}=4**~~

As shown in figure 16, the Page Indicators of N_{PICH} consecutive frames form a PICH block, N_{PICH} is configured by higher layers. Thus, $N=N_{PICH}*N_{PI}$ Page Indicators are transmitted in each PICH block.

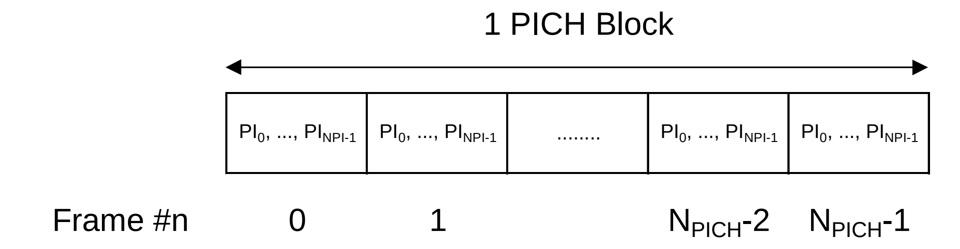


Figure 16: Structure of a PICH block

The PI calculated by higher layers for use for a certain UE, see [15], is mapped to the Page Indicator PI_p in the nth frame of one PICH block, where p is given by

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

and n is given by

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

The Page Indicator PI_p in one time slot is mapped to the bits $\{b_{Lpi*p},\ldots,b_{Lpi*p+Lpi-1},b_{NPIB/2+Lpi*p},\ldots,b_{NPIB/2+Lpi*p+Lpi-1}\}$ within this time slot.

6.2.2 The Paging Channel (PCH)

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

To allow an efficient DRX, the PCH is divided into PCH blocks, each of which comprising N_{PCH}~~several~~ paging sub-channels.~~ within the allocated multiframe structure. Examples of multiframe structures are given in the Annex B of this document.~~ N_{PCH} is configured by higher layers. Each paging sub-channel is mapped onto 2 consecutive PCH frames within one PCH block. ~~that are allocated to the PCH on the same S-CCPCH~~. Layer 3 information to a particular UE ~~paging group~~ is transmitted only in ~~associated~~ the paging sub-channel, that is assigned to the UE by higher layers, see [15]. The assignment of UEs to paging sub-channels~~groups~~ is independent of the assignment of UEs to page indicators.

6.2.2.1 PCH/PICH Association

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

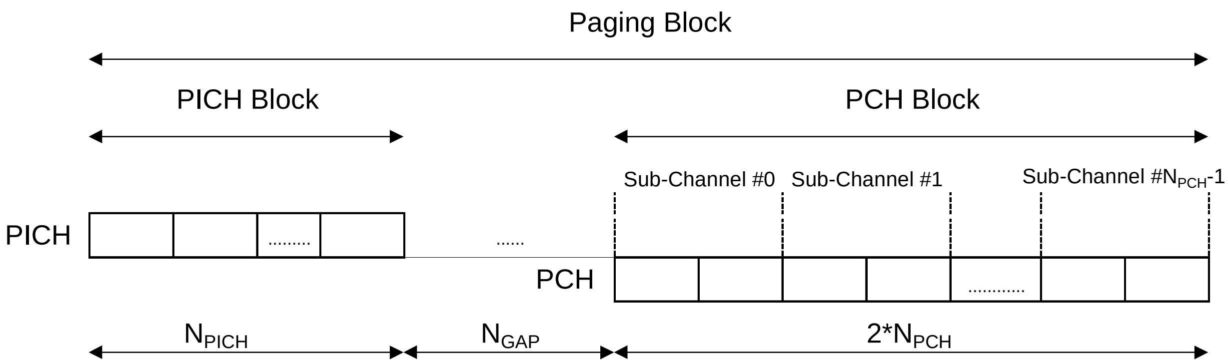


Figure 21: Paging Sub-Channels and Association of PICH and PCH blocks