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25.221 CR 001r2 Current Version: 3.0.0

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

For submission to:	RAN #6	for approval	X	strategic	(for SMG
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Proposed change affects: *(at least one should be marked with an X)*	(U)SIM		ME	X	UTRAN / Radio	X	Core Network	

Source: Siemens AG, Motorola, Nokia **Date:** 1999-12-02

Subject: Primary and Secondary CCPCH in TDD

Work item:

Category:	F	Correction	X	**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		Release 99	X
				Release 00	

Reason for change:
- Due to recent changes in WG2 (CR25.321-014 and CR25.301-018r1) the transport to physical channel mapping in TDD can be changed in order to facilitate the channel description and harmonize TDD and FDD mapping.
- TFCI is used for S-CCPCH
- Two beacons are provided in the case 3 of synchronisation schemes
- Block STTD for P-CCPCH

Clauses affected: 3, 5.3, 5.4, 5.5, 5.6, 5.7, 6, Annex B

Other specs affected:				
	Other 3G core specifications	X	→ List of CRs:	25.223-001r1, 25.224-001r1, 25.225-001r1, 25.222-013, 25.224-004r1, 25.225-002r1
	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: This CR contains several technical items, which influence the text of each other. Therefore the following Tdocs and CR's were merged in this CR: CR001r1-221, R1-99J62, R1-99I93, CR004-221.

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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
ODCH	ODMA Dedicated Transport Channel
ODMA	Opportunity Driven Multiple Access
ORACH	ODMA Random Access Channel
OVSF	Orthogonal Variable Spreading Factor
P-CCPCH	Primary CCPCH
PCH	Paging Channel
PDSCH	Physical Downlink Shared Channel
PICH	Page Indicator Channel
PDU	Protocol Data Unit
PRACH	Physical Random Access Channel
PSCH	Physical Synchronisation 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

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 $a_{Q=16}^{(k=1)}$.

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.

5.3.2.2 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.

5.3.2.3 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 10, the contents of the access burst fields are listed in table 7 and table 8.

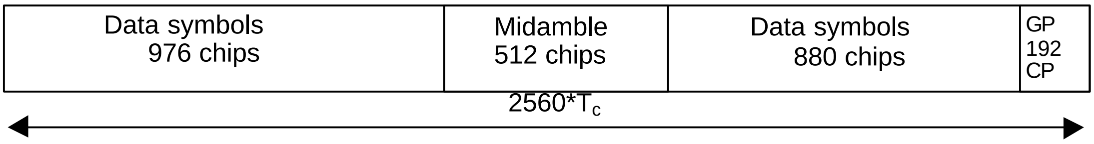

Figure 12: PRACH burst, GP denotes the guard period

Table 7: 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 8: 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 Spreading Codes

For the PRACH there exists a fixed association between the training sequence and the spreading code. The generic rule to define this association is based on the order of the spreading codes $\mathbf{a}_Q^{(k)}$ 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 13 is straightforward.

- For the case that only odd k are allowed the principle of the association is shown in figure 14. This association is applied for one and two basic periodic codes.

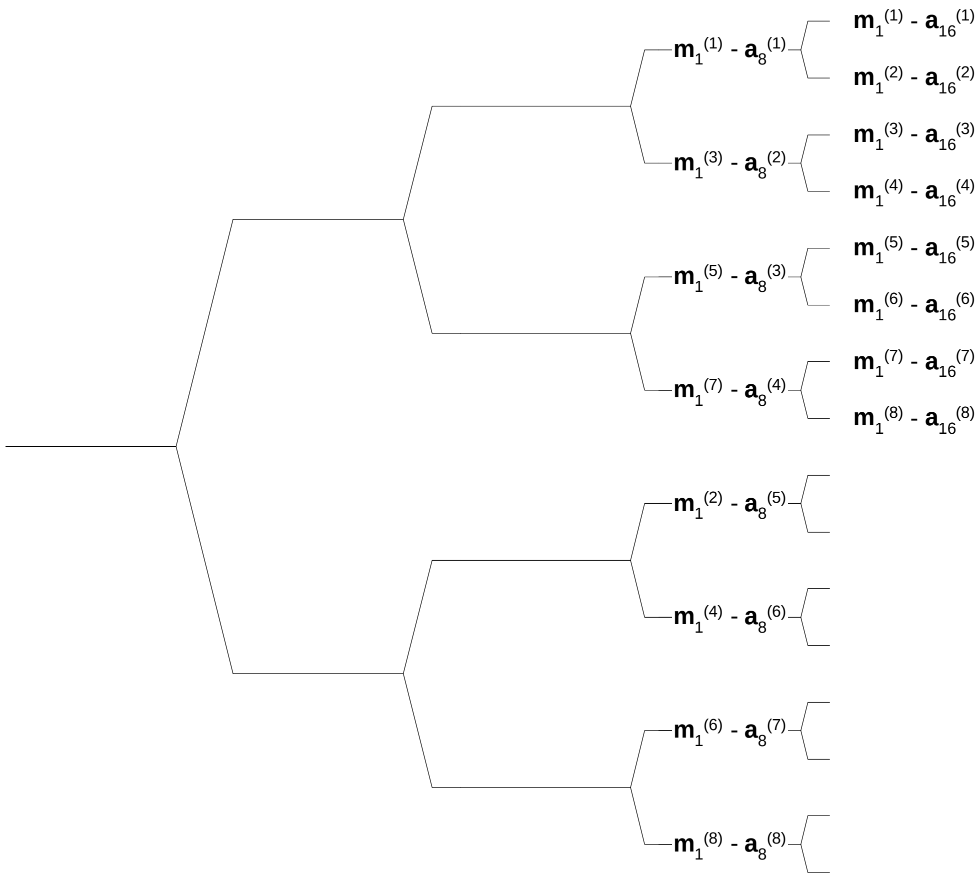

Figure 13: Association of Midambles to Spreading Codes in the OVSF tree for all *k*

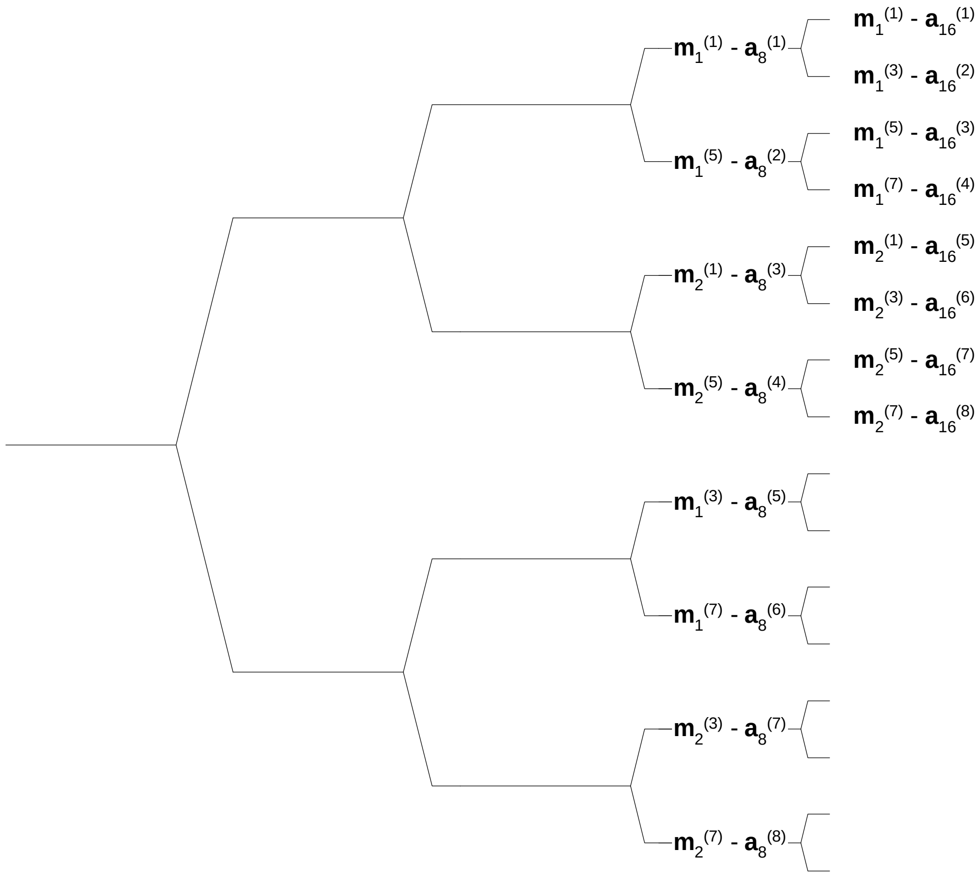

Figure 14: Association of Midambles to Spreading Codes in the OVSF tree for odd *k*

5.3.4 The physical synchronisation channel (PSCH)

In TDD mode code group of a cell can be derived from the synchronisation channel. Additional information, received from higher layers on SCH transport channel, is also transmitted to the UE in PSCH in case 3 from below. In order not to limit the uplink/downlink asymmetry the PSCH is mapped on one or two downlink slots per frame only.

There are three cases of PSCH and P-CCPCH allocation as follows:

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

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

Case 3) PSCH allocated in two TS, TS#k and TS#k+8, k=0…6, and the P-CCPCH allocated in TS#i, i=0…6, pointed by PSCH. Pointing is determined via the SCH from the higher layers.

These three cases are addressed by higher layers using the SCCH in TDD Mode. The position of PSCH (value of k) in frame can change on a long term basis in any case.

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

Figure 15 is an example for transmission of PSCH, k=0, of Case 2 or Case 3.

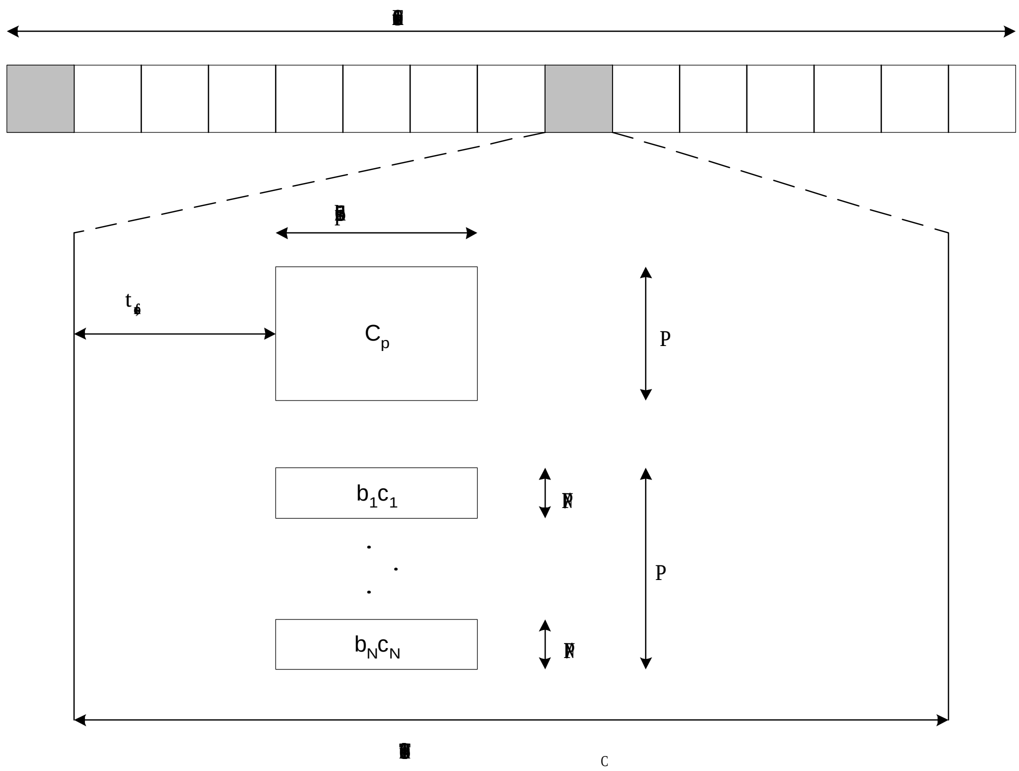

Figure 15: Scheme for Physical Synchronisation channel PSCH consisting of one primary sequence C_p and N=3 parallel secondary sequences in slot k and k+8

(example for k=0 in Case 2 or Case 3)

As depicted in figure 15, the PSCH 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'. The secondary codes are transmitted either in the I channel or the Q channel, depending on the code group.

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 PSCH 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]. The exact value for t_{offset}, regarding column ‘Associated t_{offset}’ in table 7 from [8] is given by:

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

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 indicated for the UE by UTRAN.

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 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 16. The PI may be repeated within one superframe. The number of repetitions within one superframe is given by the repetition factor RF_{PI}. The number of page indicators N_{PI} per superframe is given by the number of time slots per superframe N_{PICH}, used for the PICH, the number L_{PI} of symbols for the page indicators, the burst type BT and the repetition factor of the paging indicators, RF_{PI}. 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 16 shows an example for L_{PI}=4, BT 1, N_{PICH}=4, RF_{PI}=2.

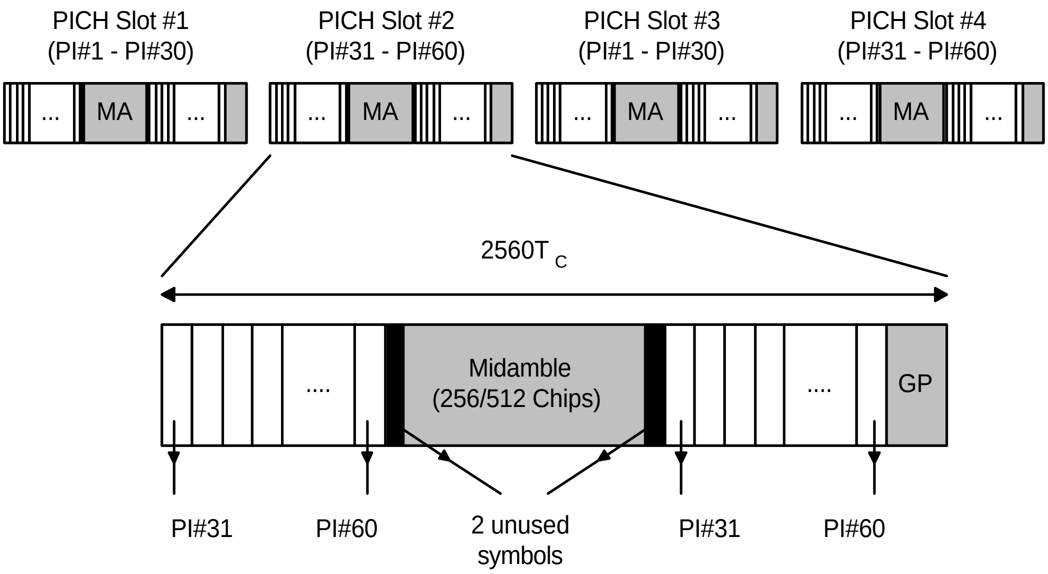

Figure 16: Example of PI Transmission in the PICH

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 PSCH and depends on the PSCH allocation case, see 5.3.4:

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

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

Case 3) All physical channels that are allocated to channelisation code $a_{Q=16}^{(k=1)}$ and in TS#i and TS#i+8, i=0…6, pointed by PSCH, 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.

6 Mapping of transport channels to physical channels

This section describes the way in which transport channels are mapped onto physical resources, see figure 17.

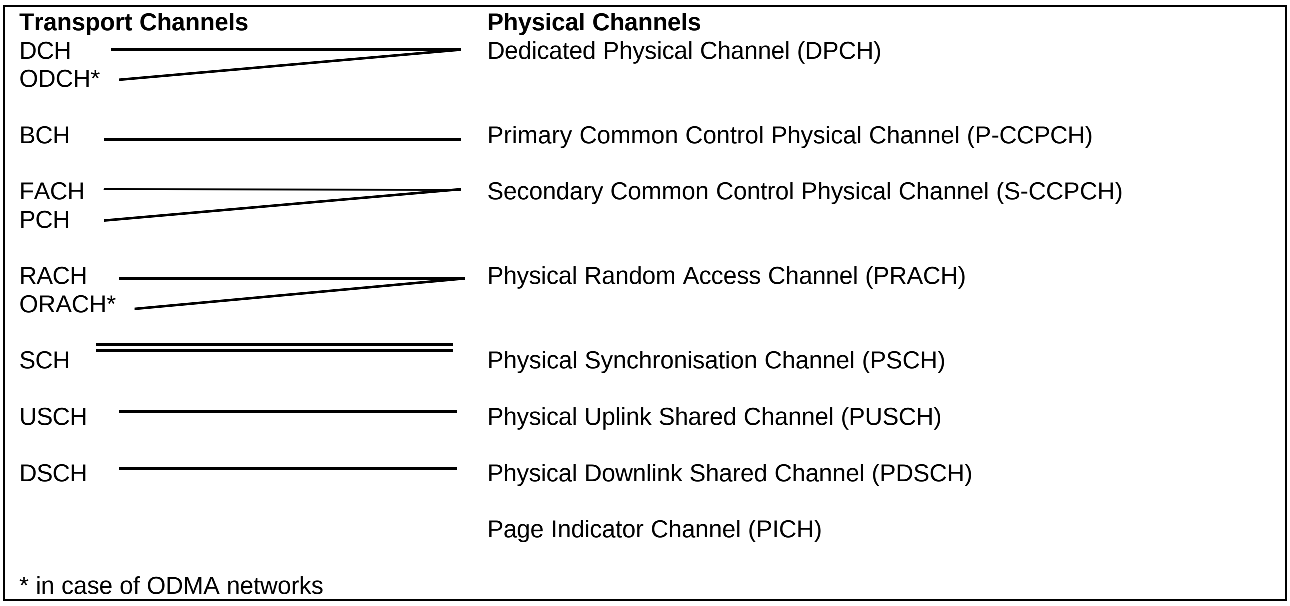

Figure 17: Transport channel to physical channel mapping

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

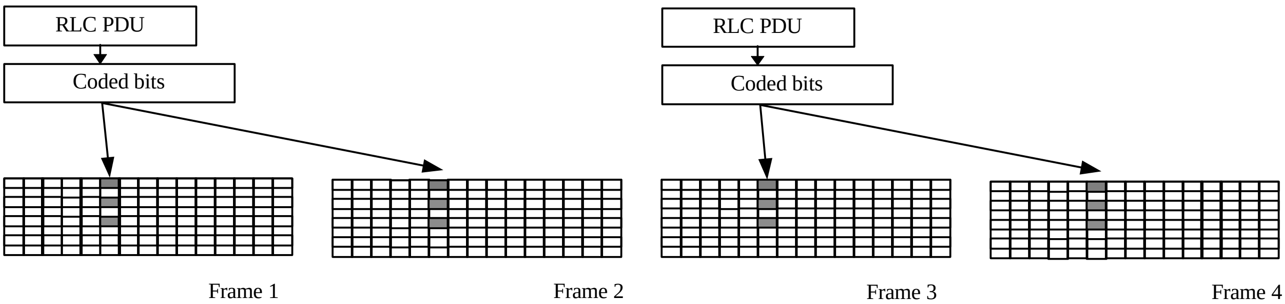

Figure 19: Mapping of PDU onto the physical bearer

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 multiframe structure of one superframe. Examples of multiframe structures are given in the Annex B of this document. Each paging sub-channel is mapped on 2 consecutive frames that are allocated to the PCH on the same S-CCPCH. Thus, the number of paging sub-channels per S-CCPCH is half of the number of frames used for the PCH in one superframe. 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.

Annex B (Informative): CCPCH Multiframe Structure

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

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

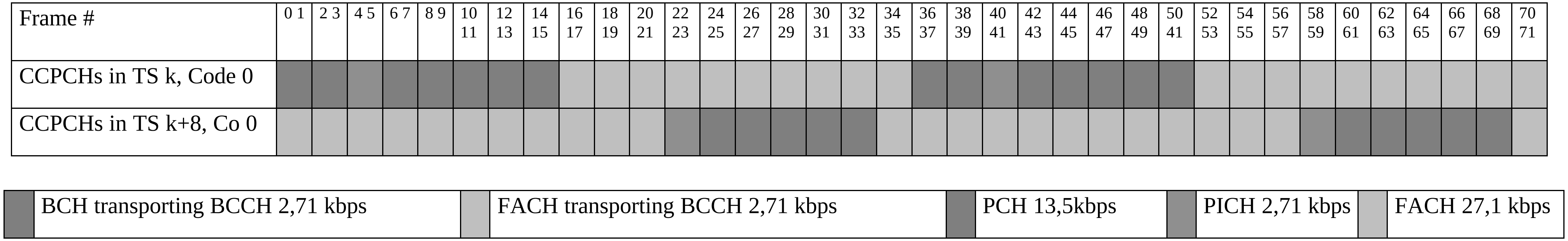

Figure B.1: Example for a multiframe structure for CCPCHs that is repeated every 72th frame.

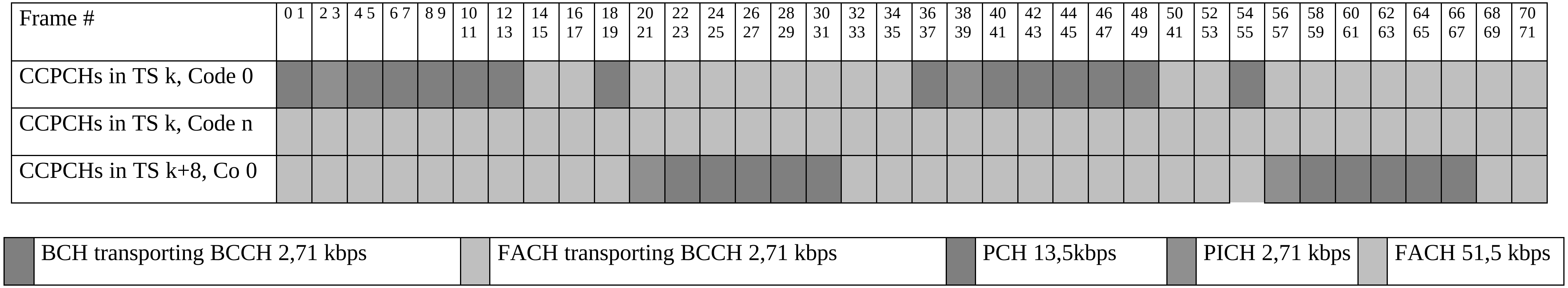

Figure B.2: Example for a multiframe structure for CCPCHs that is repeated every 72th frame, n=1…7

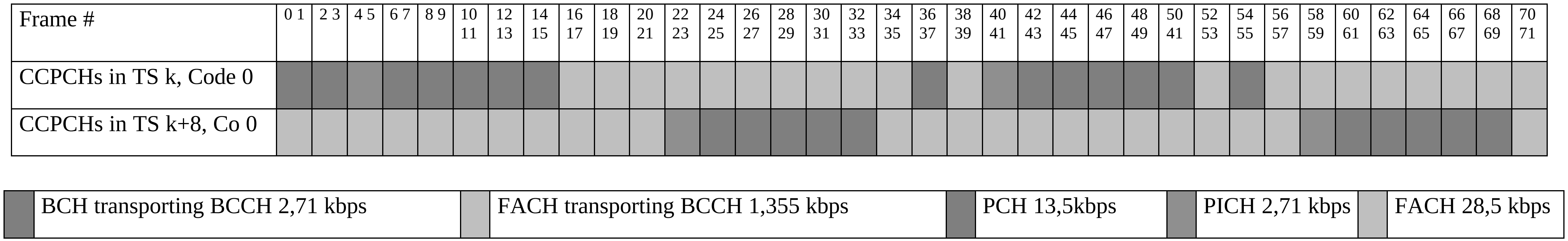

Figure B.3: Example for a multiframe structure for CCPCHs that is repeated every 72th frame.