

<h2 style="margin: 0;">CHANGE REQUEST</h2>		Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.	
<b>25.221 CR 007r2</b>		Current Version: <b>V3.0.0</b>	
GSM (AA.BB) or 3G (AA.BBB) specification number ↑		↑ CR number as allocated by MCC support team	
For submission to: <b>RAN #6</b>	for approval for information	<input checked="" type="checkbox"/>	strategic <input type="checkbox"/> non-strategic <input type="checkbox"/> <span style="font-size: x-small;">(for SMG use only)</span>
list expected approval meeting # here ↑			

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     Core Network   
 (at least one should be marked with an X)

**Source:**    Nokia, Siemens, Alcatel    **Date:**    02 Dec 1999

**Subject:**    Clarifications for Spreading in UTRA TDD

**Work item:**    Spreading/Channelisation/Scrambling Issues

<b>Category:</b>	F Correction <input type="checkbox"/> A Corresponds to a correction in an earlier release <input type="checkbox"/> B Addition of feature <input type="checkbox"/> C Functional modification of feature <input checked="" type="checkbox"/> D Editorial modification <input type="checkbox"/>	<b>Release:</b>	Phase 2 <input type="checkbox"/> Release 96 <input type="checkbox"/> Release 97 <input type="checkbox"/> Release 98 <input type="checkbox"/> Release 99 <input checked="" type="checkbox"/> Release 00 <input type="checkbox"/>
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(only one category shall be marked with an X)

**Reason for change:**    Alignment of the terms 'Spreading', 'Channelisation' and 'Scrambling' according to usage in FDD mode. Clarification on usage of Multicode / Variable Spreading Factor

**Clauses affected:**    5, 5.2.1, 5.2.2, 5.2.2.2, 5.3.2.4, 5.4

<b>Other specs affected:</b>	Other 3G core specifications <input checked="" type="checkbox"/> Other GSM core specifications <input type="checkbox"/> MS test specifications <input type="checkbox"/> BSS test specifications <input type="checkbox"/> O&M specifications <input type="checkbox"/>	→ List of CRs: 25.223-CR003r1, 25.224-CR005r1 → List of CRs: → List of CRs: → List of CRs: → List of CRs:
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**Other comments:**



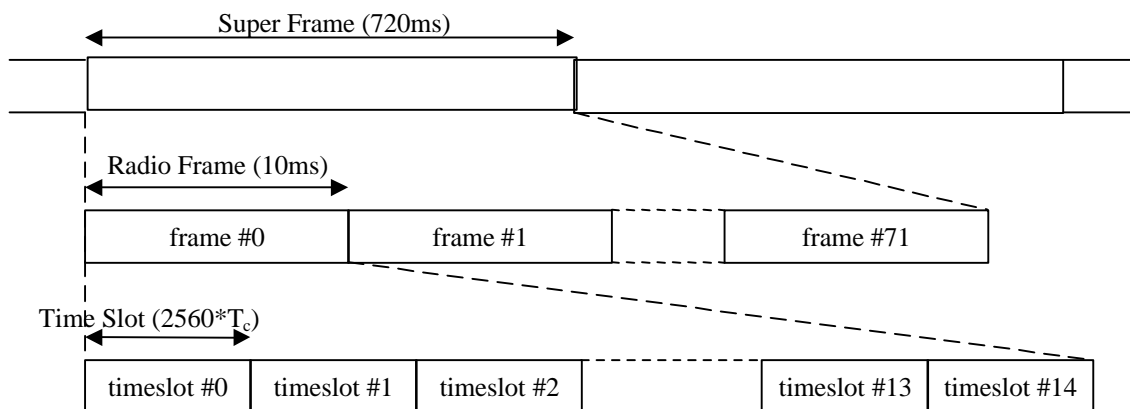
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## 5 Physical channels

All physical channels take three-layer structure of superframes, radio frames, and timeslots. 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 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 OVFSF 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**

A physical channel in TDD is a burst, which is repeated in the same timeslot with a certain repetition length of consecutive RF in and after each RF defined by a repetition period, starting at a certain frame number defined by the superframe offset in the multiframe, where the repetition period is a submultiple of 72, i.e. 1, 2, 3, 4, 6, 8, 9, 12, 18, 24, 36, or 72, and the superframe offset is in the interval 0...(repetition period-1). The repetition length of each repeated allocation can have the values 1, 2, 4 or 8 frames. It should be equal to the longest interleaving depth of all transport channels on this physical channel.

The data part of the burst is spread with a combination of channelisation code and scrambling code. ThisThe channelisation code is a OVFSF 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 OVFSF 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.

## 5.2.1 Spreading codes

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 SF and different channelisation codes, see [8].

Two options are being considered for the bursts that can be sent as described below. Both options allow a high degree of bit rate granularity and flexibility, thus allowing the implementation of the whole service range from low to high bit rates.

Spreading factor of and the number of codes for multicode transmission are assigned independently for uplink and downlink. The number of timeslots is also assigned independently for uplink and downlink.

#### 5.2.1.1 Multicode transmission with fixed spreading

Within each time slot of length  $2560 * T_c$ , an additional separation of user signals by spreading codes is used. This means, that within one time slot of length  $2560 * T_c$ , more than one burst of corresponding length as described in section 5.2.2 can be transmitted. These multiple bursts within the same time slot can be allocated to different users as well as partly or all to a single user. For the multiple bursts within the same time slot, different spreading codes are used to allow the distinction of the multiple bursts.

#### 5.2.1.2 Single code transmission with variable spreading

Within each time slot of  $2560 * T_c$  duration,

- a UE always uses single code transmission by adapting the spreading factor as a function of the data rate. This limits the peak to average ratio of the modulated signal and consequently the stress imposed to the power amplifier resulting in an improved terminal autonomy. Several mobiles can be received in the same time slot by the base station, they are separated by their codes and the individual decoding can take profit of the joint detection.
- a base station should broadcast a single burst per mobile again by adapting the spreading as a function of the data rate. High rate data transmissions requiring more than one timeslot per mobile can be supported by terminals having the processing power for joint detection on a single slot : the required throughput occupies in a general way an integer number of slots plus a fraction of an extra slot. Single burst transmission should occur in the integer number of slots, while the extra slot can be occupied by a burst for the considered mobile plus extra bursts for other mobiles, joint detection is only needed for this last time slot in the considered mobile.

## 5.2.2 Burst Types

As explained in the section 5.2.1, two options are being considered for the spreading. The bursts described in this section can be used for both options.

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.

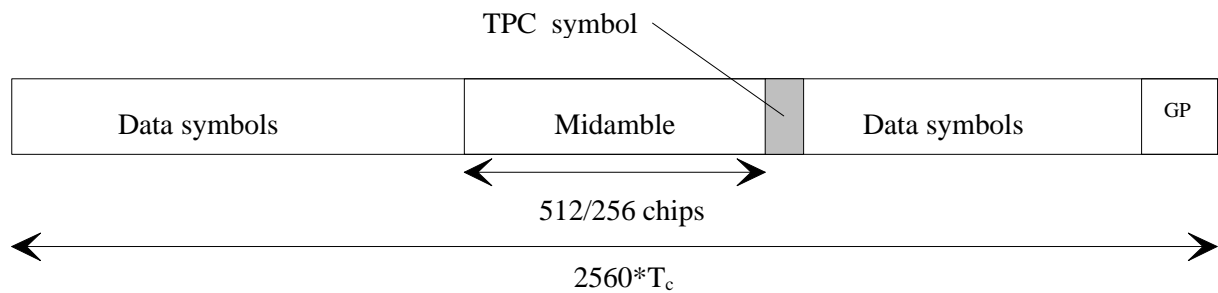
Because of the longer midamble, the burst type 1 is suited for the uplink, where up to 16 different channel impulse responses can be estimated. The burst type 2 can be used for the downlink and, if the bursts within a time slot are allocated to less than four users, also for the uplink.

### 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 11 shows the position of the TPC in a traffic burst.

For every user the TPC information is to be transmitted once per frame. The TPC is spread with the same spreading factor (SF) and spreading code as the data parts. TPC and TFCI are always transmitted in the same physical channel.



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

### 5.3.2.4 Association between Training Sequences and Spreading Channelisation Codes

For the PRACH there exists a fixed association between the training sequence and the spreading channelisation code. The generic rule to define this association is based on the order of the spreading channelisation 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  $\mathbf{m}_1$  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.

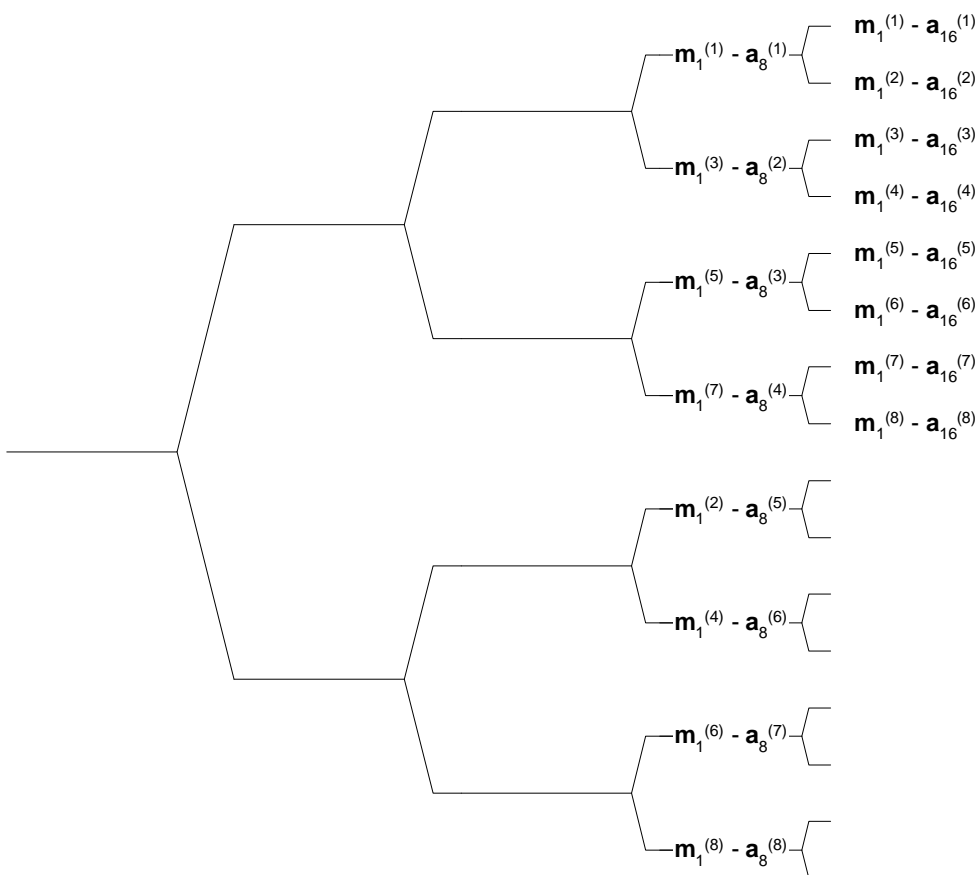


Figure 13: Association of Midambles to Spreading Channelisation Codes in the OVFS tree for all  $k$

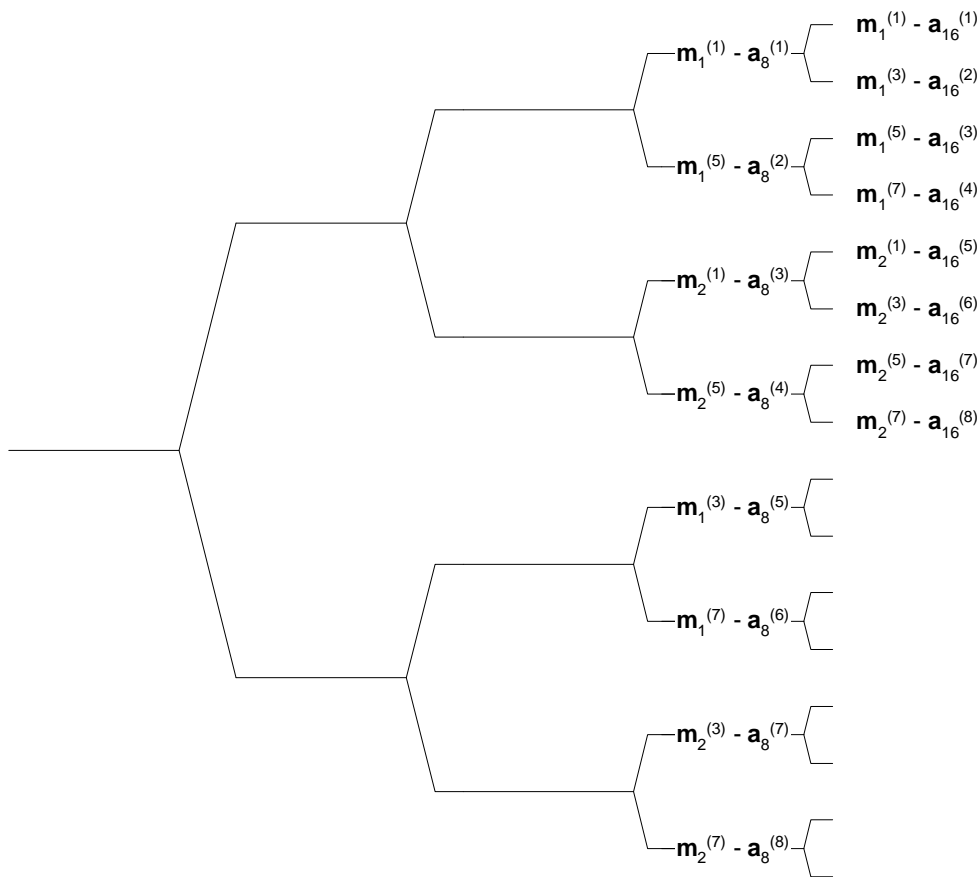


Figure 14: Association of Midambles to Spreading Channelisation Codes in the OVSF tree for odd  $k$

## 5.4 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 PCCPCH allocation as follows:

- Case 1) PSCH and PCCPCH allocated in TS#k, k=0...14
- Case 2) PSCH in two TS and PCCPCH in the same two TS: TS#k and TS#k+8, k=0...6
- Case 3) PSCH in two TS, TS#k and TS#k+8, k=0...6, and the PCCPCH in TS#i, i=0...14, 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 PCCPCH is known from the PSCH. The PCCPCH are using burst type 1, spreading channelisation code  $a_{Q=16}^{(k=1)}$  and midamble  $m_1^{(1)}$ . To simplify measurements of PCCPCH power, this midamble shall not be used by other physical channels in the same timeslot.