**3GPP TSG-RAN WG1 Meeting #19**
**Las Vegas, USA, 27th February – 2nd March 2001**

***R1-01-0379***

CR-Form-v3

# CHANGE REQUEST

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ✍ | **25.221** | **CR** | **045** | ✍ rev | **1** | ✍ Current version: | **3.5.0** ✍ |

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ✍ symbols.*

***Proposed change affects:*** ✍ (U)SIM [ ] ME/UE [ ] Radio Access Network [X] Core Network [ ]

| | | | |
|---|---|---|---|
| ***Title:*** ✍ | Corrections on the PRACH and clarifications on the midamble generation and the behaviour in case of an invalid TFI combination on the DCHs | | |
| ***Source:*** ✍ | Siemens | | |
| ***Work item code:*** ✍ | | ***Date:*** ✍ | 28 February 2001 |
| ***Category:*** ✍ | **F** | ***Release:*** ✍ | R99 |
| | *Use one of the following categories:*<br>***F*** *(essential correction)*<br>***A*** *(corresponds to a correction in an earlier release)*<br>***B*** *(Addition of feature),*<br>***C*** *(Functional modification of feature)*<br>***D*** *(Editorial modification)*<br>Detailed explanations of the above categories can be found in 3GPP TR 21.900. | | *Use one of the following releases:*<br>*2 (GSM Phase 2)*<br>*R96 (Release 1996)*<br>*R97 (Release 1997)*<br>*R98 (Release 1998)*<br>*R99 (Release 1999)*<br>*REL-4 (Release 4)*<br>*REL-5 (Release 5)* |

| | |
|---|---|
| ***Reason for change:*** ✍ | The physical properties of channels mapped to the same timslot as a PRACH are restricted without reason. In addition to this, the mapping of the RACH to PRACH is not aligned with higher layer specs. Also, the description of the midamble generation is not clear and there is no hint to the behaviour in case of an invalid TFI combination on the DCHs. |
| ***Summary of change:*** ✍ | The mapping of a RACH is limited to one PRACH and an restriction on the physical layer structure of physical channels mapped to the same timeslot as the PRACH is removed. Furthermore the description of the midamble generation is clarified and a reference to 25.427 is introduced, where the behaviour in case of an invalid TFI combination on the DCHs is described. In addition to this some minor changes are proposed. |
| ***Consequences if not approved:*** ✍ | The mapping of the RACH to PRACH is not aligned with higher layer specs. The physical properties of channels sharing the same timeslot as the PRACH is unnecessarily limited. The midamble generation might not be implemented correctly. |

| | | |
|---|---|---|
| ***Clauses affected:*** ✍ | 5, 5.2.2.4, 5.2.3, 5.3.3, 5.3.3.1, 5.5.1 | |
| ***Other specs affected:*** ✍ | [ ] Other core specifications<br>[ ] Test specifications<br>[ ] O&M Specifications | ✍ |
| ***Other comments:*** ✍ | | |

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3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

# 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 a guard period~~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 two~~a~~ data parts, a midamble part 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 parts must use different OVSF channelisation codes, but the same scrambling code. The midamble parts ~~has to use the same basic midamble code, but can use different midambles~~are either identicaly or differently shifted versions of a cell-specific basic midamble code, see section 5.2.3.

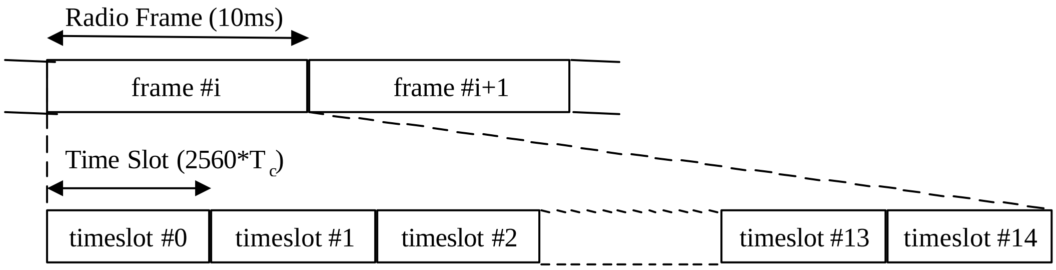


**Figure 1: Physical channel signal format**

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.

### 5.2.2.4 Transmission of TFCI

All burst types 1, 2 and 3 provide the possibility for transmission of TFCI.

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. Independent of the SF that is applied to the data symbols in the burst, the data in the TFCI field are always spread with SF=16 using the channelisation code in the lowest branch of the allowed OVSF sub tree, 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. Figure 7 shows the position of the TFCI in a traffic burst in uplink.

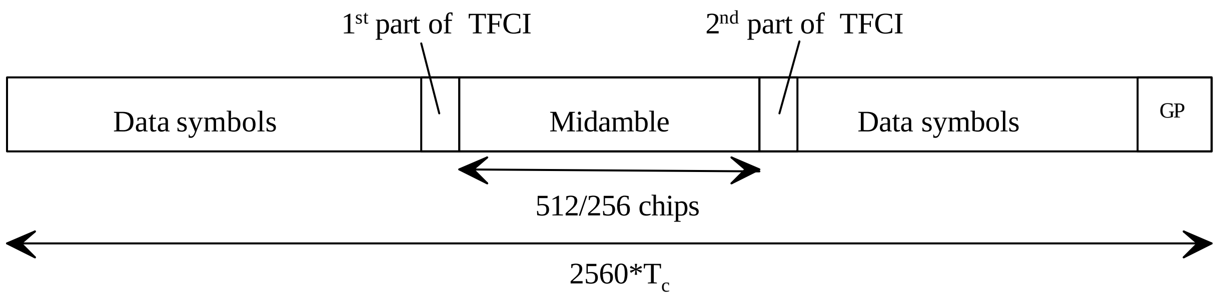


**Figure 7: Position of TFCI information in the traffic burst in case of downlink**

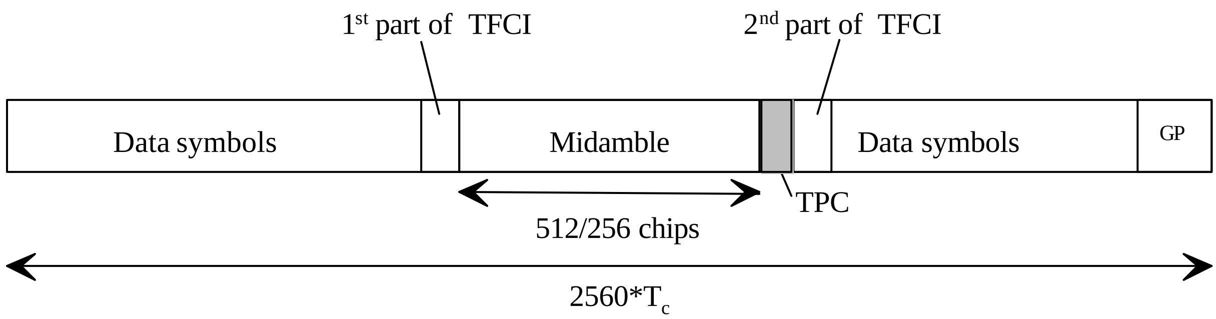


**Figure 8: Position of TFCI information in the traffic burst in case of uplink**

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.

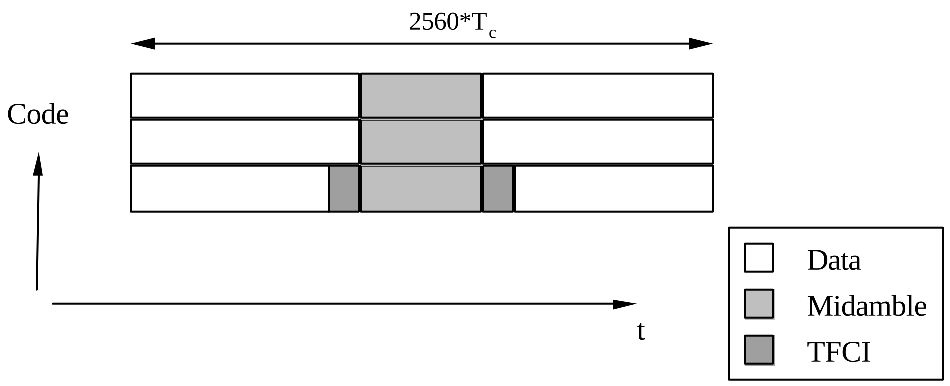


**Figure 9: Example of TFCI transmission with physical channels multiplexed in code domain**

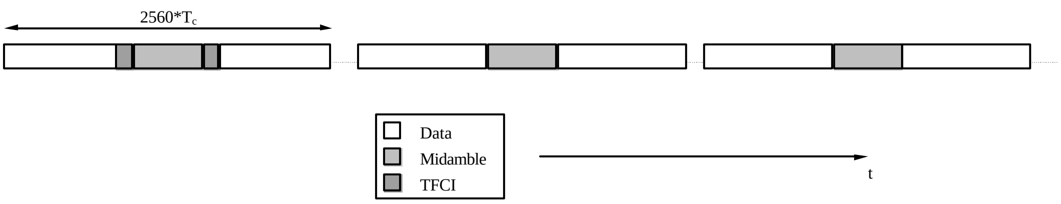


**Figure 10: Example of TFCI transmission with physical channels multiplexed in time domain**

In case the Node B receives an invalid TFI comb ination on the DCHs mapped to one CCTrCH the procedure described in [16] shall be applied. According to this procedure DTX shall be applied to all DPCHs to which the CCTrCH is mapped to.

## 5.2.3 Training sequences for spread bursts

In this subclause, the training sequences for usage as midambles in burst type 1, 2 and 3 (see subclause 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 cell-specific 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 3, and Annex and A.2 shows $\mathbf{m}_{PS}$ for burst type 2. It should be noted that burst type 2 must not be mixed with burst type 1 or 3 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 6: 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 $\mathbf{m}_P$ :

$$\mathbf{m}_P = (m_1, m_2, \ldots, m_P) \qquad (1)$$

According to Annex A.1, the size of this vector $\mathbf{m}_P$ is P=456 for burst type 1 and 3. 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 $\underline{\mathbf{m}}_P$ :

$$\underline{\mathbf{m}}_P = (\underline{m}_1, \underline{m}_2, \ldots, \underline{m}_P) \qquad (2)$$

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

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

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

To derive the required training sequences (different shifts), this vector $\underline{\mathbf{m}}_P$ is periodically extended to the size:

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

Notes on equation (4):

- $L_m$ : Midamble length

- K' : Maximum number of different midamble shifts in a cell, when no intermediate shifts are used. This value depends on the midamble length.
- K : Maximum number of different midamble shifts in a cell, when intermediate shifts are used, K=2K'. This value depends on the midamble length.
- W : Shift between the midambles, when the number of midambles is K'.
- ~~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'~~
- ?x? denotes the largest integer smaller or equal to x

Allowed values for $L_m$, K' and W are given in Annex A.1 and A.2.

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

$$\underline{\mathbf{m}} ? (\underline{m}_1, \underline{m}_2, ..., \underline{m}_{i_{max}}) ? (\underline{m}_1, \underline{m}_2, ..., \underline{m}_{L_m ? (K'?1)W ? ?P/K?}) \quad (5)$$

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:

$$\underline{m}_i ? \underline{m}_{i?P} \text{ for the subset } i ? (P ? 1), ..., i_{max} \quad (6)$$

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

$$\underline{\mathbf{m}}^{(k)} ? (\underline{m}_1^{(k)}, \underline{m}_2^{(k)}, ..., \underline{m}_{L_m}^{(k)}) \quad (7)$$

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

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

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

$$\underline{m}_i^{(k)} ? \underline{m}_{i?(K?k?1)W ? ?P/K?} \text{ with } i ? 1, ..., L_m \text{ and } k ? K'?1, ..., K ? 1 \quad (9)$$

$$\underline{m}_i^{(k)} ? \underline{m}_{i?(K'?1)W? ?P/K?} \text{ with } i ? 1, ..., L_m \text{ and } k ? K \quad (10)$$

Whether intermediate shifts are allowed in a cell is signalled by higher layers~~broadcast on the BCH~~.

The midamble sequences derived according to equations (7) to (10) have complex values and are not subject to 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).

### 5.3.3 The physical random access channel (PRACH)

The RACH as described in subclause 4.1.2 is mapped onto one ~~or more~~ uplink physical random access channel~~s~~ (PRACH). ~~In such a way the capacity of RACH 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.~~

#### 5.3.3.1 PRACH Spreading

The uplink PRACH uses either spreading factor SF=16 or SF=8 as described in subclause 5.2.1.2~~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).

### 5.5.1 Location of beacon channels

The beacon locations are determined by the SCH and depend on the SCH allocation case, see subclause 5.3.4:

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

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

Note that by this definition the P-CCPCH always has beacon characteristics.