**3GPP TSG RAN WG1 (Radio) Meeting #10**
**Beijing, China, 18-21 Jan 2000**

***Document*** ***R1-00-0076***
*e.g. for 3GPP use the format TP-99xxx*
*or for SMG, use the format P-99-xxx*

# CHANGE REQUEST

*Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.*

**25.221** **CR** **011** Current Version: V3.1.0

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

| | | | | | |
|---|---|---|---|---|---|
| For submission to: | RAN #7 | 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 [X] UTRAN / Radio [X] Core Network [ ]
*(at least one should be marked with an X)*

**Source:** Siemens AG **Date:** 13 Jan 2000

**Subject:** Correction of Midamble Definition for TDD

**Work item:**

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

| | | | | |
|---|---|---|---|---|
| F | Correction | X | 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 | | Release 99 | X |
| | | | Release 00 | |

(**Release:**)

**Reason for change:** Removal of an error in mathematical representation and simplified mathematical representation.

**Clauses affected:** 5.2.3

**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:**

help.doc

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### 5.2.3 Training sequences for spread bursts

~~As explained in the section 5.2.1, two options are being considered for the spreading. The training sequences presented here are common to both options.~~

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 ~~time~~ cyclically shifted versions of one single ~~periodic~~ 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 4 below.

**Table 4: 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 $\mathbf{m}_P$ :

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

According to Annex A.1, the size of this vector $\mathbf{m}_P$ 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 $\underline{\mathbf{m}}_P$ :

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

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

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

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 $\underline{\mathbf{m}}_P$ is periodically extended to the size:

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

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 $\mathbf{m}$ containing the periodic basic midamble sequence:

$$\mathbf{m} = \left(m_1, m_2, \ldots, m_{i_{\max}}\right) = \left(m_1, m_2, \ldots, m_{L_m+(K'-1)W+\lfloor P/K \rfloor}\right) \quad (5)$$

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

$$m_i = m_{i-P} \text{ for the subset } i = (P+1), \ldots, i_{\max} \quad (6)$$

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

$$\mathbf{m}^{(k)} = \left(m_1^{(k)}, m_2^{(k)}, \ldots, m_{L_m}^{(k)}\right) \quad (7)$$

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

$$m_i^{(k)} = m_{i+(K'-k)W} \text{ with } i = 1, \ldots, L_m \text{ and } k = 1, \ldots, K' \quad (8)$$

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:

$$m_i^{(k)} = m_{i+(K-k)W+\lfloor P/K \rfloor} \text{ with } i = 1, \ldots, L_m \text{ and } k = K'+1, \ldots, K \quad (9)$$

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 $m_i^{(k)}$ 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 $\mathbf{m}^{(k)}$ ; k=1,...,K, based on a single basic midamble code $\mathbf{m}_P$ according to (1).

Different cells use different periodic basic codes, i.e. different midamble sets. In this way a joint channel estimation for the channel impulse responses of all active users within one time slot can be done by one single cyclic correlation. The different user specific channel impulse response estimates are obtained sequentially in time at the output of the correlator. Following this principle it is shown hereafter how to derive the midambles from the periodic basic code.

Section 5.2.2 contains a description of the spread speech/data bursts. These bursts contain Lm midamble chips, which are also termed midamble elements. The Lm elements $m_i^{(k)}$; i=1,...,Lm; k=1,...,K; of the midamble codes $\mathbf{m}^{(k)}$; k=1,...,K; are taken from the complex set

$$\underline{V}_m = \{1, j, -1, -j\}. \quad (1)$$

K is the maximum number of users, i.e. the available number of spreading codes per time slot.

The elements $\underline{m}_i^{(k)}$ of the complex midamble codes $\underline{\mathbf{m}}^{(k)}$ fulfil the relation

$$\underline{m}_i^{(k)} = (\mathrm{j})^i \cdot m_i^{(k)} \quad m_i^{(k)} \in \{1, -1\}; i = 1,\dots,L_m; k = 1,\dots,K. \tag{2}$$

Hence, the elements $\underline{m}_i^{(k)}$ of the complex midamble codes $\underline{\mathbf{m}}^{(k)}$ of the K users are alternating real and imaginary.

With W being the number of taps of the impulse response of the mobile radio channels, the Lm binary elements $m_i^{(k)}; \mathrm{i} = 1,\dots,L_\mathrm{m}; k = 1,\dots,K;$ of (2) for the complex midambles $\underline{\mathbf{m}}^{(k)}$; k=1,...,K; of the K users are generated according to the following method from a single periodic basic code

$$\mathbf{m} = \left(m_1, m_2, \dots, m_{L_m+(K'-1)W+\lfloor P/K \rfloor}\right)^\mathrm{T} \quad m_i \in \{1, -1\}; \; i = 1,\dots,(L_m + (K'-1)W + \lfloor P/K \rfloor). \tag{3}$$

$\lfloor x \rfloor$ denotes the largest integer smaller or equal to x, K' = K/2.

The elements $m_i; i = 1,\dots,(L_m + (K'\ 1)W + \lfloor P/K \rfloor)$, of (3) fulfil the relation

$$m_i = m_{i-P} \text{ for the subset } i = (P+1),\dots,(L_m + (K'\ 1)W + \lfloor P/K \rfloor). \tag{4}$$

The P elements $m_i; i = 1,\dots,P$, of one period of m according to (3) are contained in the vector

$$\mathbf{m}_\mathrm{P} = \left(m_1, m_2, \dots, m_P\right)^\mathrm{T}. \tag{5}$$

With $\mathbf{m}$ according to (3) the Lm binary elements $m_i^{(k)}; \mathrm{i} = 1,\dots,\mathrm{L_m}; k = 1,\dots,K;$ of (2) for the midambles of the first K' users are generated based on the following formula

$$m_i^{(k)} = m_{i+(K'-k)W} \quad i = 1,\dots,L_m; k = 1,\dots,K'. \tag{6}$$

The midambles for the second K' users are generated based on a slight modification of this formula introducing intermediate shifts

$$m_i^{(k)} = m_{i+(K-k)W+\lfloor P/K \rfloor} \quad i = 1,\dots,L_m; k = K'+1,\dots,K. \tag{7}$$

Whether intermediate shifts are allowed in a cell is broadcast on the BCH.

In the following the term 'a midamble code set' or 'a midamble code family' denotes K specific midamble codes $\underline{\mathbf{m}}^{(k)}$; k=1,...,K. Different midamble code sets $\underline{\mathbf{m}}^{(k)}$; k=1,...,K; are specified based on different periods $\mathbf{m}_\mathrm{P}$ according (5).

In adjacent cells of the cellular mobile radio system, different midamble codes sets $\underline{\mathbf{m}}^{(k)}$; k=1,...,K; should be used to guarantee a proper channel estimation.

As mentioned above a single midamble code set $\underline{\mathbf{m}}^{(k)}$; k=1,...,K; consisting of K midamble codes is based on a single period $\mathbf{m}_\mathrm{P}$ according to (5).

In the Annex A the periods $\mathbf{m}_\mathrm{P}$ according to (5), i.e. the Basic Midamble Codes, which shall be used to generate different midamble code sets $\underline{\mathbf{m}}^{(k)}$; k=1,...,K; are listed in tables in a hexadecimal representation. As shown in table 4 always 4 binary elements $m_i$ are mapped on a single hexadecimal digit.

Table 4: Mapping of 4 binary elements $m_i$ on a single hexadecimal digits

| ~~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~~ |

~~As different Basic Midamble Codes are required for different burst formats, the Annex A shows the codes $m_{PL}$ for burst type 1 and $m_{PS}$ for burst type 2. It should be noted that the different burst types must not be mixed in the same timeslot of one cell.~~