

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.

The training sequences, i.e. midambles, of different users active in the same time slot are time shifted versions of one single periodic basic code. 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 L_m midamble chips, which are also termed midamble elements. The L_m elements $m_i^{(k)}$; $i=1, \dots, L_m$; $k=1, \dots, K$; of the midamble codes $\mathbf{m}^{(k)}$; $k=1, \dots, K$; 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 $m_i^{(k)}$ of the complex midamble codes $\mathbf{m}^{(k)}$ fulfil the relation

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

Hence, the elements $m_i^{(k)}$ of the complex midamble codes $\mathbf{m}^{(k)}$ 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 L_m binary elements $m_i^{(k)}$; $i=1, \dots, L_m$; $k=1, \dots, K$; of (2) for the complex midambles $\mathbf{m}^{(k)}$; $k=1, \dots, K$; of the K users are generated according to the following method from a single periodic basic code

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

$\lfloor x \rfloor$ 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

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

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

$$\mathbf{m}_p = (m_1, m_2, \dots, m_p)^T. \quad (5)$$

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

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

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

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

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 $\underline{\mathbf{m}}^{(k)}$; $k=1,\dots,K$. Different midamble code sets $\underline{\mathbf{m}}^{(k)}$; $k=1,\dots,K$; are specified based on different periods \mathbf{m}_p according (5).

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

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

In the Annex A the periods \mathbf{m}_p according to (5), i.e. the Basic Midamble Codes, which shall be used to generate different midamble code sets $\underline{\mathbf{m}}^{(k)}$; $k=1,\dots,K$; 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 \mathbf{m}_{pL} for burst type 1 and \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.