3GPP TSG RAN WG1 (Radio) Meeting #9
Dresden, Germany, 30 Nov-03 Dec 1999

***Document* R1-99k62**
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.

25.223 CR 003r1 Current Version: V3.0.0

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 use only)
list expected approval meeting # here ↑		for information		non-strategic	

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:** 01 Dec 1999

Subject: Alignment of Terminology Regarding Spreading for TDD Mode

Work item: Change Request on the corrections/clarifications to the WG1 specifications

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

Reason for change: Alignment of the terms 'Spreading', 'Channelisation' and 'Scrambling' according to usage in FDD mode.

Clauses affected: 5.2, 6.1, 6.2, 6.3, 6.4

Other specs affected:				
	Other 3G core specifications	X	→ List of CRs:	25.221-CR007r1, 25.224-CR005r1
	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

<--------- double-click here for help and instructions on how to create a CR.

5.2 Mapping of bits onto signal point constellation

A certain number K of CDMA codes can be assigned to either a single user or to different users who are simultaneously transmitting bursts in the same time slot and the same frequency. The maximum possible number of CDMA codes, which is smaller or equal to 16, depends on the individual spreading factors, the actual interference situation and the service requirements. The applicable burst formats are shown in ~~0~~[7]. Each user burst has two data carrying parts, termed data blocks:

$$\underline{\mathbf{d}}^{(k,i)} = (\underline{d}_1^{(k,i)}, \underline{d}_2^{(k,i)}, \ldots, \underline{d}_{N_k}^{(k,i)})^{\mathrm{T}} \quad \mathrm{i} = 1, 2; \mathrm{k} = 1,\ldots,\mathrm{K}. \tag{1}$$

N_k is the number of symbols per data field for the user k. This number is linked to the spreading factor Q_k as described in table 1 of [7] ~~document TS 25.221~~.

Data block $\underline{\mathbf{d}}^{(k,1)}$ is transmitted before the midamble and data block $\underline{\mathbf{d}}^{(k,2)}$ after the midamble. Each of the N_k data symbols $\underline{d}_n^{(k,i)}$; i=1, 2; k=1,...,K; n=1,...,N_k; of equation 1 has the symbol duration $T_s^{(k)} = Q_k . T_c$ as already given.

The data modulation is QPSK, thus the data symbols $\underline{d}_n^{(k,i)}$ are generated from two interleaved and encoded data bits

$$b_{l,n}^{(k,i)} \in \{0,1\} \qquad l = 1,2;\ k = 1,\ldots K;\ n = 1,\ldots,N_k;\ i = 1,2 \tag{2}$$

using the equation

$$\begin{aligned} \mathrm{Re}\{\underline{d}_n^{(k,i)}\} &= \frac{1}{\sqrt{2}}(2b_{1,n}^{(k,i)} - 1) \\ \mathrm{Im}\{\underline{d}_n^{(k,i)}\} &= \frac{1}{\sqrt{2}}(2b_{2,n}^{(k,i)} - 1) \quad \mathrm{k} = 1,\ldots,\mathrm{K};\ \mathrm{n} = 1,\ldots,\mathrm{N_k};\ \mathrm{i} = 1, 2. \end{aligned} \tag{3}$$

Equation 3 corresponds to a QPSK modulation of the interleaved and encoded data bits $b_{l,n}^{(k,i)}$ of equation 2.

6 Spreading modulation

6.1 Basic spreading parameters

Spreading of data consists of two operations: Channelisation and Scrambling. Firstly, e~~E~~ach data symbol $\underline{d}_n^{(k,i)}$ of equation 1 is spread with a complex channelisation ~~spreading~~ code $\underline{\mathbf{c}}^{(k)}$ of length $Q_k \in \{1, 2, 4, 8, 16\}$. The resulting sequence is then scrambled by a sequence ν of length 16.

6.2 Channelisation ~~Spreading~~ codes

The elements $\underline{c}_q^{(k)}$; k=1,...,K; q=1,...,Q_k; of the ~~spreading~~ complex channelisation codes $\underline{\mathbf{c}}^{(k)} = (\underline{c}_1^{(k)}, \underline{c}_2^{(k)}, \ldots, \underline{c}_{Q_k}^{(k)})$; k=1,...,K; shall be taken from the complex set

$$\underline{\mathrm{V}}_{\mathrm{c}} = \{1, \mathrm{j}, -1, -\mathrm{j}\}. \tag{4}$$

In equation 4 the letter j denotes the imaginary unit. A ~~spreading~~ complex channelisation code $\underline{\mathbf{c}}^{(k)}$ is generated from the binary codes $\mathbf{a}_{Q_k}^{(k)} = \left(a_1^{(k)}, a_2^{(k)}, \ldots, a_{Q_k}^{(k)}\right)$ of length Q_k shown in figure 2 allocated to the k^{th} user. The relation between the elements $\underline{c}_q^{(k)}$ and $\underline{a}_q^{(k)}$ is given by:

$$\underline{c}_q^{(k)} = (\mathrm{j})^q \cdot a_q^{(k)} \quad a_q^{(k)} \in \{1,-1\};\ \mathrm{q} = 1,\ldots,\mathrm{Q_k}. \tag{5}$$

Hence, the elements $\underline{c}_q^{(k)}$ of the ~~CDMA~~ complex channelisation codes $\underline{\mathbf{c}}^{(k)}$ are alternating real and imaginary.

The $\mathbf{a}_{Q_k}^{(k)}$ are Orthogonal Variable Spreading Factor (OVSF) codes, allowing to mix in the same timeslot channels with different spreading factors while preserving the orthogonality. The OVSF codes can be defined using the code tree of figure 2.

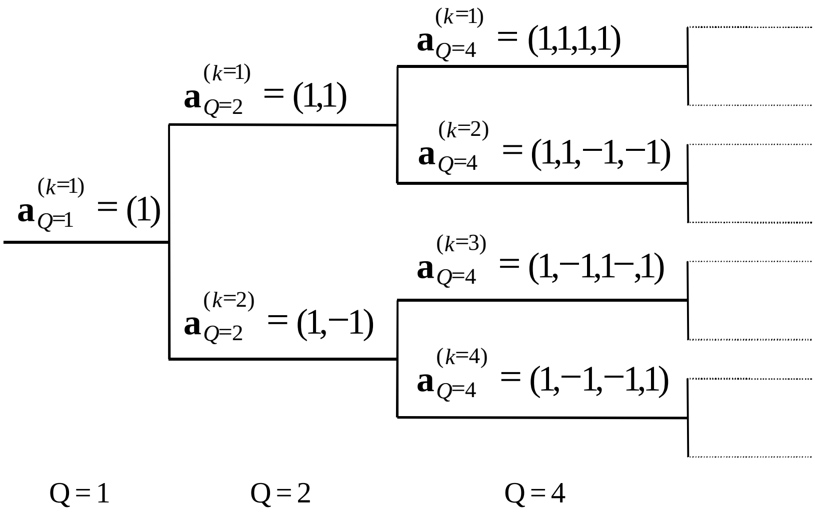

Figure 1: Code-tree for generation of Orthogonal Variable Spreading Factor (OVSF) codes for Channelisation Operation

Each level in the code tree defines a spreading factor~~s~~ indicated by the value of Q in the figure. All codes within the code tree cannot be used simultaneously in a given timeslot. A code can be used in a timeslot if and only if no other code on the path from the specific code to the root of the tree or in the sub-tree below the specific code is used in this timeslot. This means that the number of available codes in a slot is not fixed but depends on the rate and spreading factor of each physical channel.

The spreading factor goes up to Q_{MAX}=16.

6.3 Scrambling codes

The spreading of data by a complex channelisation code $\mathbf{c}^{(k)}$ of length Q_k is followed by a cell specific scrambling sequence $\mathbf{v}=(v1, v2, \ldots v_{QMAX})$. The length matching is obtained by concatenating Q_{MAX}/Q_k spread words before the scrambling. The scheme is illustrated in figure 3 below and is described in more detail in section 6.4. The applicable scrambling codes are shown in Annex A.

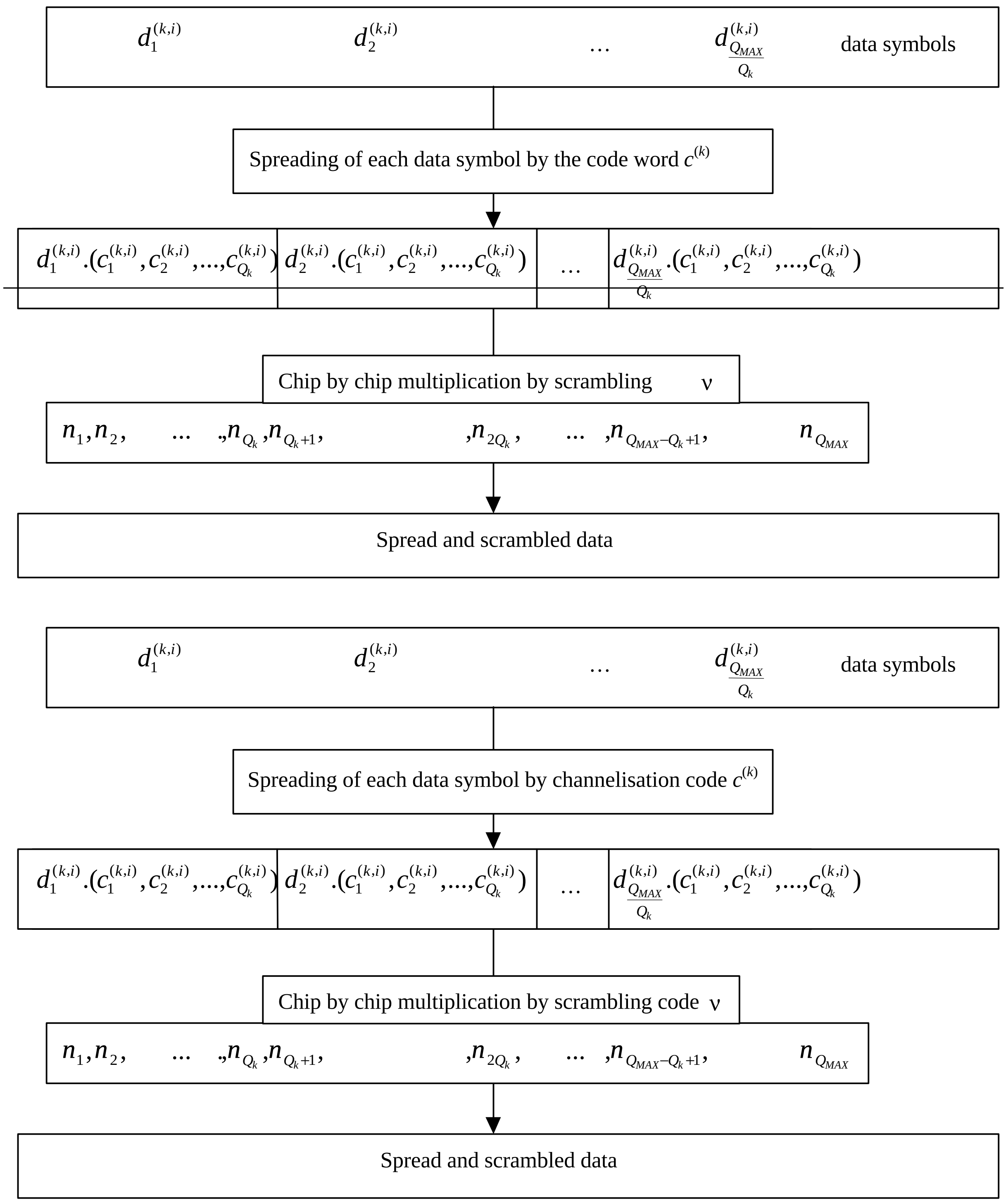

Figure 2: Spreading~~ and subsequent scrambling~~ of data symbols

6.4 Spread~~ and scrambled~~ signal of data symbols and data blocks

The combination of the user specific channelisation ~~spreading~~ and cell specific scrambling codes can be seen as a user and cell specific spreading code $\mathbf{s}^{(k)} = \left(s_p^{(k)}\right)$ with $s_p^{(k)} = c^{(k)}_{1+[(p-1) \bmod Q_k]} .\acute{\imath}_{1+[(p-1) \bmod Q_{MAX}]}$, k=1,…,K, p=1,…,$N_k Q_k$.

With the root raised cosine chip impulse filter $Cr_0(t)$ the transmitted signal belonging to the data block $\underline{\mathbf{d}}^{(k,1)}$ of equation 1 transmitted before the midamble is

$$\underline{d}^{(k,1)}(t) = \sum_{n=1}^{N_k} \underline{d}_n^{(k,1)} \sum_{q=1}^{Q_k} s_{(n-1)Q_k+q}^{(k)} \cdot Cr_o(t-(q-1)T_c-(n-1)Q_kT_c) \tag{6}$$

and for the data block $\underline{\mathbf{d}}^{(k,2)}$ of equation 1 transmitted after the midamble

$$\underline{d}^{(k,2)}(t) = \sum_{n=1}^{N_k} \underline{d}_n^{(k,2)} \sum_{q=1}^{Q_k} s_{(n-1)Q_k+q}^{(k)} \cdot Cr_0(t-(q-1)T_C-(n-1)Q_kT_c-N_kQ_kT_c-L_mT_c). \tag{7}$$

where L_m is the number of midamble chips.

7 Synchronisation codes

7.1 Code Generation

The Primary code sequence, C_p is constructed as a so-called generalised hierarchical Golay sequence. The Primary SCH is furthermore chosen to have good aperiodic auto correlation properties.