TSG-RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

RP-000273

Title: **Agreed CRs to TS 25.223**

Source: **TSG-RAN WG1**

Agenda item: **5.1.3**

No.	Doc #	Spec	CR	Rev	Subject	Cat	Current_v	New_v
1	R1-000512	25.223	008	-	Editorial Modifications for 25.223	D	3.2.0	3.3.0
2	R1-000630	25.223	009	-	Editorial modification of 25.223	D	3.2.0	3.3.0
3	R1-000631	25.223	010	-	Editorial modification of 25.223	D	3.2.0	3.3.0
4	R1-000717	25.223	011	2	Editorial modification of 25.223	D	3.2.0	3.3.0
5	R1-000779	25.223	012	2	Modified code sets on SCH for cell search in	F	3.2.0	3.3.0
6	R1-000748	25.223	013	1	Editorial update of TS25.223	D	3.2.0	3.3.0

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Document *R1-00-0512*

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25.223 CR 008 Current Version: 3.2.0

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

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Proposed change affects: (U)SIM [ ] ME [ ] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: TSG RAN WG1 **Date:** 07.04.2000

Subject: Editorial Modifications for 25.223

Work item:

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

F	Correction		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	X	Release 99	X
			Release 00	

Reason for change: Some editorial modifications to 25.223 are required after approval of removal of synch-case 3 and change of signal point constellation. The scope of the spec was somehow changed in a former release of the document.

Clauses affected: 1, 7.1, 7.2

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:

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1 Scope

The present document describes spreading and modulation for UTRA Physical Layer TDD mode.

~~The present document describes multiplexing, channel coding and interleaving for UTRA Physical Layer TDD mode.~~

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.

Define a = < x_1, x_2, x_3, …, x_{16} > = < 1, 1, 1, 1, 1, 1, -1, -1, 1, -1, 1, -1, 1, -1, -1, 1 >

The PSC code word is generated by repeating the sequence 'a' modulated by a Golay complementary sequence and creating a complex-valued sequence with identical real and imaginary components.

The PSC code word C_p is defined as C_p=< y(0),y(1),y(2),...,y(255) >

where $y = (1+\mathrm{j}) \times < a, a, a, -a, -a, a, -a, -a, a, a, a, -a, a, -a, a, a >$

and the left most index corresponds to the chip transmitted first in each time slot.

The ~~16~~ 12 secondary synchronization code words, {C_0,…,~~C_{15}~~ C_{11}} are complex valued with identical real and imaginary components, and are constructed from the position wise multiplication of a Hadamard sequence and a sequence z, defined as

z = $< b, b, b, -b, b, b, -b, -b, b, -b, b, -b, -b, -b, -b, -b >$, where

b = $< x_1, \ldots, x_8, -x_9, \ldots, -x_{16} >$ = <1, 1, 1, 1, 1, 1, -1, -1, -1, 1, -1, 1, -1, 1, 1, -1>.

The Hadamard sequences are obtained as the rows in a matrix H_8 constructed recursively by:

$$H_0 = (1)$$
$$H_k = \begin{pmatrix} H_{k-1} & H_{k-1} \\ H_{k-1} & -H_{k-1} \end{pmatrix}, \quad k \geq 1$$

The rows are numbered from the top starting with row *0* (the all zeros sequence).

Denote the *n*:th Hadamard sequence h_n as a row of H_8 numbered from the top, n = 0, 1, 2, …, 255, in the sequel.

Furthermore, let $h_m(i)$ and $z(i)$ denote the *i*:th symbol of the sequence h_m and *z*, respectively where i = 0, 1, 2, …, 255 and i = 0 corresponds to the leftmost symbol.

The i:th SCH code word, $C_{SCH,i}$, i = 0, …, ~~15~~ 11 is then defined as

$C_{SCH,i} = (1 + j) \times <h_m(0) \times z(0), h_m(1) \times z(1), h_m(2) \times z(2), \ldots, h_m(255) \times z(255)>$,

where m = (16×i) and the leftmost chip in the sequence corresponds to the chip transmitted first in time.

~~This code word is chosen from every 16th row of the matrix H_8., which yields 16 possible codewords.~~

The Secondary SCH code words are defined in terms of $C_{SCH,i}$ and the definition of {C_0,…,~~C_{15}~~ C_{11}} now follows as:

$C_i = C_{SCH,i}$, i=0,…,11~~5~~

7.2 Code Allocation

Three SCH codes are QPSK modulated and transmitted in parallel with the primary synchronization code. The QPSK modulation carries the following information.

- The code group that the base station belongs to (5 bits; Cases 1, 2)
- The position of the frame within an interleaving period of 20 msec (1 bit, Cases 1, 2)

- The position of the slot within the frame (1 bit, Case 2)

The modulated codes are also constructed such that their cyclic-shifts are unique, i.e. a non-zero cyclic shift less than 2 (Case 1) and 4 (Case 2) of any of the sequences is not equivalent to some cyclic shift of any other of the sequences. Also, a non-zero cyclic shift less than 2 (Case 1) and 4 (Case 2) of any of the sequences is not equivalent to itself with any other cyclic shift less than 8. The secondary synchronization codes are partitioned into two code sets for Case 1 and four code sets for Case 2. The set is used to provide the following information:

Case 1:

Table 2: Code Set Allocation for Case 1

Code Set	Code Group
1	0-15
2	16-31

The code group and frame position information is provided by modulating the secondary codes in the code set.

Case 2:

Table 3: Code Set Allocation for Case 2

Code Set	Code Group
1	0-7
2	8-15
3	16-23
4	24-31

The slot timing and frame position information is provided by the comma free property of the code word and the Code group is provided by modulating some of the secondary codes in the code set.

The following SCH codes are allocated for each code set:

Case 1

Code set 1: C_0, C_1, $C_{2.}$

Code set 2: C_3, C_4, $C_{5.}$

Case 2

Code set 1: C_0, C_1, $C_{2.}$

Code set 2: C_3, C_4, $C_{5.}$

Code set 3: C_6, C_7, $C_{8.}$

Code set 4: C_9, C_{10}, $C_{11.}$

The following subsections 7.2.1 to 7.2.2 refer to the two cases of SCH/P-CCPCH usage as described in [7].

Note that in the Tables 4-~~6~~ 5 corresponding to Cases 1,2~~, and 3~~, respectively, Frame 1 implies the frame with an odd SFN and Frame 2 implies the frame with an even SFN.

7.2.1 Code allocation for Case 1:

~~NOTE: Modulation by "j" indicates that the code is transmitted on the Q channel.~~

Table 4: Code Allocation for Case 1

Code Group	Code Set	Frame 1			Frame 2			Associated t_{offset}
0	1	C_0	C_1	C_2	C_0	C_1	$-C_2$	t_0
1	1	C_0	$-C_1$	C_2	C_0	$-C_1$	$-C_2$	t_1
2	1	$-C_0$	C_1	C_2	$-C_0$	C_1	$-C_2$	t_2
3	1	$-C_0$	$-C_1$	C_2	$-C_0$	$-C_1$	$-C_2$	t_3
4	1	jC_0	~~JC_1~~jC_1	C_2	jC_0	jC_1	$-C_2$	t_4
5	1	jC_0	$-jC_1$	C_2	jC_0	$-jC_1$	$-C_2$	t_5
6	1	$-jC_0$	~~JC_1~~jC_1	C_2	$-jC_0$	jC_1	$-C_2$	t_6
7	1	$-jC_0$	$-jC_1$	C_2	$-jC_0$	$-jC_1$	$-C_2$	t_7
8	1	jC_0	~~JC_2~~jC_2	C_1	jC_0	jC_2	$-C_1$	t_8
9	1	jC_0	$-jC_2$	C_1	jC_0	$-jC_2$	$-C_1$	t_9
10	1	$-jC_0$	~~JC_2~~jC_2	C_1	$-jC_0$	jC_2	$-C_1$	t_{10}
11	1	$-jC_0$	$-jC_2$	C_1	$-jC_0$	$-jC_2$	$-C_1$	t_{11}
12	1	jC_1	~~JC_2~~jC_2	C_0	~~JC_1~~jC_1	jC_2	$-C_0$	t_{12}
13	1	jC_1	$-jC_2$	C_0	~~JC_1~~jC_1	$-jC_2$	$-C_0$	t_{13}
14	1	$-jC_1$	~~JC_2~~jC_2	C_0	$-jC_1$	jC_2	$-C_0$	t_{14}
15	1	$-jC_1$	$-jC_2$	C_0	$-jC_1$	$-jC_2$	$-C_0$	t_{15}
16	2	C_3	C_4	C_5	C_3	C_4	$-C_5$	t_{16}
17	2	C_3	$-C_4$	C_5	C_3	$-C_4$	$-C_5$	t_{17}
…	…	…	…	…	…	…	…	…
20	2	jC_3	~~JC_4~~jC_4	C_5	jC_3	jC_4	$-C_5$	t_{20}
…	…	…	…	…	…	…	…	…
24	2	jC_3	~~JC_5~~jC_5	C_4	jC_3	~~JC_5~~jC_5	$-C_4$	t_{24}
…	…	…	…	…	…	…	…	…
31	2	$-jC_4$	$-jC_5$	C_3	$-jC_4$	$-jC_5$	$-C_3$	t_{31}

NOTE: The code construction for code groups 0 to 15 using only the SCH codes from code set 1 is shown. The construction for code groups 16 to 31 using the SCH codes from code set 2 is done in the same way.

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25.223	**CR**	**009**	Current Version:	3.2.0

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

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Proposed change affects: (U)SIM [ ] ME [ ] UTRAN / Radio [X] Core Network [ ]
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Source:	TSG RAN WG1	**Date:**	10, May 2000
Subject:	Editorial modification of 25.223		
Work item:	TS 25.223		

Category:	F Correction		**Release:**	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: There is a reference to the document itself and references to the documents not referred to, also there are abbreviations used but not defined.

Clauses affected: Reference, Abbreviations

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:

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2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] 3G TS 25.201: "Physical layer - general description"

[2] 3G TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)"

[3] 3G TS 25.212: "Multiplexing and channel coding (FDD)"

[4] 3G TS 25.213: "Spreading and modulation (FDD)"

[5] 3G TS 25.214: "Physical layer procedures (FDD)"

[6] 3G TS 25.215: "Physical layer – Measurements (FDD)"

[7] 3G TS 25.221: "Physical channels and mapping of transport channels onto physical channels (TDD)"

[8] 3G TS 25.222: "Multiplexing and channel coding (TDD)"

~~[9] 3G TS 25.223: "Spreading and modulation (TDD)"~~

~~[10] 3G TS 25.224: "Physical layer procedures (TDD)"~~

~~[11] 3G TS 25.225: "Physical layer – Measurements (TDD)"~~

3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

CDMA	Code Division Multiple Access
P-CCPCH	Primary Common Control Physical Channel
PN	Pseudo Noise
OVSF	Orthogonal Variable Spreading Factor
PRACH	Physical Random Access Channel
QPSK	Quadrature Phase Shift Keying
RACH	Random Access Channel
SCH	Synchronisation Channel

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25.223	**CR**	**010**	Current Version:	3.2.0

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Proposed change affects: *(at least one should be marked with an X)*	(U)SIM		ME		UTRAN / Radio	X	Core Network	

Source:	TSG RAN WG1	**Date:**	10, May 2000
Subject:	Editorial modification of 25.223		
Work item:	TS 25.223		

Category:	F	Correction		**Release:**	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:	. Typing errors found
Clauses affected:	6.2, 6.3, 6.4

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:	

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6.2 Channelisation codes

The elements $c_q^{(k)}$; k=1,...,K; q=1,...,Q_k; of the real valued channelisation codes

$$\mathbf{c}^{(k)} = (c_1^{(k)}, c_2^{(k)}, \ldots, c_{Q_k}^{(k)}) \text{ ; k=1,...,K;}$$

shall be taken from the set

$$V_c = \{1, -1\} \qquad (3)$$

The $\mathbf{c}_{Q_k}^{(k)}$ 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 1.

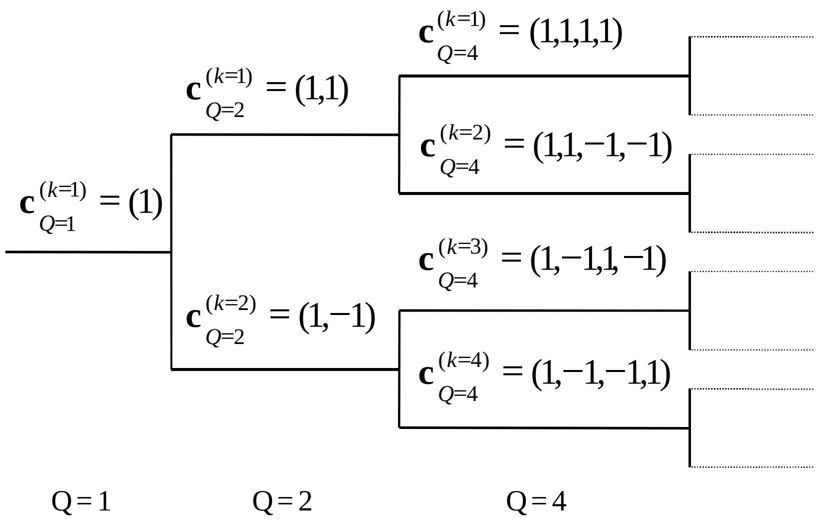

Figure 1:Code-tree for generation of Orthogonal Variable Spreading Factor (OVSF) codes for Channelisation Operation

Each level in the code tree defines a spreading factor 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 real valued channelisation code $\mathbf{c}^{(k)}$ of length Q_k is followed by a cell specific complex scrambling sequence $\underline{\mathbf{í}} = (\underline{í}_1, \underline{í}_2, \ldots, \underline{í}_{16})$. The elements $\underline{í}_i; i = 1,\ldots,16$ of the complex valued scrambling codes shall be taken from the complex set

$$\underline{V}_{\underline{v}} = \{1, j, -1, -j\} \qquad (~~5~~4)$$

In equation ~~5~~ 4 the letter j denotes the imaginary unit. A complex scrambling code $\underline{v}$ is generated from the binary scrambling codes $v = (v_1, v_2, \ldots, v_{16})$ of length 16 shown in Annex A. The relation between the elements $\underline{v}$ and v is given by:

$$\underline{v}_i = (j)^i \cdot v_i \qquad v_i \in \{1, -1\},\ i = 1, \ldots, 16 \qquad (~~6~~5)$$

Hence, the elements $\underline{v}_i$ of the complex scrambling code $\underline{v}$ are alternating real and imaginary.
The length matching is obtained by concatenating Q_{MAX}/Q_k spread words before the scrambling. The scheme is illustrated in figure ~~3~~2 below and is described in more detail in section 6.4.

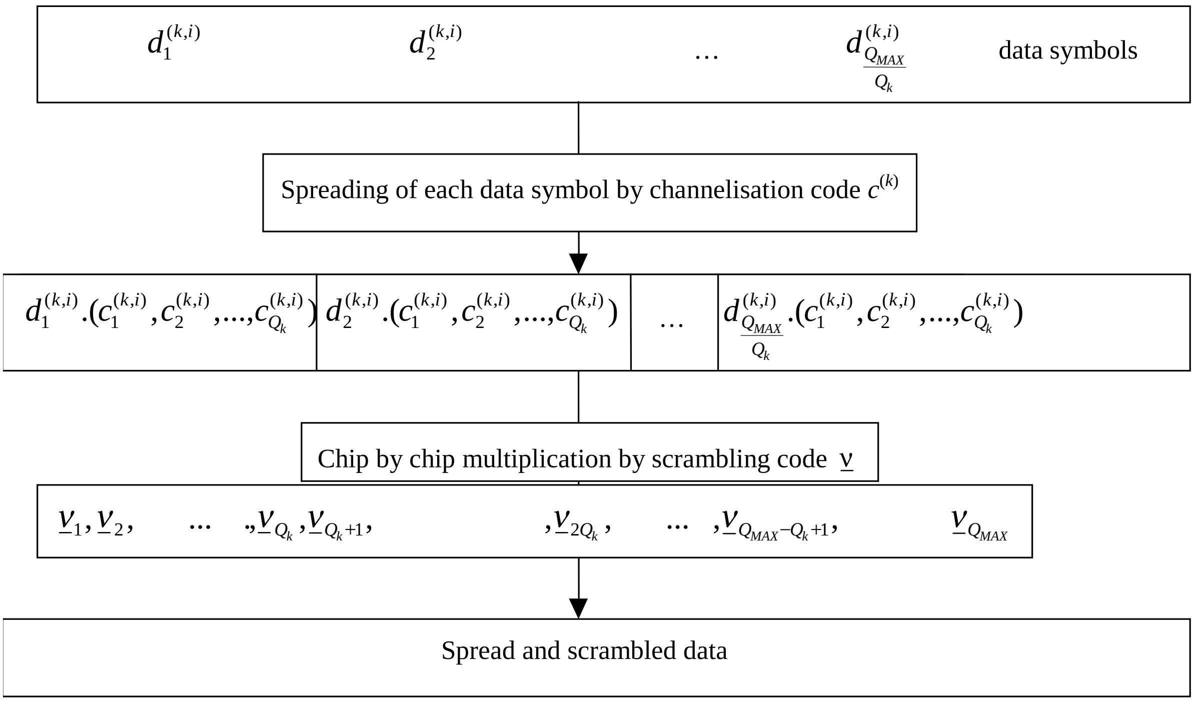

Figure 2: Spreading of data symbols

6.4 Spread signal of data symbols and data blocks

The combination of the user specific channelisation 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

$$s_p^{(k)} = c^{(k)}_{1+[(p-1) \bmod Q_k]} \cdot \underline{v}_{1+[(p-1) \bmod Q_{MAX}]}, \quad k=1,\ldots,K,\ p=1,\ldots,N_kQ_k.$$

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 transmitted before the midamble is

$$\underline{d}^{(k,1)}(t) = \sum_{n=1}^{N_k} \underline{d}_n^{(k,1)} \sum_{q=1}^{Q_k} s_{(n-1)Q_k+q}^{(k)} \cdot Cr_o(t-(q-1)T_c-(n-1)Q_kT_c) \qquad (36)$$

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

$$\underline{d}^{(k,2)}(t) = \sum_{n=1}^{N_k} \underline{d}_n^{(k,2)} \sum_{q=1}^{Q_k} s_{(n-1)Q_k+q}^{(k)} \cdot Cr_0(t-(q-1)T_C-(n-1)Q_kT_c-N_kQ_kT_c-L_mT_c). \qquad (47)$$

where L_m is the number of midamble chips.

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25.223	**CR**	**011r2**	Current Version:	3.2.0

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Proposed change affects: (U)SIM [ ] ME [ ] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: TSG RAN WG1 **Date:** 22, May 2000

Subject: Editorial modification of 25.223

Work item: TS 25.223

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

F	Correction	
A	Corresponds to a correction in an earlier release	
B	Addition of feature	
C	Functional modification of feature	
D	Editorial modification	X

Release:

Phase 2	
Release 96	
Release 97	
Release 98	
Release 99	X
Release 00	

Reason for change: To correct wrong reference to a table.

Clauses affected: Annex A

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:

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Annex A (Normative): Scrambling Codes

The applicable scrambling codes are listed in below. Code numbers are referring to table 6 ‘Mapping scheme for Cell Parameters, Code Groups, Scrambling Codes, Midambles and t_{offset}’ in section 7.2 3 ‘Code AllocationEvaluation of synchronisation codes’.

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25.223 CR 012r2 Current Version: 3.2.0

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

For submission to: TSG RAN#8 — for approval: X; for information: (blank) — strategic: (blank); non-strategic: (blank) *(for SMG use only)*

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Proposed change affects: (U)SIM: (blank); ME: X; UTRAN / Radio: X; Core Network: (blank)
(at least one should be marked with an X)

Source: TSG RAN WG1 **Date:** 24/05/2000

Subject: Modified Code Sets on SCH for Cell Search in UTRA TDD

Work item:

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

F	Correction	X
A	Corresponds to a correction in an earlier release	
B	Addition of feature	
C	Functional modification of feature	
D	Editorial modification	

Release:

Phase 2	
Release 96	
Release 97	
Release 98	
Release 99	X
Release 00	

Reason for change: The modified Code Sets benefit from improved cross-correlation properties with the Primary Synchronisation Code.

Clauses affected: 7.1, 7.2

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: Note: Proposed changes of this CR in the *last* paragraph of section 7.1 (e.g. from "The Secondary SCH code words are defined in terms of $C_{SCH,i}$ and the definition…" onwards) are not necessary anymore, as CR013r1-25.223 (R1-00-0748) is approved and this paragraph has been removed.

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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.

Define a = < x_1, x_2, x_3, …, x_{16} > = < 1, 1, 1, 1, 1, 1, -1, -1, 1, -1, 1, -1, 1, -1, -1, 1 >

The PSC code word is generated by repeating the sequence 'a' modulated by a Golay complementary sequence and creating a complex-valued sequence with identical real and imaginary components.

The PSC code word C_p is defined as C_p=< y(0),y(1),y(2),...,y(255) >

where $y = (1+\mathrm{j}) \times < a, a, a, -a, -a, a, -a, -a, a, a, a, -a, a, -a, a, a >$

and the left most index corresponds to the chip transmitted first in each time slot.

The 12~~6~~ secondary synchronization code words, {C_0, C_1, C_3, C_4, C_5, C_6, C_8, C_{10}, C_{12}, C_{13}, C_{14}~~…~~,C_{15} } are complex valued with identical real and imaginary components, and are constructed from the position wise multiplication of a Hadamard sequence and a sequence z, defined as

z = $< b, b, b, -b, b, b, -b, -b, b, -b, b, -b, -b, -b, -b, -b >$, where

b = $< x_1, \ldots, x_8, -x_9, \ldots, -x_{16} >$ = <1, 1, 1, 1, 1, 1, -1, -1, -1, 1, -1, 1, -1, 1, 1, -1>.

The Hadamard sequences are obtained as the rows in a matrix H_8 constructed recursively by:

$$H_0 = (1)$$
$$H_k = \begin{pmatrix} H_{k-1} & H_{k-1} \\ H_{k-1} & -H_{k-1} \end{pmatrix}, \quad k \geq 1$$

The rows are numbered from the top starting with row *0* (the all zeros sequence).

Denote the *n*:th Hadamard sequence as a row of H_8 numbered from the top, n = 0, 1, 2, …, 255, in the sequel.

Furthermore, let $h_m(i)$ and $z(i)$ denote the *i*:th symbol of the sequence h_m and *z*, respectively where i = 0, 1, 2, …, 255 and i = 0 corresponds to the leftmost symbol.

The i:th SCH code word, $C_{SCH,i}$, i = 0, 1, 3, 4, 5, 6, 8, 10, 12, 13, 14~~…~~, 15 is then defined as

$C_{SCH,i} = (1 + j) \times <h_m(0) \times z(0), h_m(1) \times z(1), h_m(2) \times z(2), \ldots, h_m(255) \times z(255)>$,

where $m = (16 \times i)$ and the leftmost chip in the sequence corresponds to the chip transmitted first in time.

This code word is chosen from every 16th row of the matrix H_8., which yields 16 possible codewords.

The Secondary SCH code words are defined in terms of $C_{SCH,i}$ and the definition of {C_0, C_1, C_3, C_4, C_5, C_6, C_8, C_{10}, C_{12}, C_{13}, C_{14}~~…~~,C_{15} } now follows as:

$C_i = C_{SCH,\,i}$, i=0, 1, 3, 4, 5, 6, 8, 10, 12, 13, 14~~…~~,15

7.2 Code Allocation

Three SCH codes are QPSK modulated and transmitted in parallel with the primary synchronization code. The QPSK modulation carries the following information:

- the code group that the base station belongs to (5 bits; Cases 1, 2);

- the position of the frame within an interleaving period of 20 msec (1 bit, Cases 1, 2);
- the position of the slot within the frame (1 bit, Case 2).

The modulated codes are also constructed such that their cyclic-shifts are unique, i.e. a non-zero cyclic shift less than 2 (Case 1) and 4 (Case 2) of any of the sequences is not equivalent to some cyclic shift of any other of the sequences. Also, a non-zero cyclic shift less than 2 (Case 1) and 4 (Case 2) of any of the sequences is not equivalent to itself with any other cyclic shift less than 8. The secondary synchronization codes are partitioned into two code sets for Case 1 and four code sets for Case 2. The set is used to provide the following information:

Case 1:

Table 2: Code Set Allocation for Case 1

Code Set	Code Group
1	0-15
2	16-31

The code group and frame position information is provided by modulating the secondary codes in the code set.

Case 2:

Table 3: Code Set Allocation for Case 2

Code Set	Code Group
1	0-7
2	8-15
3	16-23
4	24-31

The slot timing and frame position information is provided by the comma free property of the code word and the Code group is provided by modulating some of the secondary codes in the code set.

The following SCH codes are allocated for each code set:

Case 1

Code set 1: $C_{\cancel{0}\underline{1}}$, $C_{\cancel{1}\underline{3}}$, $C_{\cancel{2}\underline{5}}$.

Code set 2: $C_{\cancel{3}\underline{10}}$, $C_{\cancel{4}\underline{13}}$, $C_{\cancel{5}\underline{14}}$.

Case 2

Code set 1: $C_{\cancel{0}\underline{1}}$, $C_{\cancel{1}\underline{3}}$, $C_{\cancel{2}\underline{5}}$.

Code set 2: $C_{\cancel{3}\underline{10}}$, $C_{\cancel{4}\underline{13}}$, $C_{\cancel{5}\underline{14}}$.

Code set 3: $C_{\cancel{6}\underline{0}}$, $C_{\cancel{7}\underline{6}}$, $C_{\cancel{8}\underline{12}}$.

Code set 4: $C_{\cancel{9}\underline{4}}$, $C_{\cancel{10}\underline{8}}$, $C_{\cancel{11}\underline{15}}$.

The following subclauses 7.2.1 to 7.2.2 refer to the two cases of SCH/P-CCPCH usage as described in [7].

Note that in the Tables 4-6 corresponding to Cases 1,2, and 3, respectively, Frame 1 implies the frame with an odd SFN and Frame 2 implies the frame with an even SFN.

7.2.1 Code allocation for Case 1

NOTE: Modulation by "j" indicates that the code is transmitted on the Q channel.

Table 4: Code Allocation for Case 1

Code Group	Code Set	Frame 1			Frame 2			Associated t_{offset}
0	1	C_{01}	C_{13}	C_{25}	C_{01}	C_{13}	$-C_{25}$	t_0
1	1	C_{01}	$-C_{13}$	C_{25}	C_{01}	$-C_{13}$	$-C_{25}$	t_1
2	1	$-C_{01}$	C_{13}	C_{25}	$-C_{01}$	C_{13}	$-C_{25}$	t_2
3	1	$-C_{01}$	$-C_{13}$	C_{25}	$-C_{01}$	$-C_{13}$	$-C_{25}$	t_3
4	1	jC_{01}	JC_{13}	C_{25}	jC_{01}	jC_{13}	$-C_{25}$	t_4
5	1	jC_{01}	$-jC_{13}$	C_{25}	jC_{01}	$-jC_{13}$	$-C_{25}$	t_5
6	1	$-jC_{01}$	JC_{13}	C_{25}	$-jC_{01}$	jC_{13}	$-C_{25}$	t_6
7	1	$-jC_{01}$	$-jC_{13}$	C_{25}	$-jC_{01}$	$-jC_{13}$	$-C_{25}$	t_7
8	1	jC_{01}	JC_{25}	C_{13}	jC_{01}	jC_{25}	$-C_{13}$	t_8
9	1	jC_{01}	$-jC_{25}$	C_{13}	jC_{01}	$-jC_{25}$	$-C_{13}$	t_9
10	1	$-jC_{01}$	JC_{25}	C_{13}	$-jC_{01}$	jC_{25}	$-C_{13}$	t_{10}
11	1	$-jC_{01}$	$-jC_{25}$	C_{13}	$-jC_{01}$	$-jC_{25}$	$-C_{13}$	t_{11}
12	1	jC_{13}	JC_{25}	C_{01}	JC_{13}	jC_{25}	$-C_{01}$	t_{12}
13	1	jC_{13}	$-jC_{25}$	C_{01}	JC_{13}	$-jC_{25}$	$-C_{01}$	t_{13}
14	1	$-jC_{13}$	JC_{25}	C_{01}	$-jC_{13}$	jC_{25}	$-C_{01}$	t_{14}
15	1	$-jC_{13}$	$-jC_{25}$	C_{01}	$-jC_{13}$	$-jC_{25}$	$-C_{01}$	t_{15}
16	2	C_{310}	C_{413}	C_{514}	C_{310}	C_{413}	$-C_{514}$	t_{16}
17	2	C_{310}	$-C_{413}$	C_{514}	C_{310}	$-C_{413}$	$-C_{514}$	t_{17}
…	…	…	…	…	…	…	…	…
20	2	jC_{310}	JC_{413}	C_{514}	jC_{310}	jC_{413}	$-C_{514}$	t_{20}
…	…	…	…	…	…	…	…	…
24	2	jC_{310}	jC_{514}	C_{413}	jC_{310}	JC_{514}	$-C_{413}$	t_{24}
…	…	…	…	…	…	…	…	…
31	2	$-jC_{413}$	$-jC_{514}$	C_{310}	$-jC_{413}$	$-jC_{514}$	$-C_{310}$	t_{31}

NOTE: The code construction for code groups 0 to 15 using only the SCH codes from code set 1 is shown. The construction for code groups 16 to 31 using the SCH codes from code set 2 is done in the same way.

7.2.2 Code allocation for Case 2

Table 5: Code Allocation for Case 2

Code Group	Code Set	Frame 1						Frame 2						Associated t_{offset}
		Slot k			Slot k+8			Slot k			Slot k+8			
0	1	C_{01}	C_{13}	C_{25}	C_{01}	C_{13}	$-C_{25}$	$-C_{01}$	$-C_{13}$	C_{25}	$-C_{01}$	$-C_{13}$	$-C_{25}$	t_0
1	1	C_{01}	$-C_{13}$	C_{25}	C_{01}	$-C_{13}$	$-C_{25}$	$-C_{01}$	C_{13}	C_{25}	$-C_{01}$	C_{13}	$-C_{25}$	t_1
2	1	jC_{01}	jC_{13}	C_{25}	jC_{01}	jC_{13}	$-C_{25}$	$-jC_{01}$	$-jC_{13}$	C_{25}	$-jC_{01}$	$-jC_{13}$	$-C_{25}$	t_2
3	1	jC_{01}	$-jC_{13}$	C_{25}	jC_{01}	$-jC_{13}$	$-C_{25}$	$-jC_{01}$	jC_{13}	C_{25}	$-jC_{01}$	jC_{13}	$-C_{25}$	t_3
4	1	jC_{01}	jC_{25}	C_{13}	jC_{01}	jC_{25}	$-C_{13}$	$-jC_{01}$	$-jC_{25}$	C_{13}	$-jC_{01}$	$-jC_{25}$	$-C_{13}$	t_4
5	1	jC_{01}	$-jC_{25}$	C_{13}	jC_{01}	$-jC_{25}$	$-C_{13}$	$-jC_{01}$	jC_{25}	C_{13}	$-jC_{01}$	jC_{25}	$-C_{13}$	t_5
6	1	jC_{13}	jC_{25}	C_{01}	jC_{13}	jC_{25}	$-C_{01}$	$-jC_{13}$	$-jC_{25}$	C_{01}	$-jC_{13}$	$-jC_{25}$	$-C_{01}$	t_6
7	1	jC_{13}	$-jC_{25}$	C_{01}	jC_{13}	$-jC_{25}$	$-C_{01}$	$-jC_{13}$	jC_{25}	C_{01}	$-jC_{13}$	jC_{25}	$-C_{01}$	t_7
8	2	C_{310}	C_{413}	C_{514}	C_{310}	C_{413}	$-C_{514}$	$-C_{310}$	$-C_{413}$	C_{514}	$-C_{310}$	$-C_{413}$	$-C_{514}$	t_8
9	2	C_{310}	$-C_{413}$	C_{514}	C_{310}	$-C_{413}$	$-C_{514}$	$-C_{310}$	C_{413}	C_{514}	$-C_{310}$	C_{413}	$-C_{514}$	t_9
10	2	jC_{310}	jC_{413}	C_{514}	jC_{310}	jC_{413}	$-C_{514}$	$-jC_{310}$	$-jC_{413}$	C_{514}	$-jC_{310}$	$-jC_{413}$	$-C_{514}$	t_{10}
11	2	jC_{310}	$-jC_{413}$	C_{514}	jC_{310}	$-jC_{413}$	$-C_{514}$	$-jC_{310}$	jC_{413}	C_{514}	$-jC_{310}$	jC_{413}	$-C_{514}$	t_{11}
12	2	jC_{310}	jC_{514}	C_{413}	jC_{310}	jC_{514}	$-C_{413}$	$-jC_{310}$	$-jC_{514}$	C_{413}	$-jC_{310}$	$-jC_{514}$	$-C_{413}$	t_{12}
13	2	jC_{310}	$-jC_{514}$	C_{413}	jC_{310}	$-jC_{514}$	$-C_{413}$	$-jC_{310}$	jC_{514}	C_{413}	$-jC_{310}$	jC_{514}	$-C_{413}$	t_{13}
14	2	jC_{413}	jC_{514}	C_{310}	jC_{413}	jC_{514}	$-C_{310}$	$-jC_{413}$	$-jC_{514}$	C_{310}	$-jC_{413}$	$-jC_{514}$	$-C_{310}$	t_{14}
15	2	jC_{413}	$-jC_{514}$	C_{310}	jC_{413}	$-jC_{514}$	$-C_{310}$	$-jC_{413}$	jC_{514}	C_{310}	$-jC_{413}$	jC_{514}	$-C_{310}$	t_{15}
16	3	C_{60}	C_{76}	C_{812}	C_{60}	C_{76}	$-C_{812}$	$-C_{60}$	$-C_{76}$	C_{812}	$-C_{60}$	$-C_{76}$	$-C_{812}$	t_{16}
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
23	3	jC_{76}	$-jC_{812}$	C_{60}	jC_{76}	$-jC_{812}$	$-C_{60}$	$-jC_{76}$	jC_{812}	C_{60}	$-jC_{76}$	jC_{812}	$-C_{60}$	t_{20}
24	4	C_{94}	C_{108}	C_{1115}	C_{94}	C_{108}	$-C_{1115}$	$-C_{94}$	$-C_{108}$	C_{1115}	$-C_{94}$	$-C_{108}$	$-C_{1115}$	t_{24}
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
31	4	jC_{108}	$-jC_{1115}$	C_{94}	jC_{108}	$-jC_{1115}$	$-C_{94}$	$-jC_{108}$	jC_{1115}	C_{94}	$-jC_{108}$	jC_{1115}	$-C_{94}$	t_{31}

NOTE: The code construction for code groups 0 to 15 using the SCH codes from code sets 1 and 2 is shown. The construction for code groups 16 to 31 using the SCH codes from code sets 3 and 4 is done in the same way.

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25.223	**CR**	**013r1**	Current Version:	3.2.0

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

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

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Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
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Source: TSG RAN WG1 **Date:** 23.05.2000

Subject: Editorial Update of TS25.223

Work item:

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

F	Correction	
A	Corresponds to a correction in an earlier release	
B	Addition of feature	
C	Functional modification of feature	
D	Editorial modification	X

Release:

Phase 2	
Release 96	
Release 97	
Release 98	
Release 99	X
Release 00	

Reason for change:
- Editorial Alignments with FDD spec
- Informative Annex B on alternative generation of Golay sequences added

Clauses affected: 2, 3, 6.5, 7.1, 7.3, former Annex B renamed to Annex C
new chapters: 3.1, 6.5.1, 6.5.2, Annex B

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:
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2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] 3G TS 25.201: "Physical layer - general description".

[2] 3G TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)".

[3] 3G TS 25.212: "Multiplexing and channel coding (FDD)".

[4] 3G TS 25.213: "Spreading and modulation (FDD)".

[5] 3G TS 25.214: "Physical layer procedures (FDD)".

[6] 3G TS 25.215: "Physical layer – Measurements (FDD)".

[7] 3G TS 25.221: "Physical channels and mapping of transport channels onto physical channels (TDD)".

[8] 3G TS 25.222: "Multiplexing and channel coding (TDD)".

[9] 3G TS 25.223: "Spreading and modulation (TDD)".

[10] 3G TS 25.224: "Physical layer procedures (TDD)".

[11] 3G TS 25.225: "Physical layer – Measurements (TDD)".

[12] 3G TS 25.102: “UTRA (UE) TDD; Radio Transmission and Reception”

[13] 3G TS 25.105: “UTRA (BS) TDD; Radio Transmission and Reception”

3 Symbols and abbreviations

3.1 Symbols

For the purposes of the present document, the following symbols apply:

C_p: PSC
C_i: i:th secondary SCH code

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

CDMA Code Division Multiple Access
P-CCPCH Primary Common Control Physical Channel
PN Pseudo Noise
PSC Primary Synchronisation Code
QPSK Quadrature Phase Shift Keying
RACH Random Access Channel
SCH Synchronisation Channel

6.5 Modulation

The complex-valued chip sequence is QPSK modulated as shown in Figure 3 below.

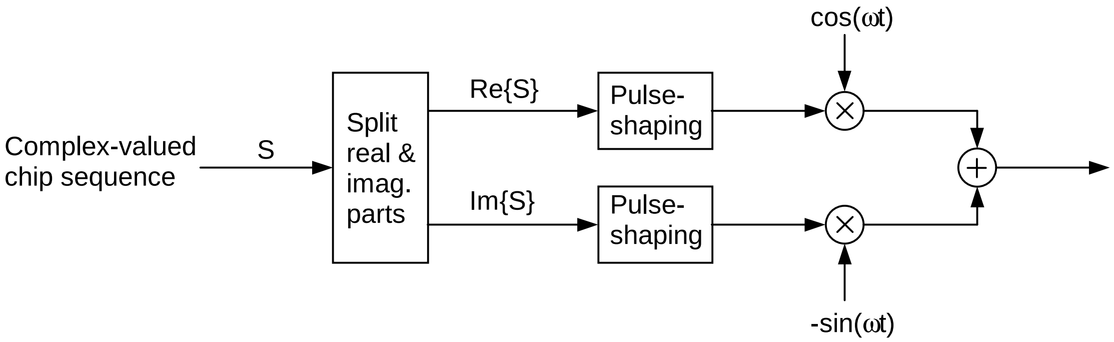

Figure 3: Modulation of complex valued chip sequences

The pulse-shaping characteristics are described in [12] and [13].

6.5.1 Combination of physical channels in uplink

Figure 4 illustrates how the maximum of two different physical uplink channels are combined within one timeslot. Each complex-valued spread channel is separately weighted by a weight factor G_i and combined using complex addition.

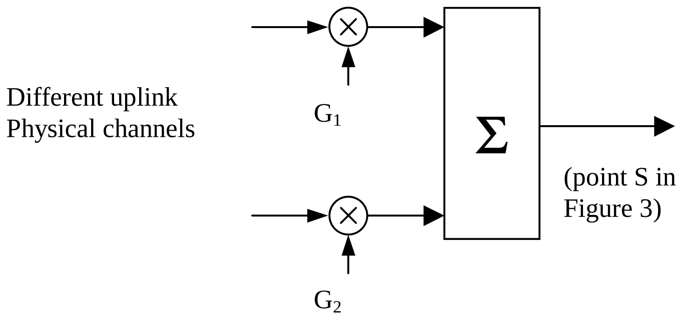

Figure 4: Combination of different physical channels in uplink

6.5.2 Combination of physical channels in downlink

Figure 5 illustrates how different physical downlink channels are combined within one timeslot. Each complex-valued spread channel is separately weighted by a weight factor G_i. If a timeslot contains the SCH, the complex-valued SCH, as described in [7] is separately weighted by a weight factor G_{SCH}. All downlink physical channels are then combined using complex addition.

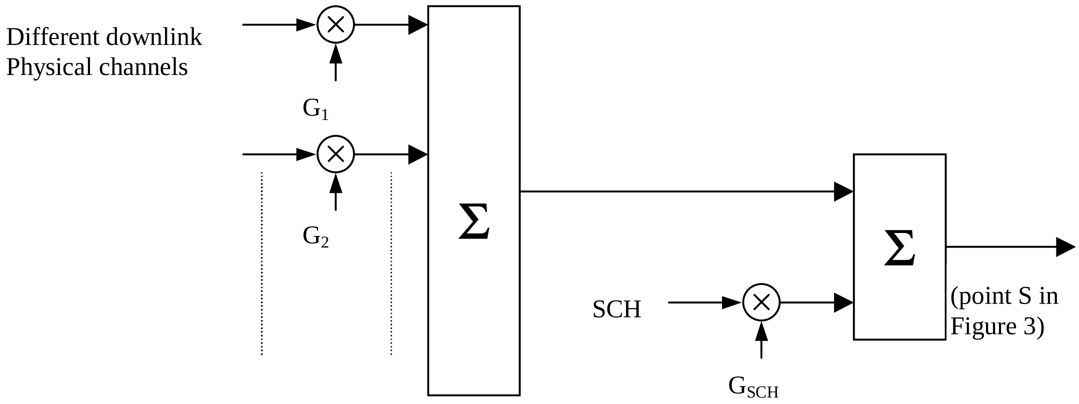

Figure 5: Combination of different physical channels in downlink in case of SCH timeslot

7 Synchronisation codes

7.1 Code Generation

The pPrimary synchronisation code sequence(PSC), C_p is constructed as a so-called generalised hierarchical Golay sequence. The PSCPrimary SCH is furthermore chosen to have good aperiodic auto correlation properties.

Define a = < x_1, x_2, x_3, …, x_{16} > = < 1, 1, 1, 1, 1, 1, -1, -1, 1, -1, 1, -1, 1, -1, -1, 1 >

The PSC code word is generated by repeating the sequence 'a' modulated by a Golay complementary sequence and creating a complex-valued sequence with identical real and imaginary components.

The PSC code word C_p is defined as C_p=< y(0),y(1),y(2),...,y(255) >

where $y = (1+\mathrm{j}) \times < a, a, a, -a, -a, a, -a, -a, a, a, a, -a, a, -a, a, a >$

and the left most index corresponds to the chip transmitted first in each time slot.

The 16 secondary synchronization codes words, {C_0,…,C_{15} } are complex valued with identical real and imaginary components, and are constructed from the position wise multiplication of a Hadamard sequence and a sequence z, defined as:

z = $< b, b, b, -b, b, b, -b, -b, b, -b, b, -b, -b, -b, -b, -b >$, where

b = $< x_1,\dots,x_8,-x_9,\dots,-x_{16} >$ $< x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, -x_9, -x_{10}, -x_{11}, -x_{12}, -x_{13}, -x_{14}, -x_{15}, -x_{16} >$
= <1, 1, 1, 1, 1, 1, -1, -1, -1, 1, -1, 1, -1, 1, 1, -1>.

and x_1, x_2, x_3, …, x_{16} are the same as in the definition of the sequence 'a' above.

The Hadamard sequences are obtained as the rows in a matrix H_8 constructed recursively by:

$$H_0 = (1)$$
$$H_k = \begin{pmatrix} H_{k-1} & H_{k-1} \\ H_{k-1} & -H_{k-1} \end{pmatrix}, \quad k \geq 1$$

The rows are numbered from the top starting with row *0* (the all zeros ones sequence).

Denote the *n*:th Hadamard sequence as a row of H_8 numbered from the top, n = 0, 1, 2, …, 255, in the sequel.

Furthermore, let $h_m(i)$ and $z(i)$ denote the *i*:th symbol of the sequence h_m and *z*, respectively where i = 0, 1, 2, …, 255 and i = 0 corresponds to the leftmost symbol.

The i:th secondary SCH code word, $C_{SCH,i}$, i = 0, …, 15 is then defined as

$C_{SCH,i} = (1 + j) \times <h_m(0) \times z(0), h_m(1) \times z(1), h_m(2) \times z(2), \dots, h_m(255) \times z(255)>$,

where $m = (16 \times i)$ and the leftmost chip in the sequence corresponds to the chip transmitted first in time.

This code word is chosen from every 16th row of the matrix H_8., which yields 16 possible codewords.

The Secondary SCH code words are defined in terms of $C_{SCH,i}$ and the definition of {C_0,…,C_{15} } now follows as:

$C_i = C_{SCH,i}$, i=0,…,15

7.3 Evaluation of synchronisation codes

The evaluation of information transmitted in SCH on code group and frame timing is shown in table 6, where the 32 code groups are listed. Each code group is containing 4 specific scrambling codes (cf. subclause 6.3), each scrambling code associated with a specific short and long basic midamble code.

Each code group is additionally linked to a specific t_{Offset}, thus to a specific frame timing. By using this scheme, the UE can derive the position of the frame border due to the position of the SCH sequence and the knowledge of t_{Offset}. The complete mapping of Code Group to Scrambling Code, Midamble Codes and t_{Offset} is depicted in table 6.

Table 6: Mapping scheme for Cell Parameters, Code Groups, Scrambling Codes, Midambles and t_{Offset}

CELL PARA-METER	Code Group	Associated Codes			Associated t_{Offset}
		Scrambling Code	Long Basic Midamble Code	Short Basic Midamble Code	
0	Group 0	Code 0	m_{PL0}	m_{SL0}	t_0
1		Code 1	m_{PL1}	m_{SL1}	
2		Code 2	m_{PL2}	m_{SL2}	
3		Code 3	m_{PL3}	m_{SL3}	
4	Group 1	Code 4	m_{PL4}	m_{SL4}	t_1
5		Code 5	m_{PL5}	m_{SL5}	
6		Code 6	m_{PL6}	m_{SL6}	
7		Code 7	m_{PL7}	m_{SL7}	
. . . .					
124	Group 31	Code 124	m_{PL124}	m_{SL124}	t_{31}
125		Code 125	m_{PL125}	m_{SL125}	
126		Code 126	m_{PL126}	m_{SL126}	
127		Code 127	m_{PL127}	m_{SL127}	

For basic midamble codes m_P cf. [7]~~TS 25.221~~, annex A 'Basic Midamble Codes'.

Each cell shall cycle through two sets of cell parameters in a code group with the cell parameters changing each frame. Table 7 shows how the cell parameters are cycled according to the SFN.

Table 7: Alignment of cell parameter cycling and SFN

Initial Cell Parameter Assignment	Code Group	Cell Parameter used when SFN mod 2 = 0	Cell Parameter used when SFN mod 2 = 1
0	Group ~~1~~0	0	1
1		1	0
2		2	3
3		3	2
4	Group ~~2~~1	4	5
5		5	4
6		6	7
7		7	6
. . . .			
124	Group ~~32~~31	124	125
125		125	124
126		126	127
127		127	126

Annex B (informative): Generalised Hierarchical Golay Sequences

B.1 Alternative generation

The generalised hierarchical Golay sequences for the PSC described in 7.1 may be also viewed as generated (in real valued representation) by the following methods:

Method 1.

The sequence y is constructed from two constituent sequences x_1 and x_2 of length n_1 and n_2 respectively using the following formula:

- $y(i) = x_2(i \bmod n_2) * x_1(i \operatorname{div} n_2)$, $i = 0 \ldots (n_1 * n_2) - 1$.

The constituent sequences x_1 and x_2 are chosen to be the following length 16 (i.e. $n_1 = n_2 = 16$) sequences:

- x_1 is defined to be the length 16 ($N^{(1)}=4$) Golay complementary sequence obtained by the delay matrix $D^{(1)} = [8, 4, 1,2]$ and weight matrix $W^{(1)} = [1, -1, 1,1]$.
- x_2 is a generalised hierarchical sequence using the following formula, selecting s=2 and using the two Golay complementary sequences x_3 and x_4 as constituent sequences. The length of the sequence x_3 and x_4 is called n_3 respectively n_4.
- $x_2(i) = x_4(i \bmod s + s*(i \operatorname{div} sn_3)) * x_3((i \operatorname{div} s) \bmod n_3)$, $i = 0 \ldots (n_3 * n_4) - 1$.
- x_3 and x_4 are defined to be identical and the length 4 ($N^{(3)}= N^{(4)}=2$) Golay complementary sequence obtained by the delay matrix $D^{(3)} = D^{(4)} = [1, 2]$ and weight matrix $W^{(3)} = W^{(4)} = [1, 1]$.

The Golay complementary sequences x_1,x_3 and x_4 are defined using the following recursive relation:

$a_0(k) = \delta(k)$ and $b_0(k) = \delta(k)$;

$a_n(k) = a_{n-1}(k) + W^{(j)}_n \cdot b_{n-1}(k-D^{(j)}_n)$;

$b_n(k) = a_{n-1}(k) - W^{(j)}_n \cdot b_{n-1}(k-D^{(j)}_n)$;

$k = 0, 1, 2, \ldots, 2^{**}N^{(j)} -1$;

$n = 1, 2, \ldots, N^{(j)}$.

The wanted Golay complementary sequence x_j is defined by a_n assuming $n=N^{(j)}$. The Kronecker delta function is described by δ, k,j and n are integers.

Method 2

The sequence y can be viewed as a pruned Golay complementary sequence and generated using the following parameters which apply to the generator equations for a and b above:

(a) Let j = 0, $N^{(0)} = 8$.

(b) $[D_1^0,D_2^0,D_3^0,D_4^0,D_5^0,D_6^0,D_7^0,D_8^0] = [128, 64, 16, 32, 8, 1, 4, 2]$.

(c) $[W_1^0,W_2^0,W_3^0,W_4^0,W_5^0,W_6^0,W_7^0,W_8^0] = [1, -1, 1, 1, 1, 1, 1, 1]$.

(d) For n = 4, 6, set $b_4(k) = a_4(k)$, $b_6(k) = a_6(k)$.

Annex ~~B~~ C (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
14/01/00	RAN_05	RP-99593	-		Approved at TSG RAN #5 and placed under Change Control	-	3.0.0
14/01/00	RAN_06	RP-99696	001	01	Primary and Secondary CCPCH in TDD	3.0.0	3.1.0
14/01/00	RAN_06	RP-99695	003	1	Alignment of Terminology Regarding Spreading for TDD Mode	3.0.0	3.1.0
14/01/00	RAN_06	RP-99696	004	-	Code allocation for Case 3	3.0.0	3.1.0
14/01/00	-	-	-		Change history was added by the editor	3.1.0	3.1.1
31/03/00	RAN_07	RP-000069	002	3	Cycling of cell parameters	3.1.1	3.2.0
31/03/00	RAN_07	RP-000069	005	-	Removal of Synchronisation Case 3 in TDD	3.1.1	3.2.0
31/03/00	RAN_07	RP-000069	006	1	Signal Point Constellation	3.1.1	3.2.0