TSG-RAN Meeting #7 ***TSGRP#7(00)0069***
Madrid, Spain, 13 – 15 March 2000

Title: **Agreed CRs to TS 25.223**

Source: **TSG-RAN WG1**

Agenda item: **6.1.3**

No.	Doc #	Spec	CR	Rev	Subject	Cat	Versio	Versio
1	R1-000135	25.223	002	3	Cycling of cell parameters	C	3.1.1	3.2.0
2	R1-000220	25.223	005	-	Removal of Synchronisation Case 3 in TDD	F	3.1.1	3.2.0
3	R1-000228	25.223	006	1	Signal Point Constellation	F	3.1.1	3.2.0

3GPP TSG RAN Meeting #7
Madrid, Spain, 13-15 March 2000

Document R1-00-0135

e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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25.223	**CR**	**002r3**	Current Version: V3.10

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

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

Source: TSG RAN WG1 — **Date:** 13 Jan 2000

Subject: Cycling of cell parameters

Work item: TS25.223

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

				Release:	
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	X		Release 98	
D	Editorial modification			Release 99	X
				Release 00	

Reason for change: Improvement in performance by increased diversity and reduction of false paths.

Clauses affected: 7.2, 7.3

Other specs affected:

Other 3G core specifications	X	→ List of CRs:	25.221-CR003r2, 25.224-CR003r2
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:

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 1,2,3)
- The position of the frame within an interleaving period of 20 msec (1 bit, Cases 1,2,3)
- The position of the slot within the frame (1 bit, Cases 2,3)
- SCH transport channel information, e.g. the location of the Primary CCPCH (3 bits, Case 3)

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 (Cases 2 and 3) 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 (Cases 2 and 3) 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, four code sets for Case 2 and thirty two code sets (possibly overlapping) for Case 3. 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.

Case 3:

Code set k, k=1:32 is associated with Code group k-1. The slot information, the frame position information is provided by the comma free property of the code and the SCH transport channel information is provided by modulating some of the 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}, $C_{11.}$

Case 3

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}, $C_{11.}$

Code set 5: C_{12}, C_{13}, $C_{14.}$

Code set 6: C_0, C_3, $C_{6.}$

Code set 7: C_0, C_4, C_7

Code set 8: C_0, C_5, $C_{8.}$

Code set 9: C_0, C_9, $C_{12.}$

Code set 10: C_0, C_{10}, $C_{13.}$

Code set 11: C_0, C_{11}, $C_{14.}$

Code set 12: C_1, C_3, $C_{7.}$

Code set 13: C_1, C_4, $C_{6.}$

Code set 14: C_1, C_5, $C_{9.}$

Code set 15: C_1, C_8, $C_{10.}$

Code set 16: C_1, C_{11}, $C_{12.}$

Code set 17: C_1, C_{13}, $C_{15.}$

Code set 18: C_2, C_3, $C_{8.}$

Code set 19: C_2, C_4, $C_{9.}$

Code set 20: C_2, C_5, $C_{6.}$

Code set 21: C_2, C_7, $C_{10.}$

Code set 22: C_2, C_{11}, $C_{13.}$

Code set 23: C_2, C_{12}, C_{15}

Code set 24: C_3, C_9, $C_{13.}$

Code set 25: C_3, C_{10}, $C_{12.}$

Code set 26: C_3, C_{11}, $C_{15.}$

Code set 27: C_4, C_8, $C_{11.}$

Code set 28: C_4, C_{10}, $C_{14.}$

Code set 29: C_5, C_7, $C_{11.}$

Code set 30: C_5, C_{10}, $C_{15.}$

Code set 31: C_6, C_9, $C_{14.}$

Code set 32: C_7, C_9, $C_{15.}$

The following subsections 7.2.1 to 7.2.3 refer to the three cases of PSCH/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.

7.3 Evaluation of synchronisation codes

The evaluation of information transmitted in SCH on code group and frame timing is shown in table 7, where the 32 code groups are listed. Each code group is containing 4 specific scrambling codes (cf. section 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 7.

Table 7: 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 1	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 2	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 32	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.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 8 shows how the cell parameters are cycled according to the SFN.

Table 8 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	1
1		1	0
2		2	3
3		3	2
4	Group 2	4	5
5		5	4
6		6	7
7		7	6
. . . .			
124	Group 32	124	125
125		125	124
126		126	127
127		127	126

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25.223 CR 005 Current Version: 3.1.0

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

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: TSG RAN WG1 **Date:** 2000-02-21

Subject: Removal of Synchronisation Case 3 in 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: Performance of SCH acquisition is too low with synchronisation case 3.

Clauses affected: 3, 7.2, 7.3

Other specs affected:

Other 3G core specifications	X	→ List of CRs:	CR014-221, CR01-224
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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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
~~PSCH~~	~~Physical Synchronisation Channel~~
QPSK	Quadrature Phase Shift Keying
RACH	Random Access Channel
SCH	Synchronisation Channel

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~~,3~~)
- The position of the frame within an interleaving period of 20 msec (1 bit, Cases 1, 2~~,3~~)
- The position of the slot within the frame (1 bit, Cases 2~~,3~~)
- ~~SCH transport channel information, e.g. the location of the Primary CCPCH (3 bits, Case 3)~~

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 (Cases 2~~ and 3~~) 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 (Cases 2~~ and 3~~) 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~~ and thirty two code sets (possibly overlapping) for Case 3~~. 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.

~~Case 3:~~

~~Code set k, k=1:32 is associated with Code group k-1. The slot information, the frame position information is provided by the comma free property of the code and the SCH transport channel information is provided by modulating some of the 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}, $C_{11.}$

~~Case 3~~

~~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}, $C_{11.}$~~

~~Code set 5: C_{12}, C_{13}, $C_{14.}$~~

~~Code set 6: C_0, C_3, $C_{6.}$~~

~~Code set 7: C_0, C_4, C_7~~

~~Code set 8: C_0, C_5, $C_{8.}$~~

~~Code set 9: C_0, C_9, $C_{12.}$~~

~~Code set 10: C_0, C_{10}, $C_{13.}$~~

~~Code set 11: C_0, C_{11}, $C_{14.}$~~

~~Code set 12: C_1, C_3, $C_{7.}$~~

~~Code set 13: C_1, C_4, $C_{6.}$~~

~~Code set 14: C_1, C_5, $C_{9.}$~~

~~Code set 15: C_1, C_8, $C_{10.}$~~

~~Code set 16: C_1, C_{11}, $C_{12.}$~~

~~Code set 17: C_1, C_{13}, $C_{15.}$~~

~~Code set 18: C_2, C_3, $C_{8.}$~~

~~Code set 19: C_2, C_4, $C_{9.}$~~

~~Code set 20: C_2, C_5, $C_{6.}$~~

~~Code set 21: C_2, C_7, $C_{10.}$~~

~~Code set 22: C_2, C_{11}, $C_{13.}$~~

~~Code set 23: C_2, C_{12}, C_{15}~~

~~Code set 24: C_3, C_9, $C_{13.}$~~

~~Code set 25: C_3, C_{10}, $C_{12.}$~~

~~Code set 26: C_3, C_{11}, $C_{15.}$~~

~~Code set 27: C_4, C_8, $C_{11.}$~~

~~Code set 28: C_4, C_{10}, $C_{14.}$~~

~~Code set 29: C_5, C_7, $C_{11.}$~~

~~Code set 30: C_5, C_{10}, $C_{15.}$~~

~~Code set 31: C_6, C_9, C_{14}.~~

~~Code set 32: C_7, C_9, C_{15}.~~

The following subsections 7.2.1 to 7.2.2~~3~~ refer to the two ~~three~~ cases of ~~P~~SCH/P-CCPCH usage as described in [7].

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	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	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	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	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	C_0	JC_1	jC_2	$-C_0$	t_{12}
13	1	jC_1	$-jC_2$	C_0	JC_1	$-jC_2$	$-C_0$	t_{13}
14	1	$-jC_1$	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	C_5	jC_3	jC_4	$-C_5$	t_{20}
…	…	…	…	…	…	…	…	…
24	2	jC_3	jC_5	C_4	jC_3	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.

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_0	C_1	C_2	C_0	C_1	$-C_2$	$-C_0$	$-C_1$	C_2	$-C_0$	$-C_1$	$-C_2$	t_0
1	1	C_0	$-C_1$	C_2	C_0	$-C_1$	$-C_2$	$-C_0$	C_1	C_2	$-C_0$	C_1	$-C_2$	t_1
2	1	jC_0	jC_1	C_2	jC_0	jC_1	$-C_2$	$-jC_0$	$-jC_1$	C_2	$-jC_0$	$-jC_1$	$-C_2$	t_2
3	1	jC_0	$-jC_1$	C_2	jC_0	$-jC_1$	$-C_2$	$-jC_0$	jC_1	C_2	$-jC_0$	jC_1	$-C_2$	t_3
4	1	jC_0	jC_2	C_1	jC_0	jC_2	$-C_1$	$-jC_0$	$-jC_2$	C_1	$-jC_0$	$-jC_2$	$-C_1$	t_4
5	1	jC_0	$-jC_2$	C_1	jC_0	$-jC_2$	$-C_1$	$-jC_0$	jC_2	C_1	$-jC_0$	jC_2	$-C_1$	t_5
6	1	jC_1	jC_2	C_0	jC_1	jC_2	$-C_0$	$-jC_1$	$-jC_2$	C_0	$-jC_1$	$-jC_2$	$-C_0$	t_6
7	1	jC_1	$-jC_2$	C_0	jC_1	$-jC_2$	$-C_0$	$-jC_1$	jC_2	C_0	$-jC_1$	jC_2	$-C_0$	t_7
8	2	C_3	C_4	C_5	C_3	C_4	$-C_5$	$-C_3$	$-C_4$	C_5	$-C_3$	$-C_4$	$-C_5$	t_8
9	2	C_3	$-C_4$	C_5	C_3	$-C_4$	$-C_5$	$-C_3$	C_4	C_5	$-C_3$	C_4	$-C_5$	t_9
10	2	jC_3	jC_4	C_5	jC_3	jC_4	$-C_5$	$-jC_3$	$-jC_4$	C_5	$-jC_3$	$-jC_4$	$-C_5$	t_{10}
11	2	jC_3	$-jC_4$	C_5	jC_3	$-jC_4$	$-C_5$	$-jC_3$	jC_4	C_5	$-jC_3$	jC_4	$-C_5$	t_{11}
12	2	jC_3	jC_5	C_4	jC_3	jC_5	$-C_4$	$-jC_3$	$-jC_5$	C_4	$-jC_3$	$-jC_5$	$-C_4$	t_{12}
13	2	jC_3	$-jC_5$	C_4	jC_3	$-jC_5$	$-C_4$	$-jC_3$	jC_5	C_4	$-jC_3$	jC_5	$-C_4$	t_{13}
14	2	jC_4	jC_5	C_3	jC_4	jC_5	$-C_3$	$-jC_4$	$-jC_5$	C_3	$-jC_4$	$-jC_5$	$-C_3$	t_{14}
15	2	jC_4	$-jC_5$	C_3	jC_4	$-jC_5$	$-C_3$	$-jC_4$	jC_5	C_3	$-jC_4$	jC_5	$-C_3$	t_{15}
16	3	C_6	C_7	C_8	C_6	C_7	$-C_8$	$-C_6$	$-C_7$	C_8	$-C_6$	$-C_7$	$-C_8$	t_{16}
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
23	3	jC_7	$-jC_8$	C_6	jC_7	$-jC_8$	$-C_6$	$-jC_7$	jC_8	C_6	$-jC_7$	jC_8	$-C_6$	t_{20}
24	4	C_9	C_{10}	C_{11}	C_9	C_{10}	$-C_{11}$	$-C_9$	$-C_{10}$	C_{11}	$-C_9$	$-C_{10}$	$-C_{11}$	t_{24}
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
31	4	jC_{10}	$-jC_{11}$	C_9	jC_{10}	$-jC_{11}$	$-C_9$	$-jC_{10}$	jC_{11}	C_9	$-jC_{10}$	jC_{11}	$-C_9$	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.

7.2.3 Code allocation for Case 3:

In addition to the information on code group three bits from SCH transport channel are transmitted to the UE with these codes.

Table 6: Code Allocation for Case 3

Code Group	Code Set	Frame 1						Frame 2						Associated t_{offset}	Addl bits from SCH transport channel
		Slot k			Slot k+8			Slot k			Slot k+8				
0	1	C_0	C_1	C_2	C_0	C_1	$-C_2$	$-C_0$	$-C_1$	C_2	$-C_0$	$-C_1$	$-C_2$	t_0	000
1	1	C_0	$-C_1$	C_2	C_0	$-C_1$	$-C_2$	$-C_0$	C_1	C_2	$-C_0$	C_1	$-C_2$	t_1	000
2	1	jC_0	jC_1	C_2	jC_0	jC_1	$-C_2$	$-jC_0$	$-jC_1$	C_2	$-jC_0$	$-jC_1$	$-C_2$	t_2	000
3	1	jC_0	$-jC_1$	C_2	jC_0	$-jC_1$	$-C_2$	$-jC_0$	jC_1	C_2	$-jC_0$	jC_1	$-C_2$	t_3	000
4	1	jC_0	jC_2	C_1	jC_0	jC_2	$-C_1$	$-jC_0$	$-jC_2$	C_1	$-jC_0$	$-jC_2$	$-C_1$	t_4	000
5	1	jC_0	$-jC_2$	C_1	jC_0	$-jC_2$	$-C_1$	$-jC_0$	jC_2	C_1	$-jC_0$	jC_2	$-C_1$	t_5	000
6	1	jC_1	jC_2	C_0	jC_1	jC_2	$-C_0$	$-jC_1$	$-jC_2$	C_0	$-jC_1$	$-jC_2$	$-C_0$	t_6	000
7	1	jC_1	$-jC_2$	C_0	jC_1	$-jC_2$	$-C_0$	$-jC_1$	jC_2	C_0	$-jC_1$	jC_2	$-C_0$	t_7	000
8	2	C_3	C_4	C_5	C_3	C_4	$-C_5$	$-C_3$	$-C_4$	C_5	$-C_3$	$-C_4$	$-C_5$	t_8	000
9	2	C_3	$-C_4$	C_5	C_3	$-C_4$	$-C_5$	$-C_3$	C_4	C_5	$-C_3$	C_4	$-C_5$	t_9	000
10	2	jC_3	jC_4	C_5	jC_3	jC_4	$-C_5$	$-jC_3$	$-jC_4$	C_5	$-jC_3$	$-jC_4$	$-C_5$	t_{10}	000
11	2	jC_3	$-jC_4$	C_5	jC_3	$-jC_4$	$-C_5$	$-jC_3$	jC_4	C_5	$-jC_3$	jC_4	$-C_5$	t_{11}	000
12	2	jC_3	jC_5	C_4	jC_3	jC_5	$-C_4$	$-jC_3$	$-jC_5$	C_4	$-jC_3$	$-jC_5$	$-C_4$	t_{12}	000
13	2	jC_3	$-jC_5$	C_4	jC_3	$-jC_5$	$-C_4$	$-jC_3$	jC_5	C_4	$-jC_3$	jC_5	$-C_4$	t_{13}	000
14	2	jC_4	jC_5	C_3	jC_4	jC_5	$-C_3$	$-jC_4$	$-jC_5$	C_3	$-jC_4$	$-jC_5$	$-C_3$	t_{14}	000
15	2	jC_4	$-jC_5$	C_3	jC_4	$-jC_5$	$-C_3$	$-jC_4$	jC_5	C_3	$-jC_4$	jC_5	$-C_3$	t_{15}	000
16	3	C_6	C_7	C_8	C_6	C_7	$-C_8$	$-C_6$	$-C_7$	C_8	$-C_6$	$-C_7$	$-C_8$	t_{16}	000
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
31	4	jC_{10}	$-jC_{11}$	C_9	jC_{10}	$-jC_{11}$	$-C_9$	$-jC_{10}$	jC_{11}	C_9	$-jC_{10}$	jC_{11}	$-C_9$	t_{31}	000
0	5	C_{12}	C_{13}	C_{14}	C_{12}	C_{13}	$-C_{14}$	$-C_{12}$	$-C_{13}$	C_{14}	$-C_{12}$	$-C_{13}$	$-C_{14}$	t_0	001
1	5	C_{12}	$-C_{13}$	C_{14}	C_{12}	$-C_{13}$	$-C_{14}$	$-C_{12}$	C_{13}	C_{14}	$-C_{12}$	C_{13}	$-C_{14}$	t_1	001
2	5	jC_{12}	jC_{13}	C_{14}	jC_{12}	jC_{13}	$-C_{14}$	$-jC_{12}$	$-jC_{13}$	C_{14}	$-jC_{12}$	$-jC_{13}$	$-C_{14}$	t_2	001
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
31	8	jC_5	$-jC_8$	C_0	jC_5	$-jC_8$	$-C_0$	$-jC_5$	jC_8	C_0	$-jC_5$	jC_8	$-C_0$	t_{31}	001
0	9	C_0	C_9	C_{12}	C_0	C_9	$-C_{12}$	$-C_0$	$-C_9$	C_{12}	$-C_0$	$-C_9$	$-C_{12}$	t_0	010
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
30	32	jC_9	jC_{15}	C_7	jC_9	jC_{15}	$-C_7$	$-jC_9$	$-jC_{15}$	C_7	$-jC_9$	$-jC_{15}$	$-C_7$	t_{30}	111
31	32	jC_9	$-jC_{15}$	C_7	jC_9	$-jC_{15}$	$-C_7$	$-jC_9$	jC_{15}	C_7	$-jC_9$	jC_{15}	$-C_7$	t_{31}	111

NOTE: The code construction using code sets 1 to 4 is exactly the same as for Case 2, and the additional bits from the SCH transport channel are "000". The code construction from code sets 5 to 32 is done in the same way with the additional bits for code sets 5 to 8 being "001", code sets 9 to 12 being "010", code sets 13 to 16 being "011", code sets 17 to 20 being "100", code sets 21 to 24 being "101", code sets 25 to 28 being "110", and code sets 29 to 32 being "111".

7.3 Evaluation of synchronisation codes

The evaluation of information transmitted in SCH on code group and frame timing is shown in table 7, where the 32 code groups are listed. Each code group is containing 4 specific scrambling codes (cf. section 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 7.

Table 7: 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 ~~1~~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 ~~2~~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 ~~32~~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.TS 25.221, annex A 'Basic Midamble Codes'.

3GPP TSG RAN Meeting #7
Madrid, Spain, 13-15 March 2000

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e.g. for 3GPP use the format TP-99xxx
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CHANGE REQUEST

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25.223 CR 006r1 Current Version: 3.1.0

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

For submission to:	TSG RAN#7	for approval	X	strategic	
list expected approval meeting # here ↑		for information		non-strategic	

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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: TSG RAN WG1 **Date:** 2000-02-25

Subject: Signal Point Constellation

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:
-description of signal point constellation aligned to FDD
-channelisation and scrambling operation modified and aligned with FDD
-SCH description aligned with FDD and signal point constellation of SCH modified

Clauses affected: 5.2, 5.2.1, 5.2.2, 6.1, 6.2, 6.3, 6.4, 6.5, 7.1

Other specs affected:

Other 3G core specifications	X	→ List of CRs:	25.221 CR015r1, 25.224 CR013
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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5 Data modulation

5.1 Symbol rate

The symbol duration T_S depends on the spreading factor Q and the chip duration T_C: $T_s = Q \times T_c$, where $T_c = \frac{1}{chiprate}$.

5.2 Mapping of bits onto signal point constellation

5.2.1 Mapping for burst type 1 and 2

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[7]. The data modulation is performed to the bits from the output of the physical channel mapping procedure in [8] and combines always 2 consecutive binary bits to a complex valued data symbol. Each user burst has two data carrying parts, termed data blocks:

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

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].

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 encodedconsecutive data bits from the output of the physical channel mapping procedure in [8]:

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

using the equationfollowing mapping to complex symbols:

consecutive binary bit pattern $b_{1,n}^{(k,i)}\ b_{2,n}^{(k,i)}$	complex symbol $\underline{d}_n^{(k,i)}$
00	+j
01	+1
10	-1
11	-j

$$\mathrm{Re}\{\underline{d}_n^{(k,i)}\} = \frac{1}{\sqrt{2}}(2b_{1,n}^{(k,i)} - 1)$$

$$\mathrm{Im}\{\underline{d}_n^{(k,i)}\} = \frac{1}{\sqrt{2}}(2b_{2,n}^{(k,i)} - 1) \qquad k = 1,...,K;\ n = 1,...,N_k;\ i = 1, 2. \qquad (3)$$

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

5.2.2 Mapping for PRACH burst type

In case of PRACH burst type, the definitions in subclause 5.2.1 apply with a modified number of symbols in the second data block.. For the PRACH burst type, the number of symbols in the second data block $\underline{\mathbf{d}}^{(k,2)}$ is decreased by $\frac{96}{Q_K}$ symbols.

6 Spreading modulation

6.1 Basic spreading parameters

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

6.2 Channelisation codes

The elements $c_q^{(k)}$ ~~$\underline{c}_q^{(k)}$~~; k=1,...,K; q=1,...,Q_k; of the real valued ~~complex~~ channelisation codes $\mathbf{c}^{(k)}=(c_1^{(k)},c_2^{(k)},...,c_{Q_k}^{(k)})$ ~~$\underline{\mathbf{c}}^{(k)}=(\underline{c}_1^{(k)},\underline{c}_2^{(k)},...,\underline{c}_{Q_k}^{(k)})$~~; k=1,...,K; shall be taken from the ~~complex~~ set

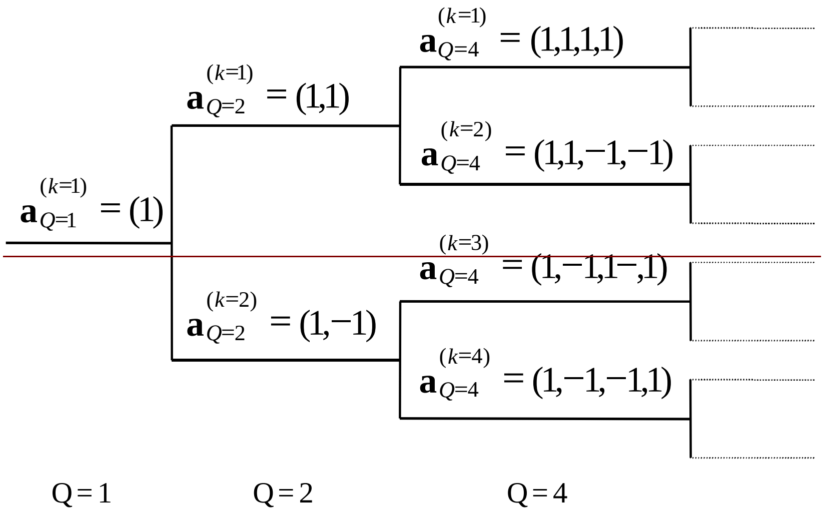
$$\sout{\underline{V}_c = \{1, j, -1, -j\}}\ V_c = \{1, -1\} \qquad (34)$$

~~In equation 4 the letter j denotes the imaginary unit. A 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:~~

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

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

The $\mathbf{c}_{Q_k}^{(k)}$ ~~$\mathbf{a}_{Q_k}^{(k)}$~~ 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 21.



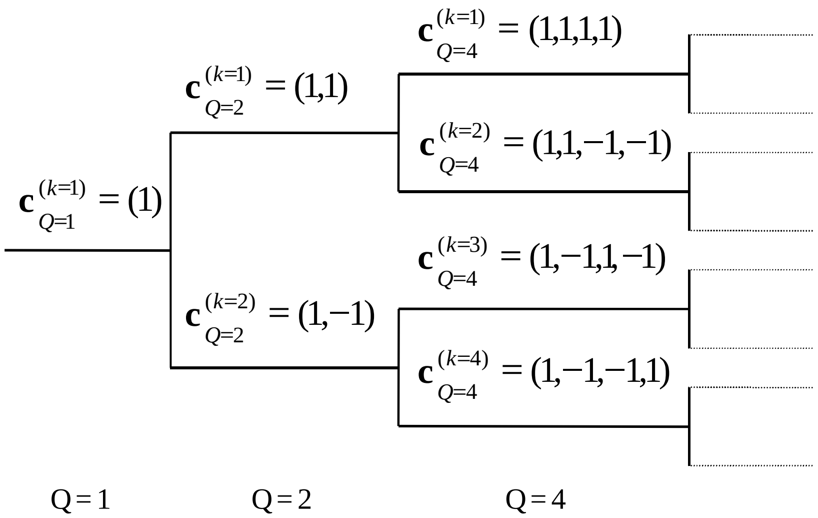


Figure 1: Code-tree for generation of Orthogonal Variable Spreading Factor (OVSF) codes for Channelisation Operation

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 ~~complex~~ real valued channelisation code $\mathbf{c}^{(k)}$ of length Q_k is followed by a cell specific complex scrambling sequence ~~v=(v1, v2, … v$_{QMAX}$)~~ $\underline{\mathbf{v}} = (\underline{v}_1, \underline{v}_2, ..., \underline{v}_{16})$. The elements $\underline{v}_i; i = 1,...,16$ of the complex valued scrambling codes shall be taken from the complex set

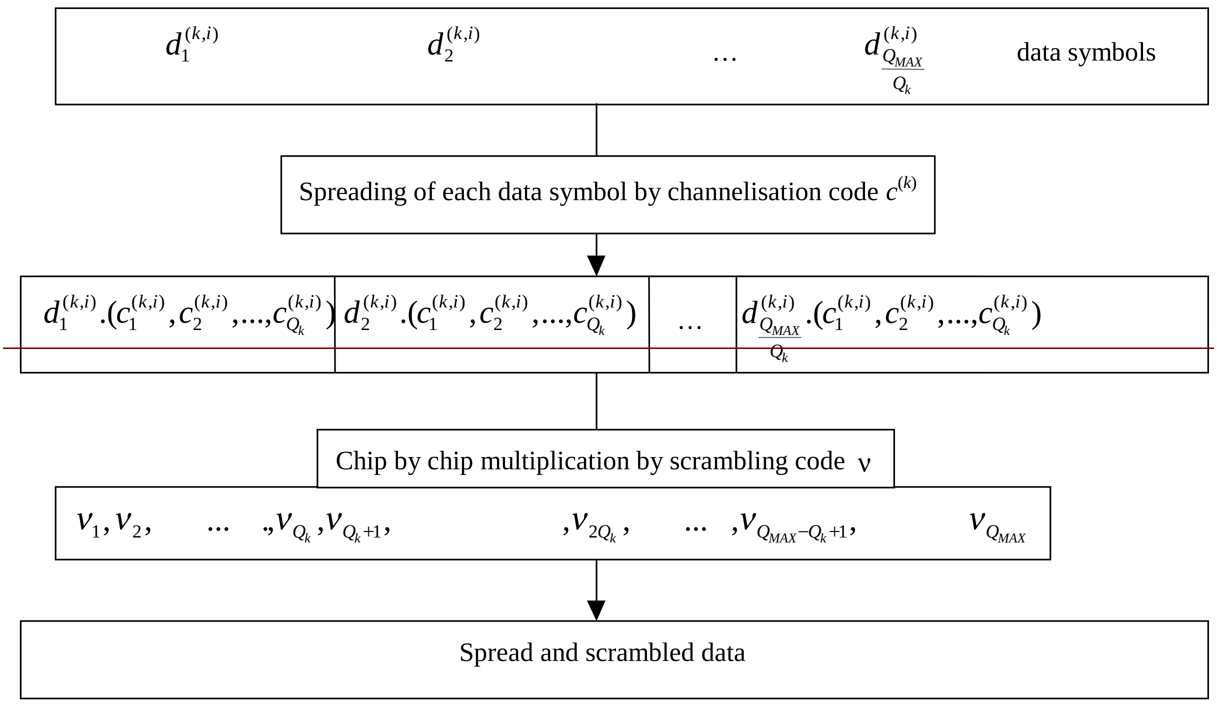
$$\underline{V}_{\underline{v}} = \{1, j, -1, -j\} \quad (5)$$

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

$$\underline{v}_i = (\mathrm{j})^i \cdot v_i \qquad v_i \in \{1, -1\},\ \mathrm{i} = 1, \dots, 16 \tag{6}$$

Hence, the elements $\underline{v}_i$ of the complex scrambling code $\underline{\mathbf{v}}$ 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 below and is described in more detail in section 6.4. ~~The applicable scrambling codes are shown in Annex A.~~



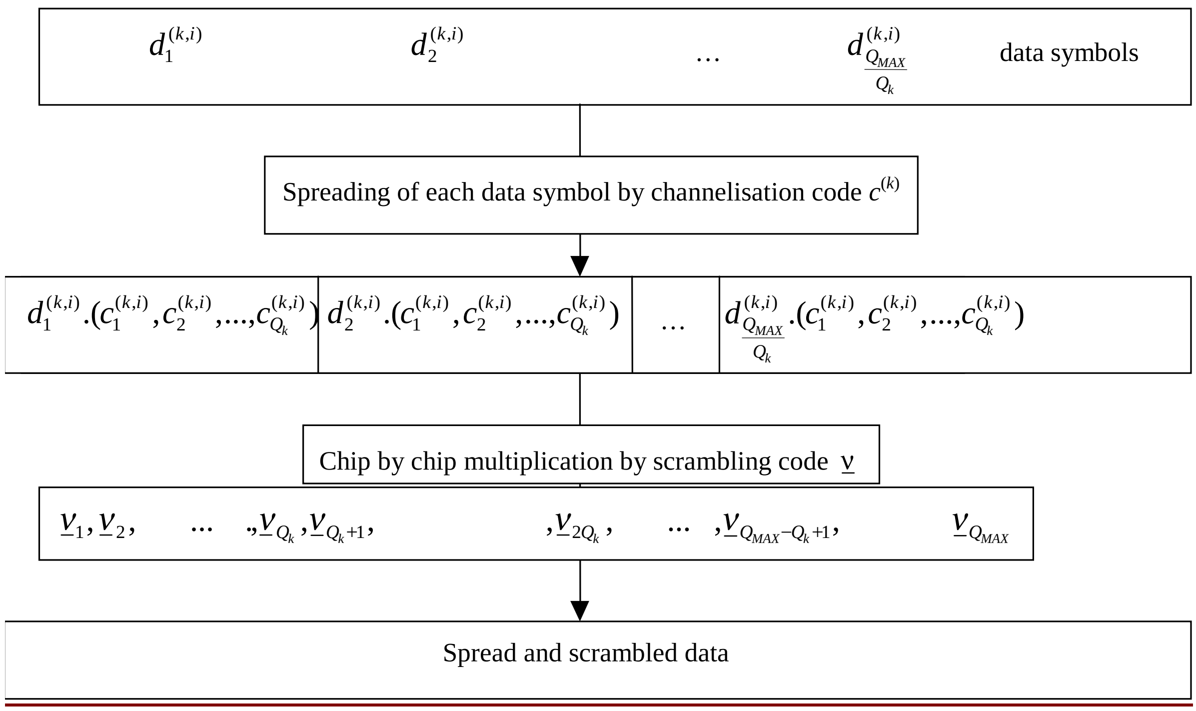


Figure 2: Spreading of data symbols

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

$s_p^{(k)} = c^{(k)}_{1+[(p-1)\bmod Q_k]} \cdot \acute{\iota}_{1+[(p-1)\bmod Q_{MAX}]}$ ~~$s_p^{(k)} = c^{(k)}_{1+[(p-1)\bmod Q_k]} \cdot \acute{\iota}_{1+[(p-1)\bmod Q_{MAX}]}$~~, k=1,…,K, p=1,…,$N_kQ_k$.

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 1 transmitted before the midamble is

$$\underline{d}^{(k,1)}(t) = \sum_{n=1}^{N_k} \underline{d}_n^{(k,1)} \sum_{q=1}^{Q_k} s_{(n-1)Q_k+q}^{(k)} \cdot Cr_0(t-(q-1)T_c-(n-1)Q_kT_c) \qquad (6)$$

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

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

where L_m is the number of midamble chips.

6.5 Modulation

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

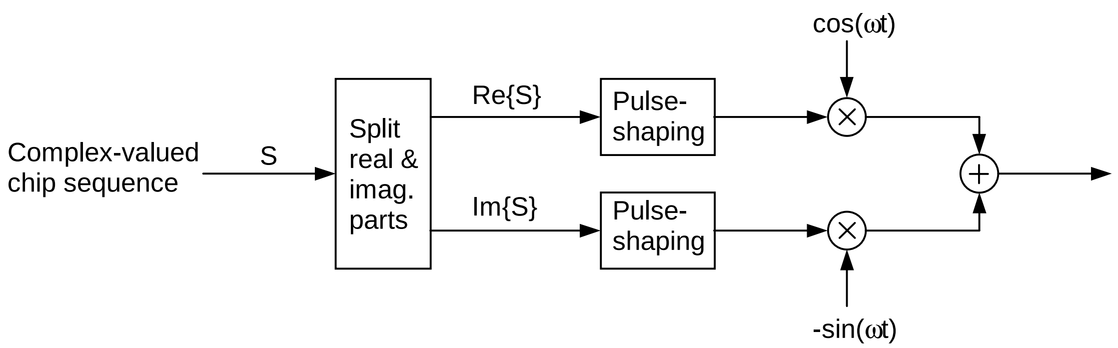


Figure 3: Modulation of complex valued chip sequences

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.~~

~~Letting a = < x_1, x_2, x_3, …, x_{16} > = < 0, 0, 0, 0, 0, 0, 1, 1, 0, 1,0, 1, 0, 1, 1, 0 > and~~

~~b = $< x_1,\ldots, x_8, \overline{x}_9,\ldots, \overline{x}_{16} >$ = <0,0,0,0,0,0,1,1,1,0,1,0,1,0,0,1>~~

~~The PSC code is generated by repeating sequence 'a' modulated by a Golay complementary sequence.~~

Letting $y = <a,a,a,\overline{a},\overline{a},a,\overline{a},\overline{a},a,a,a,\overline{a},a,\overline{a},a,a>$

The definition of the PSC code word C_p follows (the left most index corresponds to the chip transmitted first in each time slot):

C_p=< y(0),y(1),y(2),...,y(255) >.

Let the length 256 mask sequence z be given as, $z = <b,b,b,\overline{b},b,b,\overline{b},\overline{b},b,\overline{b},b,\overline{b},\overline{b},\overline{b},\overline{b},\overline{b}>$.

Then the Secondary Synchronization code words, $\{C_0,\ldots,C_{15}\}$ are constructed as the position wise addition modulo 2 of a Hadamard sequence and the sequence *z*.

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

$$H_0 = (0)$$
$$H_k = \begin{pmatrix} H_{k-1} & H_{k-1} \\ H_{k-1} & \overline{H_{k-1}} \end{pmatrix}, \quad k \geq 1$$

The rows are numbered from the top starting with row *0* (the all zeros sequence), h_0.

The Hadamard sequence *h* depends on the chosen code number *n* and is denoted h_n in the sequel.

This code word is chosen from every 16[th] row of the matrix H_8., which yields 16 possible codewords $n = 0, 1,\ldots,15$.

Furthermore, let $h_n(i)$ and $z(i)$ denote the *i*:th symbol of the sequence h_n and *z*, respectively.

The definition of the *n*:th SCH code word follows (the left most index correspond to the chip transmitted first in each slot):

$C_{SCH,n}$ = < $h_n(0)$+ z(0), $h_n(1)$+ z(1), $h_n(2)$+ z(2), …,$h_n(255)$+ z(255) >,

All sums of symbols are taken modulo 2.

These PSC and SSC binary code words are converted to real valued sequences by the transformation '0' -> '+1', '1' -> '-1'.

The Secondary SCHcode words are defined in terms of $C_{SCH,n}$ and the definition of $\{C_0,\ldots,C_{15}\}$ now follows as:

$C_i = C_{SCH,i}$; i=0,…,15

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 $y = (1 + j) \times <a,a,a,-a,-a,a,-a,-a,a,a,a,-a,a,-a,a,a>$

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

The 16 secondary synchronization code words, $\{C_0,\ldots,C_{15}\}$ 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 $i = 0, 1, 2, \ldots, 255$ and $i = 0$ corresponds to the leftmost symbol.

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

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

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 $\{C_0,\ldots,C_{15}\}$ now follows as:

$C_i = C_{SCH,i}$, i=0,…,15