TSG-RAN Meeting #7 ***RP-000063***
Madrid, Spain, 13 – 15 March 2000

Title: **Agreed CRs to TS 25.213**

Source: **TSG-RAN WG1**

Agenda item: **6.1.3**

No.	Doc #	Spec	CR	Rev	Subject	Ca	Versio	Versio
1	R1-000118	25.213	020	1	Consistent numbering of scrambling code groups	F	3.1.1	3.2.0
2	R1-000087	25.213	021	-	Downlink signal flow corrections	F	3.1.1	3.2.0
3	R1-000087	25.213	022	-	Uplink signal flow corrections	F	3.1.1	3.2.0
4	R1-000245	25.213	023	1	Number of RACH scrambling codes	C	3.1.1	3.2.0
5	R1-000213	25.213	024	1	Editorial changes to 25.213	F	3.1.1	3.2.0
6	R1-000427	25.213	025	3	Number of PCPCH scrambling codes per cell	C	3.1.1	3.2.0
7	R1-000253	25.213	027	-	A typo correction for 5.2.2 and clarification for	F	3.1.1	3.2.0
8	R1-000416	25.213	028	2	Channelization code allocation method for PCPCH	C	3.1.1	3.2.0
9	R1-000300	25.213	029	-	Clarifications to DSCH scrambling and modulation	C	3.1.1	3.2.0
10	R1-000422	25.213	032	-	Clean up of USTS related specifications	F	3.1.1	3.2.0

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

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25.213	**CR**	**020r1**	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	*(for SMG use only)*
list expected approval meeting # here ↑		for information		non-strategic	

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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:**	2000-01-18
Subject:	Consistent numbering of scrambling code groups		
Work item:			

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

Reason for change:	The numbering of the scrambling code groups in Table 4 in section 5.2.3.2 of TS 25.213 is not consistent with the numbering used in section 5.2.2. It is proposed to change the numbering for the scrambling code groups in Table 4 from 1…64 to 0…63. Furthermore, some editorial corrections are proposed in section 5.2.1 and 5.2.2.
Clauses affected:	5.2.1, 5.2.2, 5.2.3.2

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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5.2 Code generation and allocation

5.2.1 Channelization codes

The channelization codes of figure 8 are the same codes as used in the uplink, namely Orthogonal Variable Spreading Factor (OVSF) codes that preserve the orthogonality between downlink channels of different rates and spreading factors. The OVSF codes are defined in figure 4 in section 4.3.1.

The channelization code for the Primary CPICH is fixed to $C_{ch,256,0}$ and the channelization code for the Primary CCPCH is fixed to $C_{ch,256,1}$.The channelization codes for all other physical channels are assigned by UTRAN.

With the spreading factor 512 a specific restriction is applied. When the code word $C_{ch,512,n}$, with n=0,2,4….510, is used in soft handover, then the code word $C_{\underline{ch,}512,n+1}$ is not allocated in the Node Bs where timing adjustment is to be used. Respectively if $C_{ch,512,n}$, with n=1,3,5….511 is used, then the code word $C_{\underline{ch,}512,n-1}$ is not allocated in the Node B where timing adjustment is to be used. This restriction shall not apply for the softer handover operation or in case UTRAN is synchronised to such a level that timing adjustments in soft handover are not used with spreading factor 512.

When compressed mode is implemented by reducing the spreading factor by 2, the OVSF code used for compressed frames is:

- $C_{ch,SF/2,\lfloor n/2 \rfloor}$ if ordinary scrambling code is used
- $\cancel{C}_{\cancel{ch}}\underline{C}_{\underline{ch},SF/2,n \bmod SF/2}$ if alternative scrambling code is used (see section 5.2.2)

where $\cancel{C}_{\cancel{ch}}\underline{C}_{\underline{ch},SF,n}$ is the channelization code used for non-compressed frames.

In case the OVSF code on the PDSCH varies from frame to frame, the OVSF codes shall be allocated such a way that the OVSF code(s) below the smallest spreading factor will be from the branch of the code tree pointed by the smallest spreading factor used for the connection. This means that all the codes for UE for the PDSCH connection can be generated according to the OVSF code generation principle from smallest spreading factor code used by the UE on PDSCH.

In case of mapping the DSCH to multiple parallel PDSCHs, the same rule applies, but all of the branches identified by the multiple codes, corresponding to the smallest spreading factor, may be used for higher spreading factor allocation.

5.2.2 Scrambling code

A total of 2^{18}-1 = 262,143 scrambling codes, numbered 0…262,142 can be generated. However not all the scrambling codes are used. The scrambling codes are divided into 512 sets each of a primary scrambling code and 15 secondary scrambling codes.

The primary scrambling codes consist of scrambling codes n=16*i where i=0…511. The i:th set of secondary scrambling codes consists of scrambling codes 16*i+k, where k=1…15.

There is a one-to-one mapping between each primary scrambling code and 15 secondary scrambling codes in a set such that i:th primary scrambling code corresponds to i:th set of <u>secondary</u> scrambling codes.

Hence, according to the above, scrambling codes k = 0, 1, …, 8191 are used. Each of these codes are associated with a left alternative scrambling code and a right alternative scrambling code, that may be used for compressed frames. The left alternative scrambling code corresponding to scrambling code k is scrambling code number k + 8192, while the right alternative scrambling code corresponding to scrambling code k is scrambling code number k + 16384. The alternative scrambling codes can be used for compressed frames. In this case, the left alternative scrambling code is used if $n<SF/2$ and the right alternative scrambling code is used if $n \geq SF/2$, where $c_{ch,SF,n}$ is the channelization code used for non-compressed frames. The usage of alternative scrambling code for compressed frames is signalled by higher layers for each physical channel respectively.

The set of primary scrambling codes is further divided into 64 scrambling code groups, each consisting of 8 primary scrambling codes. The j:th scrambling code group consists of primary scrambling codes 16*8*j+16*k, where j=0..63 and k=0..7.

Each cell is allocated one and only one primary scrambling code. The primary CCPCH and primary CPICH are always transmitted using the primary scrambling code. The other downlink physical channels can be transmitted with either the primary scrambling code or a secondary scrambling code from the set associated with the primary scrambling code of the cell.

The mixture of primary scrambling code and secondary scrambling code for one CCTrCH is allowable.

The scrambling code sequences are constructed by combining two real sequences into a complex sequence. Each of the two real sequences are constructed as the position wise modulo 2 sum of 38400 chip segments of two binary *m*-sequences generated by means of two generator polynomials of degree 18. The resulting sequences thus constitute segments of a set of Gold sequences. The scrambling codes are repeated for every 10 ms radio frame. Let *x* and *y* be the two sequences respectively. The *x* sequence is constructed using the primitive (over GF(2)) polynomial $1+X^7+X^{18}$. The y sequence is constructed using the polynomial $1+X^5+X^7+X^{10}+X^{18}$.

The sequence depending on the chosen scrambling code number *n* is denoted z_n, in the sequel. Furthermore, let *x(i)*, *y(i)* and $z_n(i)$ denote the *i:*th symbol of the sequence *x*, *y*, and z_n, respectively

The *m*-sequences *x*and *y* are constructed as:

Initial conditions:

x is constructed with x (0)=1, x(1)= x(2)=...= x (16)= x (17)=0

y(0)=y(1)= … =y(16)= y(17)=1

Recursive definition of subsequent symbols:

$x(i+18) = x(i+7) + x(i)$ modulo 2, $i=0,\dots,2^{18}-20$,

$y(i+18) = y(i+10)+y(i+7)+y(i+5)+y(i)$ modulo 2, $i=0,\dots,2^{18}-20$.

The n:th Gold code sequence z_n, $n=0,1,2,\dots,2^{18}-2$, is then defined as

$z_n(i) = x((i+n) \text{ modulo } (2^{18}-1) + y(i) \text{ modulo } 2, \quad i=0,\dots,2^{18}-2$.

These binary sequences are converted to real valued sequences Z_n by the following transformation:

$$Z_n(i) = \begin{cases} +1 & if \;\; z_n(i) = 0 \\ -1 & if \;\; z_n(i) = 1 \end{cases} \quad for \quad i = 0,1,\dots,2^{18}-2.$$

Finally, the n:th complex scrambling code sequence $S_{dl,n}$ is defined as:

$S_{dl,n}(i) = Z_n(i) + j\, Z_n((i+131072) \text{ modulo } (2^{18}-1)), \quad i=0,1,\dots,38399$.

Note that the pattern from phase 0 up to the phase of 38399 is repeated.

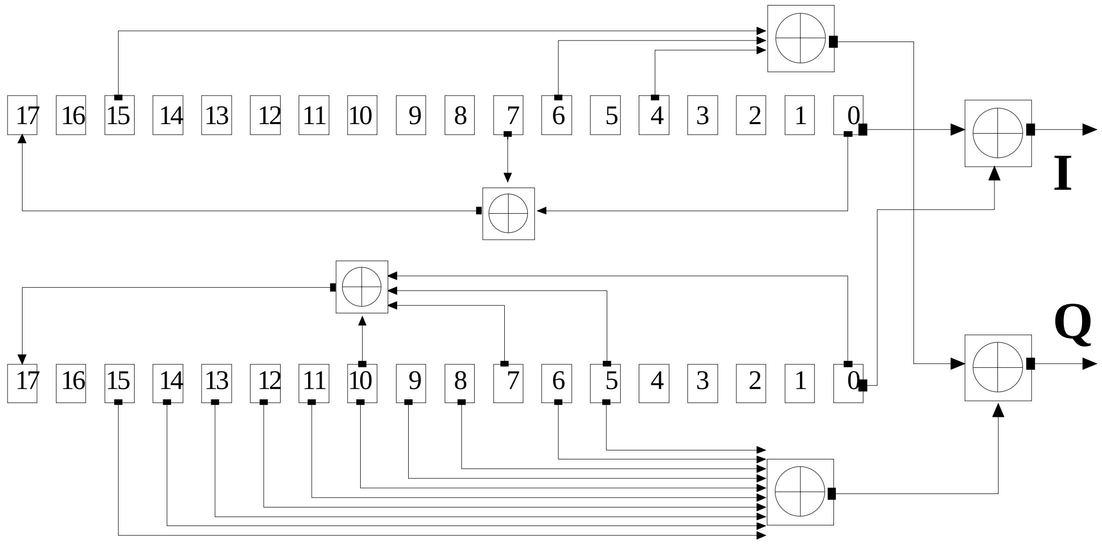

Figure 10: Configuration of downlink scrambling code generator

5.2.3 Synchronisation codes

5.2.3.1 Code generation

The primary synchronisation code (PSC), C_{psc} is constructed as a so-called generalised hierarchical Golay sequence. The PSC 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 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 C_{psc} is defined as

C_{psc} = (1 + j) × <a, a, a, -a, -a, a, -a, -a, a, a, a, -a, a, -a, a, a>,

where the leftmost chip in the sequence corresponds to the chip transmitted first in time

The 16 secondary synchronization codes (SSCs), {$C_{ssc,1}$,…,$C_{ssc,16}$}, are complex-valued with identical real and imaginary components, and are constructed from position wise multiplicationof 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, 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}>.

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

The k:th SSC, $C_{ssc,k}$, k = 1, 2, 3, …, 16 is then defined as

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

where $m = 16\times(k - 1)$ and the leftmost chip in the sequence corresponds to the chip transmitted first in time.

5.2.3.2 Code allocation of SSC

The 64 secondary SCH sequences are constructed such that their cyclic-shifts are unique, i.e., a non-zero cyclic shift less than 15 of any of the 64 sequences is not equivalent to some cyclic shift of any other of the 64 sequences. Also, a non-zero cyclic shift less than 15 of any of the sequences is not equivalent to itself with any other cyclic shift less than 15. Table 4 describes the sequences of SSCs used to encode the 64 different scrambling code groups. The entries in table 4 denote what SSC to use in the different slots for the different scrambling code groups, e.g. the entry "7" means that SSC $C_{ssc,7}$ shall be used for the corresponding scrambling code group and slot.

Table 4: Allocation of SSCs for secondary SCH.

Scrambling Code Group	slot number														
	#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14
Group ~~1~~0	1	1	2	8	9	10	15	8	10	16	2	7	15	7	16
Group ~~2~~1	1	1	5	16	7	3	14	16	3	10	5	12	14	12	10
Group ~~3~~2	1	2	1	15	5	5	12	16	6	11	2	16	11	15	12
Group ~~4~~3	1	2	3	1	8	6	5	2	5	8	4	4	6	3	7
Group ~~5~~4	1	2	16	6	6	11	15	5	12	1	15	12	16	11	2
Group ~~6~~5	1	3	4	7	4	1	5	5	3	6	2	8	7	6	8
Group ~~7~~6	1	4	11	3	4	10	9	2	11	2	10	12	12	9	3
Group ~~8~~7	1	5	6	6	14	9	10	2	13	9	2	5	14	1	13
Group ~~9~~8	1	6	10	10	4	11	7	13	16	11	13	6	4	1	16
Group ~~10~~9	1	6	13	2	14	2	6	5	5	13	10	9	1	14	10
Group ~~11~~10	1	7	8	5	7	2	4	3	8	3	2	6	6	4	5
Group ~~12~~11	1	7	10	9	16	7	9	15	1	8	16	8	15	2	2
Group ~~13~~12	1	8	12	9	9	4	13	16	5	1	13	5	12	4	8
Group ~~14~~13	1	8	14	10	14	1	15	15	8	5	11	4	10	5	4
Group ~~15~~14	1	9	2	15	15	16	10	7	8	1	10	8	2	16	9
Group ~~16~~15	1	9	15	6	16	2	13	14	10	11	7	4	5	12	3
Group ~~17~~16	1	10	9	11	15	7	6	4	16	5	2	12	13	3	14
Group ~~18~~17	1	11	14	4	13	2	9	10	12	16	8	5	3	15	6
Group ~~19~~18	1	12	12	13	14	7	2	8	14	2	1	13	11	8	11
Group ~~20~~19	1	12	15	5	4	14	3	16	7	8	6	2	10	11	13
Group ~~21~~20	1	15	4	3	7	6	10	13	12	5	14	16	8	2	11
Group ~~22~~21	1	16	3	12	11	9	13	5	8	2	14	7	4	10	15
Group ~~23~~22	2	2	5	10	16	11	3	10	11	8	5	13	3	13	8
Group ~~24~~23	2	2	12	3	15	5	8	3	5	14	12	9	8	9	14
Group ~~25~~24	2	3	6	16	12	16	3	13	13	6	7	9	2	12	7
Group ~~26~~25	2	3	8	2	9	15	14	3	14	9	5	5	15	8	12
Group ~~27~~26	2	4	7	9	5	4	9	11	2	14	5	14	11	16	16
Group ~~28~~27	2	4	13	12	12	7	15	10	5	2	15	5	13	7	4
Group ~~29~~28	2	5	9	9	3	12	8	14	15	12	14	5	3	2	15
Group ~~30~~29	2	5	11	7	2	11	9	4	16	7	16	9	14	14	4
Group ~~31~~30	2	6	2	13	3	3	12	9	7	16	6	9	16	13	12
Group ~~32~~31	2	6	9	7	7	16	13	3	12	2	13	12	9	16	6
Group ~~33~~32	2	7	12	15	2	12	4	10	13	15	13	4	5	5	10
Group ~~34~~33	2	7	14	16	5	9	2	9	16	11	11	5	7	4	14
Group ~~35~~34	2	8	5	12	5	2	14	14	8	15	3	9	12	15	9
Group ~~36~~35	2	9	13	4	2	13	8	11	6	4	6	8	15	15	11
Group ~~37~~36	2	10	3	2	13	16	8	10	8	13	11	11	16	3	5
Group ~~38~~37	2	11	15	3	11	6	14	10	15	10	6	7	7	14	3
Group ~~39~~38	2	16	4	5	16	14	7	11	4	11	14	9	9	7	5
Group ~~40~~39	3	3	4	6	11	12	13	6	12	14	4	5	13	5	14
Group ~~41~~40	3	3	6	5	16	9	15	5	9	10	6	4	15	4	10
Group ~~42~~41	3	4	5	14	4	6	12	13	5	13	6	11	11	12	14
Group ~~43~~42	3	4	9	16	10	4	16	15	3	5	10	5	15	6	6
Group ~~44~~43	3	4	16	10	5	10	4	9	9	16	15	6	3	5	15
Group ~~45~~44	3	5	12	11	14	5	11	13	3	6	14	6	13	4	4
Group ~~46~~45	3	6	4	10	6	5	9	15	4	15	5	16	16	9	10
Group ~~47~~46	3	7	8	8	16	11	12	4	15	11	4	7	16	3	15
Group ~~48~~47	3	7	16	11	4	15	3	15	11	12	12	4	7	8	16
Group ~~49~~48	3	8	7	15	4	8	15	12	3	16	4	16	12	11	11
Group ~~50~~49	3	8	15	4	16	4	8	7	7	15	12	11	3	16	12

Scrambling Code Group	slot number														
	#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14
Group ~~51~~50	3	10	10	15	16	5	4	6	16	4	3	15	9	6	9
Group ~~52~~51	3	13	11	5	4	12	4	11	6	6	5	3	14	13	12
Group ~~53~~52	3	14	7	9	14	10	13	8	7	8	10	4	4	13	9
Group ~~54~~53	5	5	8	14	16	13	6	14	13	7	8	15	6	15	7
Group ~~55~~54	5	6	11	7	10	8	5	8	7	12	12	10	6	9	11
Group ~~56~~55	5	6	13	8	13	5	7	7	6	16	14	15	8	16	15
Group ~~57~~56	5	7	9	10	7	11	6	12	9	12	11	8	8	6	10
Group ~~58~~57	5	9	6	8	10	9	8	12	5	11	10	11	12	7	7
Group ~~59~~58	5	10	10	12	8	11	9	7	8	9	5	12	6	7	6
Group ~~60~~59	5	10	12	6	5	12	8	9	7	6	7	8	11	11	9
Group ~~61~~60	5	13	15	15	14	8	6	7	16	8	7	13	14	5	16
Group ~~62~~61	9	10	13	10	11	15	15	9	16	12	14	13	16	14	11
Group ~~63~~62	9	11	12	15	12	9	13	13	11	14	10	16	15	14	16
Group ~~64~~63	9	12	10	15	13	14	9	14	15	11	11	13	12	16	10

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25.213	**CR**	**021**	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:** 12-Jan-2000

Subject: Downlink signal flow corrections

Work item:

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

F	Correction	X	**Release:**	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	

Reason for change: Correction of erroneous indication of signal flow between downlink block diagrams.

Clauses affected: 5.1 ,5.3.2

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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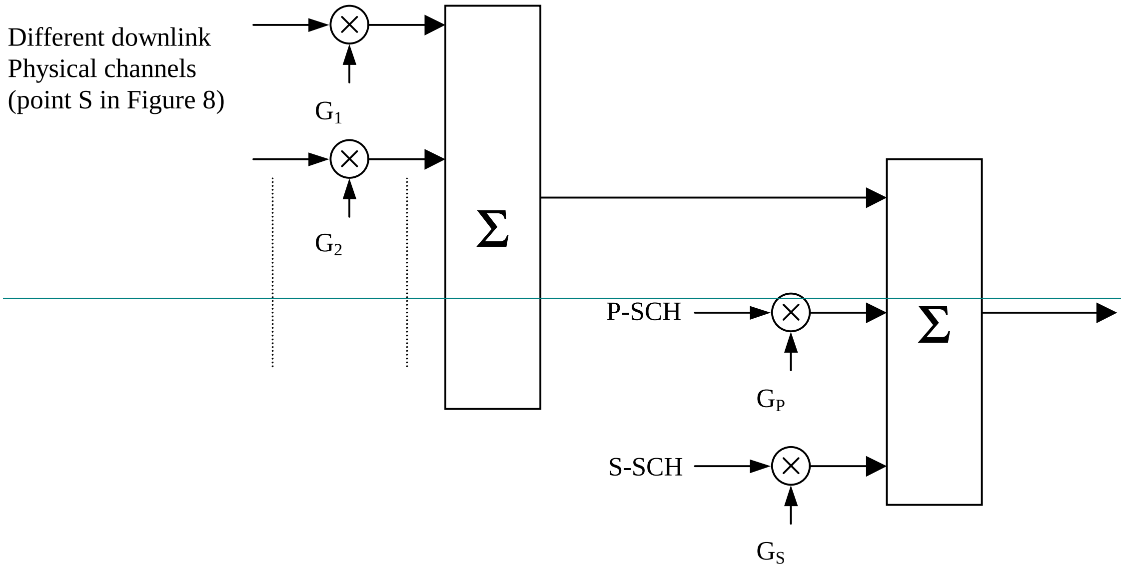

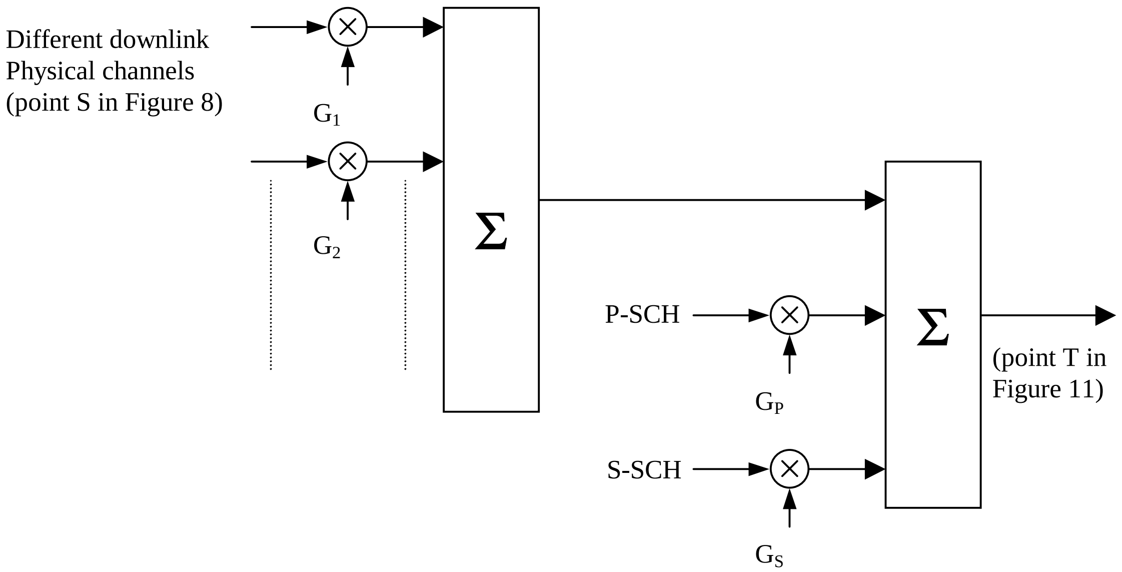

Figure 9: Spreading and modulation for SCH and P-CCPCH

5.3.2 Modulation

In the downlink, the complex-valued chip sequence generated by the spreading process is QPSK modulated as shown in Figure 11 below.

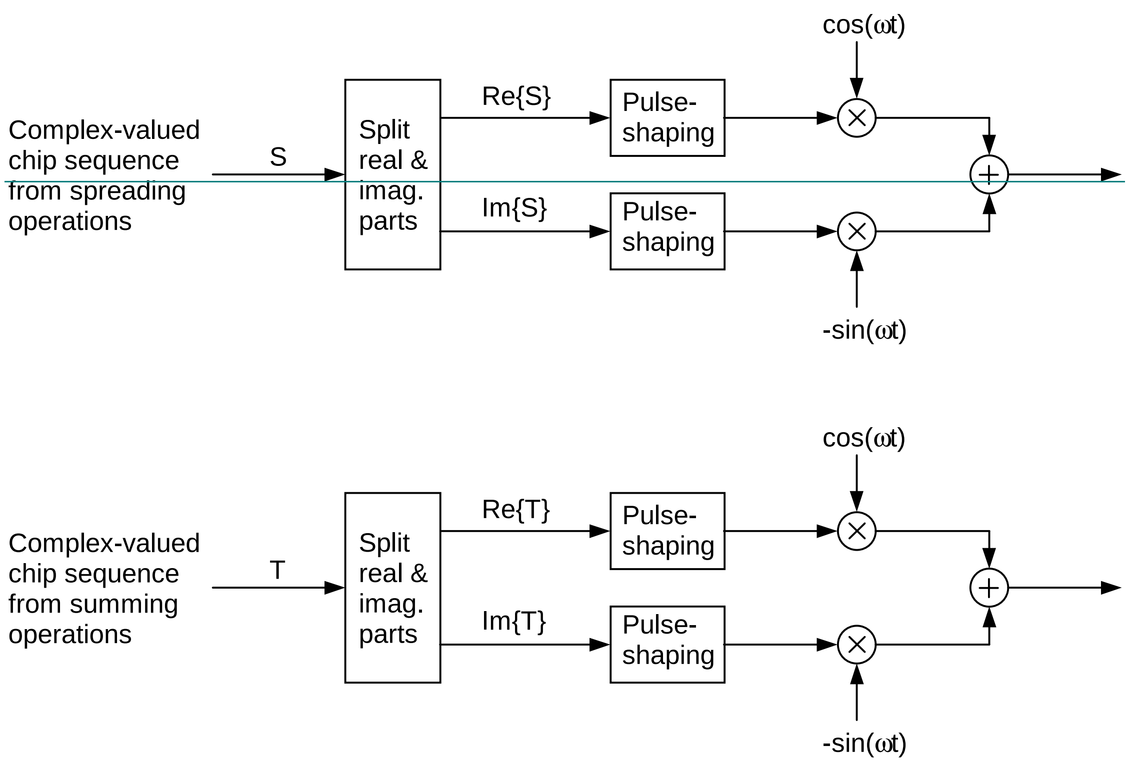

Figure 11: Downlink modulation.

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25.213	**CR**	**022**		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)
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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:** 12-Jan-2000

Subject: Uplink signal flow corrections

Work item:

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

F	Correction	X	**Release:**	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	

Reason for change: Clarification of indication of signal flow between uplink block diagrams.
Change of notation for DPCH scrambling code to align with PCPCH notation which can also take long or short constituent codes.

Clauses affected: 3.2, 4.2, 4.2.2.2, 4.2.3.2, 4.3.2.4

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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3.2 Symbols

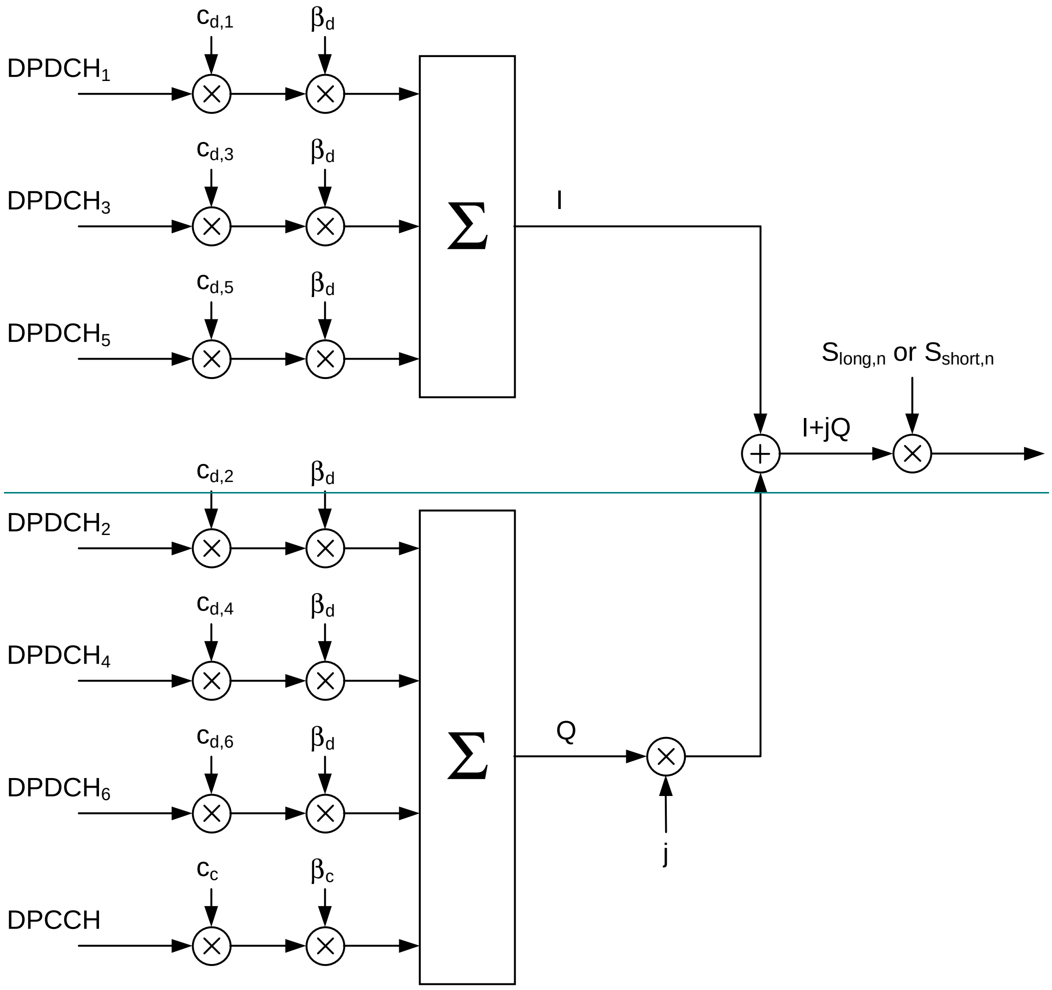
For the purposes of the present document, the following symbols apply:

$C_{ch,SF,n}$:	n:th channelisation code with spreading factor SF
$C_{pre,n,s}$:	PRACH preamble code for *n*:th preamble scrambling code and signature *s*
$C_{c\text{-}acc,n,s}$:	PCPCH access preamble code for *n*:th preamble scrambling code and signature *s*
$C_{c\text{-}cd,n,s}$:	PCPCH CD preamble code for *n*:th preamble scrambling code and signature *s*
$C_{sig,s}$:	PRACH/PCPCH signature code for signature *s*
$S_{dpch,n}$:	*n*:th DPCCH/DPDCH uplink scrambling code
~~$S_{long,n}$:~~	~~*n*:th DPCCH/DPDCH long uplink scrambling code~~
~~$S_{short,n}$:~~	~~*n*:th DPCCH/DPDCH short uplink scrambling code~~
$S_{r\text{-}pre,n}$:	*n*:th PRACH preamble scrambling code
$S_{r\text{-}msg,n}$:	*n*:th PRACH message scrambling code
$S_{c\text{-}acc}$:	*n*:th PCPCH access preamble scrambling code
$S_{c\text{-}cd}$:	*n*:th PCPCH CD preamble scrambling code
$S_{c\text{-}msg,n}$:	*n*:th PCPCH message scrambling code
$S_{dl,n}$:	DL scrambling code
C_{psc}:	PSC code
$C_{ssc,n}$:	n:th SSC code

4.2 Spreading

4.2.1 DPCCH/DPDCH~~)~~

Figure 1 illustrates the principle of the uplink spreading of DPCCH and DPDCHs. The binary DPCCH and DPDCHs to be spread are represented by real-valued sequences, i.e. the binary value "0" is mapped to the real value +1, while the binary value "1" is mapped to the real value –1. The DPCCH is spread to the chip rate by the channelization code c_c, while the *n*:th DPDCH called $DPDCH_n$ is spread to the chip rate by the channelization code $c_{d,n}$. One DPCCH and up to six parallel DPDCHs can be transmitted simultaneously, i.e. $0 \le n \le 6$.



DPDCH1
DPDCH3
DPDCH5
DPDCH2
DPDCH4
DPDCH6
DPCCH
cd,1
cd,3
cd,5
cd,2
cd,4
cd,6
cc
βd
βc
Σ
I
Q
j
I+jQ
Slong,n or Sshort,n

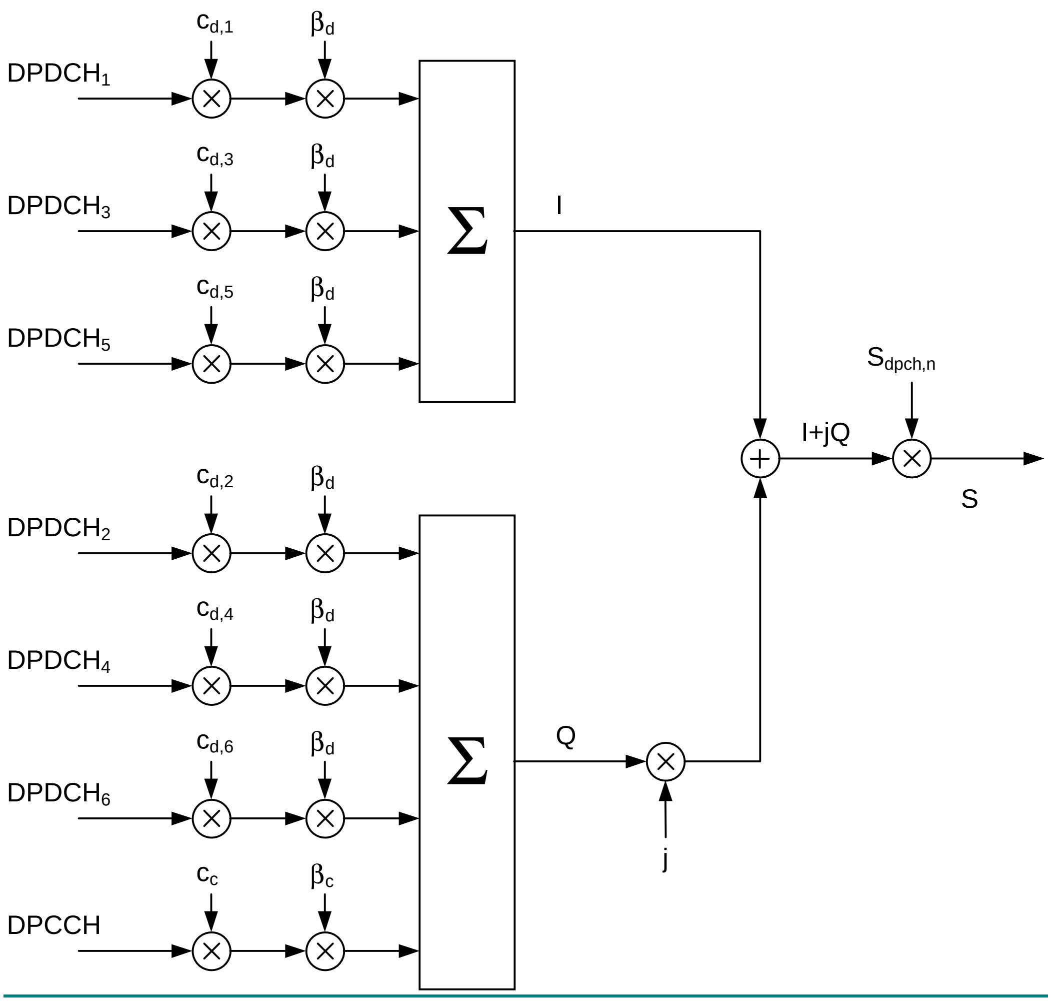


Figure 1: Spreading for uplink DPCCH and DPDCHs

After channelization, the real-valued spread signals are weighted by gain factors, β_c for DPCCH and β_d for all DPDCHs.

At every instant in time, at least one of the values β_c and β_d has the amplitude 1.0. The β-values are quantized into 4 bit words. The quantization steps are given in table 1.

Table 1: The quantization of the gain parameters

Signalling values for β_c and β_d	Quantized amplitude ratios β_c and β_d
15	1.0
14	0.9333
13	0.8666
12	0.8000
11	0.7333
10	0.6667
9	0.6000
8	0.5333
7	0.4667
6	0.4000
5	0.3333
4	0.2667
3	0.2000
2	0.1333
1	0.0667
0	Switch off

After the weighting, the stream of real-valued chips on the I- and Q-branches are then summed and treated as a complex-valued stream of chips. This complex-valued signal is then scrambled by the complex-valued scrambling code $S_{longdpch,n}$ ~~or $S_{short,n}$, depending on if long or short scrambling codes are used~~. The scrambling code is applied aligned with the radio frames, i.e. the first scrambling chip corresponds to the beginning of a radio frame.

4.2.2 PRACH

4.2.2.1 PRACH preamble part

The PRACH preamble part consist of a complex-valued code, described in section 4.3.3.

4.2.2.2 PRACH message part

Figure 2 illustrates the principle of the spreading and scrambling of the PRACH message part, consisting of data and control parts. The binary control and data parts to be spread are represented by real-valued sequences, i.e. the binary value "0" is mapped to the real value +1, while the binary value "1" is mapped to the real value –1. The control part is spread to the chip rate by the channelization code c_c, while the data part is spread to the chip rate by the channelization code c_d.

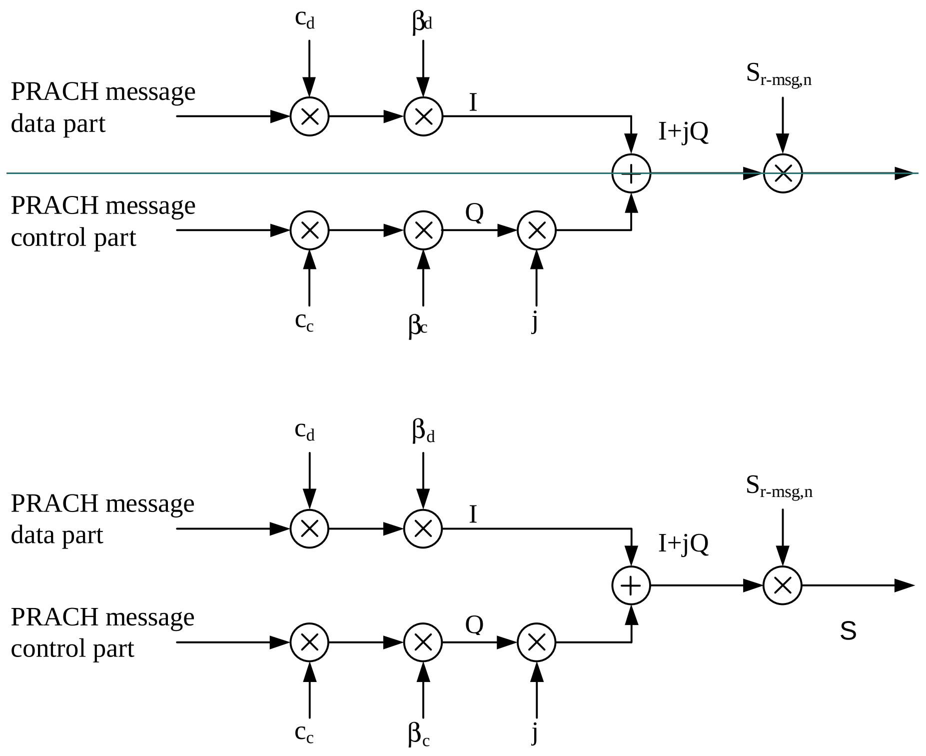


Figure 2: Spreading of PRACH message part

After channelization, the real-valued spread signals are weighted by gain factors, β_c for the control part and β_d for the data part. At every instant in time, at least one of the values β_c and β_d has the amplitude 1.0. The β-values are quantized into 4 bit words. The quantization steps are given in section 4.2.1.

After the weighting, the stream of real-valued chips on the I- and Q-branches are treated as a complex-valued stream of chips. This complex-valued signal is then scrambled by the complex-valued scrambling code $S_{r\text{-}msg,n}$. The 10 ms scrambling code is applied aligned with the 10 ms message part radio frames, i.e. the first scrambling chip corresponds to the beginning of a message part radio frame.

4.2.3 PCPCH

4.2.3.1 PCPCH preamble part

The PCPCH preamble part consist of a complex-valued code, described in section 4.3.4.

4.2.3.2 PCPCH message part

Figure 3 illustrates the principle of the spreading of the PCPCH message part, consisting of data and control parts. The binary control and data parts to be spread are represented by real-valued sequences, i.e. the binary value "0" is mapped to the real value +1, while the binary value "1" is mapped to the real value –1. The control part is spread to the chip rate by the channelization code c_c, while the data part is spread to the chip rate by the channelization code c_d.

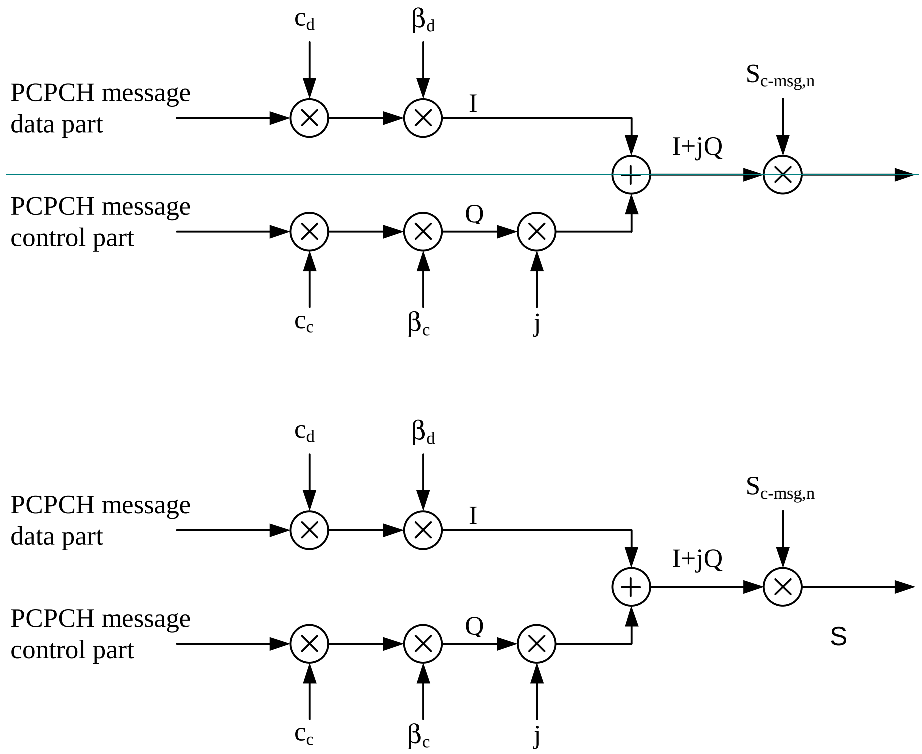


Figure 3: Spreading of PCPCH message part

After channelization, the real-valued spread signals are weighted by gain factors, β_c for the control part and β_d for the data part. At every instant in time, at least one of the values β_c and β_d has the amplitude 1.0. The β-values are quantized into 4 bit words. The quantization steps are given in section 4.2.1.

After the weighting, the stream of real-valued chips on the I- and Q-branches are treated as a complex-valued stream of chips. This complex-valued signal is then scrambled by the complex-valued scrambling code $S_{c\text{-}msg,n}$. The 10 ms scrambling code is applied aligned with the 10 ms message part radio frames, i.e. the first scrambling chip corresponds to the beginning of a message part radio frame.

4.3.2.4 DPCCH/DPDCH scrambling code

The code used for scrambling of the uplink DPCCH/DPDCH may be of either long or short type. When the scrambling code is formed, different consituent codes are used for the long and short type as defined below.

The *n*:th ~~long~~ uplink scrambling code for DPCCH/DPDCH, denoted $S_{\cancel{long}dpch,\,n}$, is defined as

$S_{\cancel{long}dpch,n}(i) = C_{long,n}(i)$, $i = 0, 1, \ldots, 38399$, when using long scrambling codes,

where the lowest index corresponds to the chip transmitted first in time and $C_{long,n}$ is defined in section 4.3.2.2.

The *n*:th ~~short~~ uplink scrambling code for DPCCH/DPDCH, denoted $S_{\cancel{short}dpch,\,n}$, is defined as

$S_{\cancel{short}dpch,n}(i) = C_{short,n}(i)$, $i = 0, 1, \ldots, 38399$, when using short scrambling codes,

where the lowest index corresponds to the chip transmitted first in time and $C_{short,n}$ is defined in section 4.3.2.3.

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25.213	**CR**	**023r1**	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		*(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:** 2000-02-22

Subject: Number of RACH scrambling codes

Work item:

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	X	Release 98	
with an X)	D	Editorial modification		Release 99	X
				Release 00	

Reason for change: There is a mismatch between the WG1 and WG2 specifications on the number of PRACH preamble scrambling codes. It is proposed that 16 different PRACH preamble codes are defined per downlink primary scrambling code, as a reasonable trade-off between signalling overhead and future-proofness. Further, the connection between RACH preamble scrambling codes and RACH message part scrambling codes is clarified.

Clauses affected:

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:

4.3.2.5 PRACH message part scrambling code

The scrambling code used for the PRACH message part is 10 ms long, and there are 8192 different PRACH scrambling codes defined.~~, cell-specific and has a one-to-one correspondence to the scrambling code used for the preamble part.~~

The *n*:th PRACH message part scrambling code, denoted $S_{r\text{-}msg,n}$, where $n = 0, 1, \ldots, 8191$, is based on the long scrambling sequence and is defined as

$S_{r\text{-}msg,n}(i) = C_{long,n}(i + 4096), \; i = 0, 1, \ldots, 38399$

where the lowest index corresponds to the chip transmitted first in time and $C_{long,n}$ is defined in section 4.3.2.2.

The message part scrambling code has a one-to-one correspondence to the scrambling code used for the preamble part. For one PRACH, the same code number is used for both scrambling codes, i.e. if the PRACH preamble scrambling code used is $S_{r\text{-}pre,m}$ then the PRACH message part scrambling code is $S_{r\text{-}msg,m}$, where the number *m* is the same for both codes.

4.3.2.6 PCPCH message part scrambling code

The set of scrambling codes used for the PCPCH message part are 10 ms long, cell-specific and have a one-to-one correspondence to the signature sequences and the access sub-channels used by the access preamble part. Both long or short scrambling codes can be used to scramble the CPCH message part.

The *n*:th PCPCH message part scrambling code, denoted $S_{c\text{-}msg,n}$, is based on the scrambling sequence and is defined as

In the case when the long scrambling codes are used,

$S_{r\text{-}msg,n}(i) = C_{long,n}(i + 8192), \; i = 0, 1, \ldots, 38399$

where the lowest index corresponds to the chip transmitted first in time and $C_{long,n}$ is defined in section 4.3.2.2.

In the case when the access resources are shared between the RACH and CPCH, then $S_{c\text{-}msg,n}$ is defined as

$S_{r\text{-}msg,n}(i) = C_{long,n}(i + 4096), \; i = 0, 1, \ldots, 38399$

where the lowest index corresponds to the chip transmitted first in time and $C_{long,n}$ is defined in section 4.3.2.2.

In the case the short scrambling codes are used,

$S_{r\text{-}msg,n}(i) = C_{short,n}(i), \; i = 0, 1, \ldots, 38399$

4.2.3.7 PCPCH power control preamble scrambling code

The scrambling code for the PCPCH power control preamble is the same as for the PCPCH message part, as described in section 4.2.3.6 above. The phase of the scrambling code shall be such that the end of the code is aligned with the frame boundary at the end of the power control preamble.

4.3.3 PRACH preamble codes

4.3.3.1 Preamble code construction

The random access preamble code $C_{pre,n,}$ is a complex valued sequence. It is built from a preamble scrambling code $S_{r\text{-}pre,n}$ and a preamble signature $C_{sig,s}$ as follows:

$$C_{pre,n,s}(k) = S_{r\text{-}pre,n}(k) \times C_{sig,s}(k) \times e^{j\left(\frac{\pi}{4}+\frac{\pi}{2}k\right)}, \; k = 0, 1, 2, 3, \ldots, 4095,$$

where k=0 corresponds to the chip transmitted first in time and $S_{r\text{-}pre,n}$ and $C_{sig,s}$ are defined in 4.3.3.2 and 4.3.3.3 below respectively.

4.3.3.2 Preamble scrambling code

The scrambling code for the PRACH preamble part is constructed from the long scrambling sequences. There are 8192 PRACH preamble scrambling codes in total.

The n:th preamble scrambling code, n = 0, 1, …, 8191, is defined as:

$$S_{r\text{-}pre,n}(i) = c_{long,1,n}(i),\ i = 0, 1, \ldots, 4095,$$

where the sequence $c_{long,1,n}$ is defined in section 4.3.2.2.

The 8192 PRACH preamble scrambling codes are divided into 512 groups with 16 codes in each group. There is a one-to-one correspondence between the group of PRACH preamble scrambling codes in a cell and the primary scrambling code used in the downlink of the cell. The k:th PRACH preamble scrambling code within the cell with downlink primary scrambling code m, k = 0, 1, 2, …, 15 and m = 0, 1, 2, …, 511, is $S_{r\text{-}pre,n}(i)$ as defined above with $n = 16\times m + k$.

4.3.3.3 Preamble signature

The preamble signature corresponding to a signature s consists of 256 repetitions of a length 16 signature $P_s(n)$, n=0…15. This is defined as follows:

$$C_{sig,s}(i) = P_s(i \text{ modulo } 16),\ i = 0, 1, \ldots, 4095.$$

The signature $P_s(n)$ is from the set of 16 Hadamard codes of length 16. These are listed in table 3.

Table 3: Preamble signatures

Preamble signature	Value of *n*															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
$P_0(n)$	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
$P_1(n)$	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1
$P_2(n)$	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1
$P_3(n)$	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1
$P_4(n)$	1	1	1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1
$P_5(n)$	1	-1	1	-1	-1	1	-1	1	1	-1	1	-1	-1	1	-1	1
$P_6(n)$	1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1
$P_7(n)$	1	-1	-1	1	-1	1	1	-1	1	-1	-1	1	-1	1	1	-1
$P_8(n)$	1	1	1	1	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1
$P_9(n)$	1	-1	1	-1	1	-1	1	-1	-1	1	-1	1	-1	1	-1	1
$P_{10}(n)$	1	1	-1	-1	1	1	-1	-1	-1	-1	1	1	-1	-1	1	1
$P_{11}(n)$	1	-1	-1	1	1	-1	-1	1	-1	1	1	-1	-1	1	1	-1
$P_{12}(n)$	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1
$P_{13}(n)$	1	-1	1	-1	-1	1	-1	1	-1	1	-1	1	1	-1	1	-1
$P_{14}(n)$	1	1	-1	-1	-1	-1	1	1	-1	-1	1	1	1	1	-1	-1
$P_{15}(n)$	1	-1	-1	1	-1	1	1	-1	-1	1	1	-1	1	-1	-1	1

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25.213 CR 024r1 Current Version: 3.1.1

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

For submission to: RAN#7
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for approval	X	strategic		*(for SMG use only)*
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:** 2000-2-21

Subject: Editorial changes to 25.213

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: correction from WG1 feedback

Clauses affected: 4.2.1, 4.2.2.1, 4.2.3.1

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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4.2 Spreading

4.2.1 DPCCH/DPDCH~~)~~

Figure 1 illustrates the principle of the uplink spreading of DPCCH and DPDCHs. The binary DPCCH and DPDCHs to be spread are represented by real-valued sequences, i.e. the binary value "0" is mapped to the real value +1, while the binary value "1" is mapped to the real value –1. The DPCCH is spread to the chip rate by the channelization code c_c, while the *n*:th DPDCH called $DPDCH_n$ is spread to the chip rate by the channelization code $c_{d,n}$. One DPCCH and up to six parallel DPDCHs can be transmitted simultaneously, i.e. ~~0~~1 $\le n \le 6$.

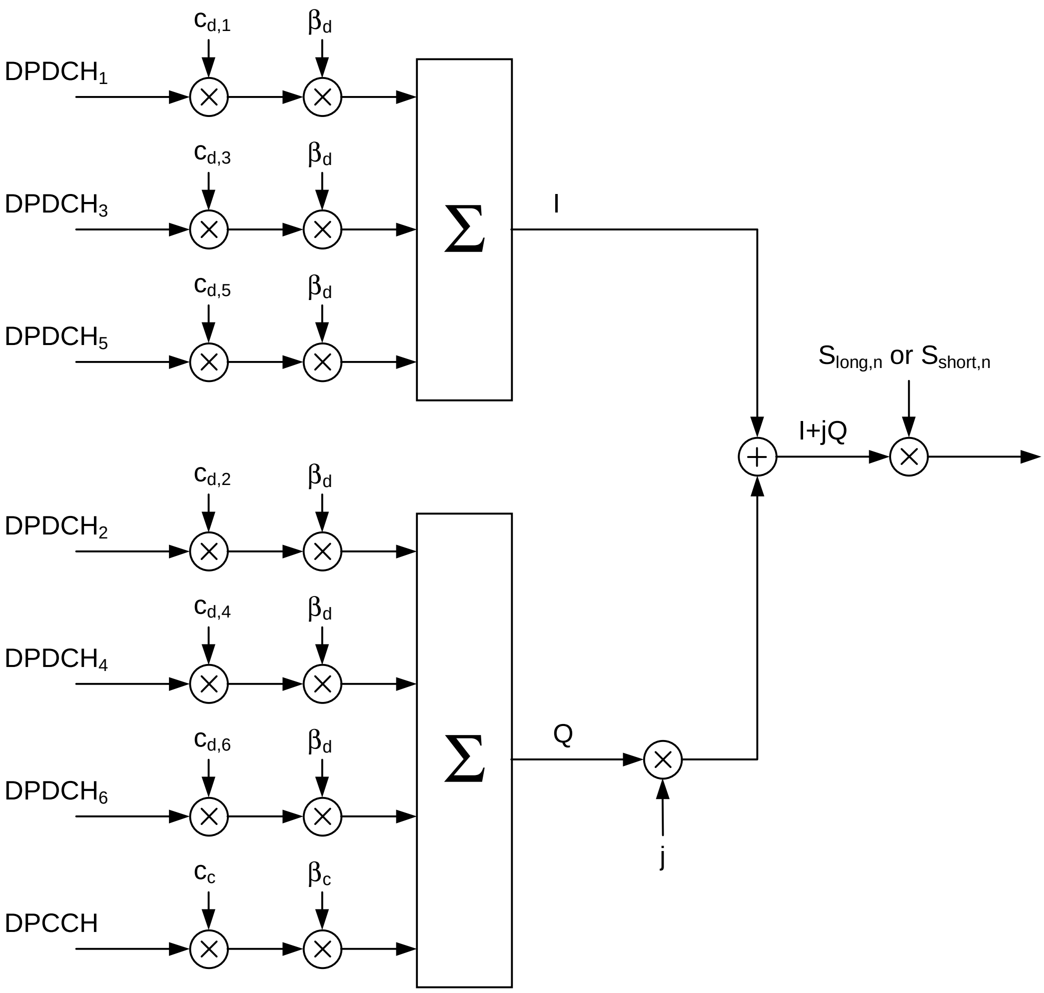

Figure 1: Spreading for uplink DPCCH and DPDCHs

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After the weighting, the stream of real-valued chips on the I- and Q-branches are then summed and treated as a complex-valued stream of chips. This complex-valued signal is then scrambled by the complex-valued scrambling code $S_{long,n}$ or $S_{short,n}$, depending on if long or short scrambling codes are used. The scrambling code is applied aligned with the radio frames, i.e. the first scrambling chip corresponds to the beginning of a radio frame.

4.2.2 PRACH

4.2.2.1 PRACH preamble part

The PRACH preamble part consists of a complex-valued code, described in section 4.3.3.

4.2.2.2 PRACH message part

Figure 2 illustrates the principle of the spreading and scrambling of the PRACH message part, consisting of data and control parts. The binary control and data parts to be spread are represented by real-valued sequences, i.e. the binary value "0" is mapped to the real value +1, while the binary value "1" is mapped to the real value –1. The control part is spread to the chip rate by the channelization code c_c, while the data part is spread to the chip rate by the channelization code c_d.

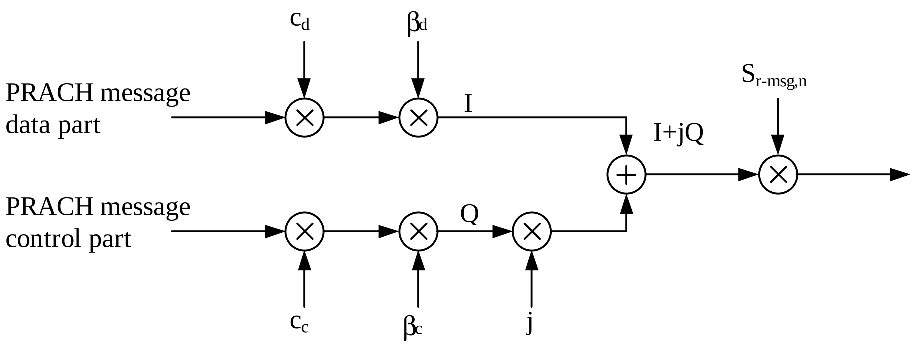

Figure 2: Spreading of PRACH message part

After channelization, the real-valued spread signals are weighted by gain factors, β_c for the control part and β_d for the data part. At every instant in time, at least one of the values β_c and β_d has the amplitude 1.0. The β-values are quantized into 4 bit words. The quantization steps are given in section 4.2.1.

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4.2.3 PCPCH

4.2.3.1 PCPCH preamble part

The PCPCH preamble part consists of a complex-valued code, described in section 4.3.4.

4.3.1.3 Code allocation for PRACH message part

The preamble signature *s*, 0~~1~~ ≤ *s* ≤ 15~~6~~, points to one of the 16 nodes in the code-tree that corresponds to channelization codes of length 16. The sub-tree below the specified node is used for spreading of the message part. The control part is spread with the channelization code c_c (as shown in section 4.2.2.2) of spreading factor 256 in the lowest branch of the sub-tree, i.e. $c_c = C_{ch,256,m}$ where m = 16×~~(~~s~~ − 1)~~ + 15. The data part uses any of the channelization codes from spreading factor 32 to 256 in the upper-most branch of the sub-tree. To be exact, the data part is spread by channelization code $c_d = C_{ch,SF,m}$ and SF is the spreading factor used for the data part and m = SF×~~(~~s~~ − 1)~~/16.

4.3.2.3 Short scrambling sequence

The short scrambling sequences $c_{\text{short},1,n}(i)$ and $c_{\text{short},2,n}(i)$ are defined from a sequence from the family of periodically extended S(2) codes.

Let $n_{23}n_{22}\ldots n_0$ be the 24 bit binary representation of the code number n.

The n:th quaternary S(2) sequence $z_n(i)$, $0 \le n \le 16777215$, is obtained by modulo 4 addition of three sequences, a quaternary sequence $a(i)$ and two binary sequences $b(i)$ and $d(i)$, where the initial loading of the three sequences is determined from the code number n. The sequence $z_n(i)$ of length 255 is generated according to the following relation:

$z_n(i) = a(i) + 2b(i) + 2d(i)$ modulo 4, $i = 0, 1, \ldots, 254$,

where the quaternary sequence $a(i)$ is generated recursively by the polynomial $g_0(x)= x^8+x^5+3x^3+x^2+2x+1$ as

$a(0) = 2n_0 + 1$ modulo 4,

$a(i) = 2n_i$ modulo 4, $i = 1, 2, \ldots, 7$,

$a(i) = 3a(i-3) + a(i-5) + 3a(i-6) + 2a(i-7) + 3a(i-8)$ modulo 4, $i = 8, 9, \ldots, 254$,

and the binary sequence $b(i)$ is generated recursively by the polynomial $g_1(x)= x^8+x^7+x^5+x+1$ as

$b(i) = n_{8+i}$ modulo 2, $i = 0, 1, \ldots, 7$,

$b(i) = b(i-1) + b(i-3) + b(i-7) + b(i-8)$ modulo 2, $i = 8, 9, \ldots, 254$,

and the binary sequence ~~c~~$d(i)$ is generated recursively by the polynomial $g_2(x)= x^8+x^7+x^5+x^4+1$ as

$d(i) = n_{16+i}$ modulo 2, $i = 0, 1, \ldots, 7$,

$d(i) = d(i-1) + d(i-3) + d(i-4) + d(i-8)$ modulo 2, $i = 8, 9, \ldots, 254$.

The sequence $z_n(i)$ is extended to length 256 chips by setting $z_n(255) = z_n(0)$.

The mapping from $z_n(i)$ to the real-valued binary sequences $c_{\text{short},1,n}(i)$ and $c_{\text{short},2,n}(i)$, , $i = 0, 1, \ldots, 255$ is defined in Table 2.

Table 2. Mapping from $z_n(i)$ to $c_{short,1,n}(i)$ and $c_{short,2,n}(i)$, $i = 0, 1, \ldots, 255$.

$z_n(i)$	$c_{short,1,n}(i)$	$c_{short,2,n}(i)$
0	+1	+1
1	-1	+1
2	-1	-1
3	+1	-1

Finally, the complex-valued short scrambling sequence $C_{\text{short, n}}$, is defined as

$$C_{short,n}(i) = c_{short,1,n}(i \bmod 256)\left(1 + j(-1)^i c_{short,2,n}\left(2\lfloor (i \bmod 256)/2 \rfloor\right)\right)$$

where $i = 0, 1, 2, \ldots$ and $\lfloor\;\rfloor$ denotes rounding to nearest lower integer.

An implementation of the short scrambling sequence generator for the 255 chip sequence to be extended by one chip is shown in Figure 6.

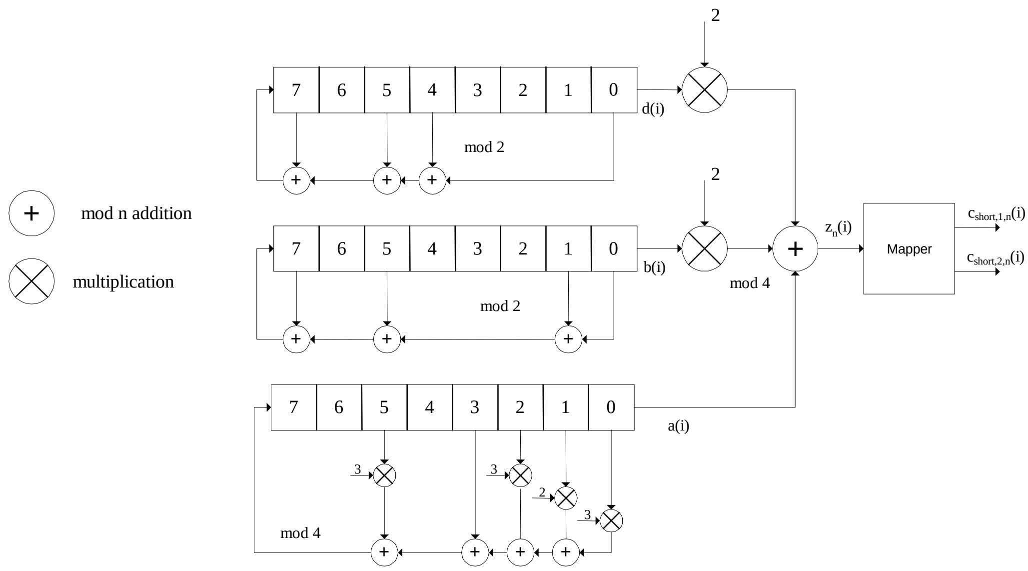

Figure 6. Uplink short scrambling sequence generator for 255 chip sequence.

4.3.2.6 PCPCH message part scrambling code

The set of scrambling codes used for the PCPCH message part are 10 ms long, cell-specific and have a one-to-one correspondence to the signature sequences and the access sub-channels used by the access preamble part. Both long or short scrambling codes can be used to scramble the CPCH message part.

The *n*:th PCPCH message part scrambling code, denoted $S_{c\text{-msg},n}$, is based on the scrambling sequence and is defined as

In the case when the long scrambling codes are used,

$S_{\cancel{r}\underline{c}\text{-msg},n}(i) = C_{long,n}(i + 8192),\ \ i = 0, 1, \ldots, 38399$

where the lowest index corresponds to the chip transmitted first in time and $C_{long,n}$ is defined in section 4.3.2.2.

In the case when the access resources are shared between the RACH and CPCH, then $S_{c\text{-msg},n}$ is defined as

$S_{\cancel{r}\underline{c}\text{-msg},n}(i) = C_{long,n}(i + 4096),\ \ i = 0, 1, \ldots, 38399$

where the lowest index corresponds to the chip transmitted first in time and $C_{long,n}$ is defined in section 4.3.2.2.

In the case the short scrambling codes are used,

$S_{\cancel{r}\underline{c}\text{-msg},n}(i) = C_{short,n}(i),\ \ i = 0, 1, \ldots, 38399$

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25.213	**CR**	**025r3.0**		Current Version:	3.1.1

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

Source: TSG RAN WG1 **Date:** 2000-03-2

Subject: Number of PCPCH scrambling codes per cell

Work item:

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	X		Release 98	
with an X)	D	Editorial modification			Release 99	X
					Release 00	

Reason for change: It is proposed that 64 different PCPCH scrambling codes are defined per downlink primary scrambling code, as a reasonable trade-off between signalling overhead and future-proofness. Further, the connection between PCPCH access preamble scrambling code, PCPCH CD preamble scrambling code and PCPCH message part scrambling codes are clarified.

Clauses affected: 4.3.2.6; 4.3.4.1.2; 4.3.4.2.2

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:

4.3.2.5 PRACH message part scrambling code

The scrambling code used for the PRACH message part is 10 ms long, cell specific and has a one to one correspondence to the scrambling code used for the preamble part.

The *n*:th PRACH message part scrambling code, denoted $S_{r\text{-}msg,n}$, is based on the long scrambling sequence and is defined as

$S_{r\text{-}msg,n}(i) = C_{long,n}(i + 4096), \; i = 0, 1, \ldots, 38399$

where the lowest index corresponds to the chip transmitted first in time and $C_{long,n}$ is defined in section 4.3.2.2.

4.3.2.6 PCPCH message part scrambling code

The set of scrambling codes used for the PCPCH message part are 10 ms long, cell-specific, and each scrambling code has ~~have~~ a one-to-one correspondence to the signature sequence~~s~~ and the access sub-channel~~s~~ used by the access preamble part. Both long or short scrambling codes can be used to scramble the CPCH message part. There are 64 uplink scrambling codes defined per cell and 32768 different PCPCH scrambling codes defined in the system.

The *n*:th PCPCH message part scrambling code, denoted $S_{c\text{-}msg,n}$, where *n =8192,8193, …,40959* is based on the scrambling sequence and is defined as

In the case when the long scrambling codes are used,

$S_{\cancel{r}c\text{-}msg,n}(i) = C_{long,n}(i \cancel{+ 8192}), \; i = 0, 1, \ldots, 38399$

~~where the lowest index corresponds to the chip transmitted first in time and $C_{long,n}$ is defined in section 4.3.2.2.~~

~~In the case when the access resources are shared between the RACH and CPCH, then $S_{c\text{-}msg,n}$ is defined as~~

~~$S_{r\text{-}msg,n}(i) = C_{long,n}(i + 4096), \; i = 0, 1, \ldots, 38399$~~

where the lowest index corresponds to the chip transmitted first in time and $C_{long,n}$ is defined in section 4.3.2.2.

In the case the short scrambling codes are used,

$S_{\cancel{r}c\text{-}msg,n}(i) = C_{short,n}(i), \; i = 0, 1, \ldots, 38399$

The 32768 PCPCH scrambling codes are divided into 512 groups with 64 codes in each group. There is a one-to-one correspondence between the group of PCPCH preamble scrambling codes in a cell and the primary scrambling code used in the downlink of the cell. The *k*:th PCPCH scrambling code within the cell with downlink primary scrambling code *m*, *k* =16,17,…, 79 and *m* = 0, 1, 2, …, 511, is $S_{c\text{-}msg,\,n}$ as defined above with $n = 64 \times m + k + 8176$.

4.2.3.7 PCPCH power control preamble scrambling code

The scrambling code for the PCPCH power control preamble is the same as for the PCPCH message part, as described in section 4.2.3.6 above. The phase of the scrambling code shall be such that the end of the code is aligned with the frame boundary at the end of the power control preamble.

4.3.3 PRACH preamble codes

4.3.3.1 Preamble code construction

The random access preamble code $C_{pre,n,}$ is a complex valued sequence. It is built from a preamble scrambling code $S_{r\text{-}pre,n}$ and a preamble signature $C_{sig,s}$ as follows:

$$C_{pre,n,s}(k) = S_{r\text{-}pre,n}(k) \times C_{sig,s}(k) \times e^{j\left(\frac{\pi}{4} + \frac{\pi}{2}k\right)}, \; k = 0, 1, 2, 3, \ldots, 4095,$$

where k=0 corresponds to the chip transmitted first in time and $S_{r\text{-}pre,n}$ and $C_{sig,s}$ are defined in 4.3.3.2 and 4.3.3.3 below respectively.

4.3.3.2 Preamble scrambling code

The scrambling code for the PRACH preamble part is constructed from the long scrambling sequences.

The *n*:th preamble scrambling code, is defined as:

$$S_{r\text{-}pre,n}(i) = c_{long,1,n}(i),\ i = 0, 1, \ldots, 4095,$$

where the sequence $c_{long,1,n}$ is defined in section 4.3.2.2.

4.3.3.3 Preamble signature

The preamble signature corresponding to a signature s consists of 256 repetitions of a length 16 signature $P_s(n)$, n=0…15. This is defined as follows:

$$C_{sig,s}(i) = P_s(i \text{ modulo } 16),\ i = 0, 1, \ldots, 4095.$$

The signature $P_s(n)$ is from the set of 16 Hadamard codes of length 16. These are listed in table 3.

Table 3: Preamble signatures

Preamble signature	Value of *n*															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
$P_0(n)$	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
$P_1(n)$	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1
$P_2(n)$	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1
$P_3(n)$	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1
$P_4(n)$	1	1	1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1
$P_5(n)$	1	-1	1	-1	-1	1	-1	1	1	-1	1	-1	-1	1	-1	1
$P_6(n)$	1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1
$P_7(n)$	1	-1	-1	1	-1	1	1	-1	1	-1	-1	1	-1	1	1	-1
$P_8(n)$	1	1	1	1	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1
$P_9(n)$	1	-1	1	-1	1	-1	1	-1	-1	1	-1	1	-1	1	-1	1
$P_{10}(n)$	1	1	-1	-1	1	1	-1	-1	-1	-1	1	1	-1	-1	1	1
$P_{11}(n)$	1	-1	-1	1	1	-1	-1	1	-1	1	1	-1	-1	1	1	-1
$P_{12}(n)$	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1
$P_{13}(n)$	1	-1	1	-1	-1	1	-1	1	-1	1	-1	1	1	-1	1	-1
$P_{14}(n)$	1	1	-1	-1	-1	-1	1	1	-1	-1	1	1	1	1	-1	-1
$P_{15}(n)$	1	-1	-1	1	-1	1	1	-1	-1	1	1	-1	1	-1	-1	1

4.3.4 PCPCH preamble codes

4.3.4.1 Access preamble

4.3.4.1.1 Access preamble code construction

Similar to PRACH access preamble codes, the PCPCH access preamble codes $C_{c\text{-}acc,n,s}$, are complex valued sequences. The PCPCH access preamble codes are built from the preamble scrambling codes $S_{c\text{-}acc,n}$ and a preamble signature $C_{sig,s}$ as follows:

$$C_{c\text{-}acc,n,s}(k) = S_{c\text{-}acc,n}(k) \times C_{sig,s}(k) \times e^{j\left(\frac{\pi}{4}+\frac{\pi}{2}k\right)},\ k = 0, 1, 2, 3, \ldots, 4095,$$

where $S_{c\text{-}acc,n}$ and $C_{sig,s}$ are defined in section 4.3.4.1.2 and 4.3.4.1.3 below respectively.

4.3.4.1.2 Access preamble scrambling code

The access preamble scrambling code generation is done in a way similar to that of PRACH. There are 32768 PCPCH scrambling codes in total.

The *n*:th PCPCH access preamble scrambling code, where $n = 8192, 8193, \ldots, 40959$ is defined as:

$$S_{c\text{-}acc,n}(i) = c_{long,1,n}(i),\ i = 0, 1, \ldots, 4095,$$

where the sequence $c_{long,1,n}$ is defined in section 4.3.2.2.

In the case when the access resources are shared between the PRACH and PCPCH, the scrambling codes used in the PRACH preamble are used for the PCPCH preamble as well.

The 32768 PCPCH scrambling codes are divided into 512 groups with 64 codes in each group. There is a one-to-one correspondence between the group of PCPCH access preamble scrambling codes in a cell and the primary scrambling code used in the downlink of the cell. The *k*:th PCPCH scrambling code within the cell with downlink primary scrambling code *m*, $k = 16,17,\ldots, 79$ and $m = 0, 1, 2, \ldots, 511$, is $S_{c\text{-}acc,\, n}$ as defined above with $n = 64\times m + k + 8176$.

In case scrambling code resource is shared between PCPCH and PRACH, the index k is less than 16 and the corresponding PRACH formulae shall be used. Otherwise, if the index k is greater than or equal to 16, the formula in this section shall be used.

4.3.4.1.3 Access preamble signature

The access preamble part of the CPCH-access burst carries one of the sixteen different orthogonal complex signatures identical to the ones used by the preamble part of the random-access burst.

4.3.4.2 CD preamble

4.3.4.2.1 CD preamble code construction

Similar to PRACH access preamble codes, the PCPCH CD preamble codes $C_{c\text{-}cd,n,s}$ are complex valued sequences. The PCPCH CD preamble codes are built from the preamble scrambling codes Sc-cd,n and a preamble signature $C_{sig,s}$ as follows:

$$C_{c\text{-}cd,n,s}(k) = S_{c\text{-}cd,n}(k) \times C_{sig,s}(k) \times e^{j(\frac{\pi}{4}+\frac{\pi}{2}k)},\ k = 0, 1, 2, 3, \ldots, 4095,$$

where $S_{c\text{-}cd,n}$ and $C_{sig,s}$ are defined in sections 4.3.4.2.2 and 4.3.4.2.3 below respectively.

4.3.4.2.2 CD preamble scrambling code

The PCPCH CD preamble scrambling code is derived from the same scrambling code used in the CPCH access preamble. . There are 32768 PCPCH scrambling codes in total.

The *n*:th PCPCH CD access preamble scrambling code~~-~~, where $n = 8192, 8193, \ldots, 40959$, is defined as:

$$S_{c\text{-}cd,n}(i) = c_{long,1,n}(i \cancel{+ 4096}),\ i = 0, 1, \ldots, 4095,$$

where the sequence $c_{long,1,n}$ is defined in section 4.3.2.2.

In the case when the access resources are shared between the RACH and CPCH, the scrambling codes used in the RACH preamble will be used for the CPCH CD preamble as well.

The 32768 PCPCH scrambling codes are divided into 512 groups with 64 codes in each group. There is a one-to-one correspondence between the group of PCPCH CD preamble scrambling codes in a cell and the primary scrambling code used in the downlink of the cell. The *k*:th PCPCH scrambling code within the cell with downlink primary scrambling code *m*, $k = 16,17, \ldots, 79$ and $m = 0, 1, 2, \ldots, 511$, is $S_{c\text{-}cd,\, n}$ as defined above with $n = 64\times m + k + 8176$.

In case scrambling code resource is shared between PCPCH and PRACH, the index k is less than 16 and the corresponding PRACH formulae shall be used. Otherwise, if the index k is greater than or equal to 16, the formula in this section shall be used.

4.3.4.2.3 CD preamble signature

The CD-preamble part of the CPCH-access burst carries one of sixteen different orthogonal complex signatures identical to the ones used by the preamble part of the random-access burst.

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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:	15-Feb-00
Subject:	A typo correction for 5.2.2 and clarification for 5.2.3.1 of TS 25.213V3.1.1
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: A right paranthesis is missing from the definition of z_n in 5.2.2. The meaning of *b* in the definition of the SSCs is clarified a bit in 5.2.3.1.

Clauses affected:

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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In case of mapping the DSCH to multiple parallel PDSCHs, the same rule applies, but all of the branches identified by the multiple codes, corresponding to the smallest spreading factor, may be used for higher spreading factor allocation.

5.2.2 Scrambling code

A total of 2^{18}-1 = 262,143 scrambling codes, numbered 0…262,142 can be generated. However not all the scrambling codes are used. The scrambling codes are divided into 512 sets each of a primary scrambling code and 15 secondary scrambling codes.

The primary scrambling codes consist of scrambling codes n=16*i where i=0…511. The i:th set of secondary scrambling codes consists of scrambling codes 16*i+k, where k=1…15.

There is a one-to-one mapping between each primary scrambling code and 15 secondary scrambling codes in a set such that i:th primary scrambling code corresponds to i:th set of scrambling codes.

Hence, according to the above, scrambling codes k = 0, 1, …, 8191 are used. Each of these codes are associated with a left alternative scrambling code and a right alternative scrambling code, that may be used for compressed frames. The left alternative scrambling code corresponding to scrambling code k is scrambling code number k + 8192, while the right alternative scrambling code corresponding to scrambling code k is scrambling code number k + 16384. The alternative scrambling codes can be used for compressed frames. In this case, the left alternative scrambling code is used if n<SF/2 and the right alternative scrambling code is used if n≥SF/2, where $c_{ch,SF,n}$ is the channelization code used for non-compressed frames. The usage of alternative scrambling code for compressed frames is signalled by higher layers for each physical channel respectively.

The set of primary scrambling codes is further divided into 64 scrambling code groups, each consisting of 8 primary scrambling codes. The j:th scrambling code group consists of primary scrambling codes 16*8*j+16*k, where j=0..63 and k=0..7.

Each cell is allocated one and only one primary scrambling code. The primary CCPCH and primary CPICH are always transmitted using the primary scrambling code. The other downlink physical channels can be transmitted with either the primary scrambling code or a secondary scrambling code from the set associated with the primary scrambling code of the cell.

The mixture of primary scrambling code and secondary scrambling code for one CCTrCH is allowable.

The scrambling code sequences are constructed by combining two real sequences into a complex sequence. Each of the two real sequences are constructed as the position wise modulo 2 sum of 38400 chip segments of two binary *m*-sequences generated by means of two generator polynomials of degree 18. The resulting sequences thus constitute segments of a set of Gold sequences. The scrambling codes are repeated for every 10 ms radio frame. Let *x* and *y* be the two sequences respectively. The *x* sequence is constructed using the primitive (over GF(2)) polynomial $1+X^7+X^{18}$. The y sequence is constructed using the polynomial $1+X^5+X^7+X^{10}+X^{18}$.

The sequence depending on the chosen scrambling code number *n* is denoted z_n, in the sequel. Furthermore, let $x(i)$, $y(i)$ and $z_n(i)$ denote the *i*:th symbol of the sequence *x, y,* and z_n, respectively

The *m*-sequences *x*and *y* are constructed as:

Initial conditions:

x is constructed with x (0)=1, x(1)= x(2)=...= x (16)= x (17)=0

y(0)=y(1)= … =y(16)= y(17)=1

Recursive definition of subsequent symbols:

$x(i+18) = x(i+7) + x(i)$ modulo 2, $i=0,\dots,2^{18}-20$,

$y(i+18) = y(i+10)+y(i+7)+y(i+5)+y(i)$ modulo 2, $i=0,\dots,2^{18}-20$.

The n:th Gold code sequence z_n, $n=0,1,2,\dots,2^{18}-2$, is then defined as

$z_n(i) = x((i+n) \text{ modulo } (2^{18} - 1)) + y(i)$ modulo 2, $i=0,\dots,2^{18}-2$.

These binary sequences are converted to real valued sequences Z_n by the following transformation:

$$Z_n(i) = \begin{cases} +1 & if \ z_n(i) = 0 \\ -1 & if \ z_n(i) = 1 \end{cases} \quad for \quad i = 0,1,\ldots,2^{18}-2.$$

Finally, the n:th complex scrambling code sequence $S_{dl,n}$ is defined as:

$$S_{dl,n}(i) = Z_n(i) + j\, Z_n((i+131072) \text{ modulo } (2^{18}-1)),\ i=0,1,\ldots,38399.$$

Note that the pattern from phase 0 up to the phase of 38399 is repeated.

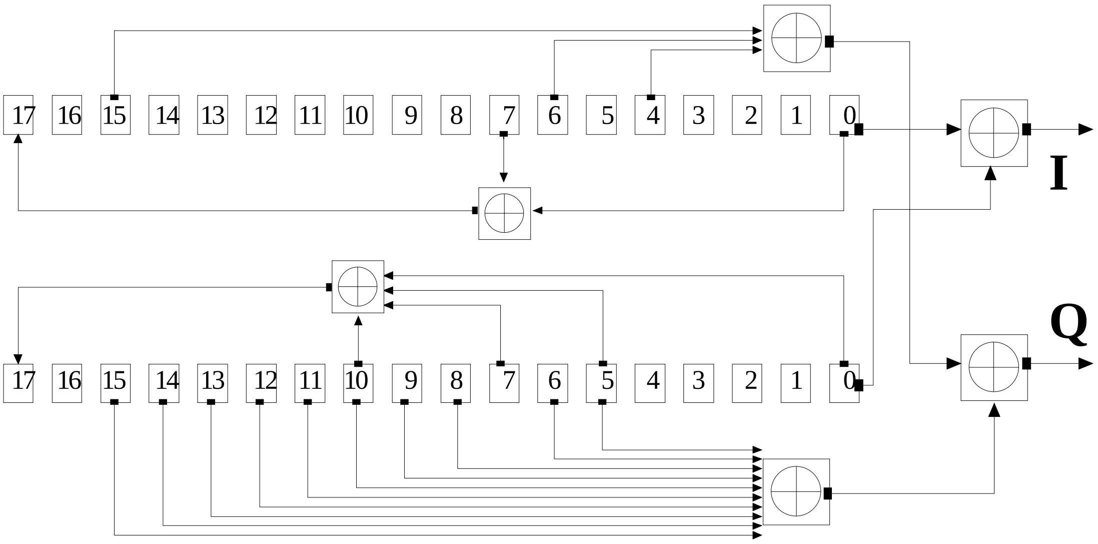

Figure 10: Configuration of downlink scrambling code generator

5.2.3 Synchronisation codes

5.2.3.1 Code generation

The primary synchronisation code (PSC), C_{psc} is constructed as a so-called generalised hierarchical Golay sequence. The PSC is furthermore chosen to have good aperiodic auto correlation properties.

Define

$a = \langle x_1, x_2, x_3, \ldots, x_{16}\rangle = \langle 1, 1, 1, 1, 1, 1, -1, -1, 1, -1, 1, -1, 1, -1, -1, 1\rangle$

The PSC 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 C_{psc} is defined as

$C_{psc} = (1 + j) \times \langle a, a, a, -a, -a, a, -a, -a, a, a, a, -a, a, -a, a, a\rangle$,

where the leftmost chip in the sequence corresponds to the chip transmitted first in time

The 16 secondary synchronization codes (SSCs), $\{C_{ssc,1},\ldots,C_{ssc,16}\}$, are complex-valued with identical real and imaginary components, and are constructed from position wise multiplicationof a Hadamard sequence and a sequence *z*, defined as

$z = \langle b, b, b, -b, b, b, -b, -b, b, -b, b, -b, -b, -b, -b, -b\rangle$, where

$b = \langle x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, -x_9, -x_{10}, -x_{11}, -x_{12}, -x_{13}, -x_{14}, -x_{15}, -x_{16}\rangle$~~.~~ and $x_1, x_2, \ldots, x_{15}, x_{16}$ are 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:

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25.213 CR 028r2 Current Version: 3.1.1

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

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for approval	X	strategic		*(for SMG use only)*
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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:** 2000-02-29

Subject: Channelization code allocation method for PCPCH message part

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	X
D	Editorial modification	

Release:

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

Reason for change: Since each PCPCH channel uses unique scrambling code, a common channelization code allocation method can be used for all the PCPCH channels. To reduce hardware complexity, it is desirable to use the current DPCH channelization code allocation method to PCPCH message part.

Clauses affected: 4.3.1.4

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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4.3.1.4 Code allocation for PCPCH message part

~~The signature in the preamble specifies one of the 16 nodes in the code-tree that corresponds to channelization codes of length 16. The sub-tree below the specified node is used for spreading of the message part. The control part is always spread with a channelization code of spreading factor 256. The code is chosen from the lowest branch of the sub-tree. The data part may use channelization codes from spreading factor 4 to 256. A UE is allowed to increase its spreading factor during the message transmission by choosing any channelization code from the uppermost branch of the sub-tree code. For channelization codes with spreading factors less that 16, the node is located on the same sub-tree as the channelization code of the access preamble.~~

For the control part and data part the following applies:

- The control part is always spread by code $c_c = C_{ch,256,0}$
- The data part is spread by code $c_d = C_{ch,SF,k}$ where SF is the spreading factor of the data part and k=SF/4.

The data part may use the code from spreading factor 4 to 256. A UE is allowed to increase SF during the message transmission on a frame by frame basis.

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

Document R1-00-0300

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

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25.213 CR 029 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		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: TSG RAN WG1 **Date:** 29.2.2000

Subject: Clarifications to DSCH scrambling and modulation in 25.213

Work item:

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	X		Release 98	
with an X)	D	Editorial modification			Release 99	X
					Release 00	

Reason for change: The DSCH is not mentioned in the modulation section of 25.213 and in connection with scrambling the CCTrCH has been given possibility for using several scrambling codes which is not necessary for multicode transmission with DSCH.

Clauses affected:

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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5 Downlink spreading and modulation

5.1 Spreading

Figure 8 illustrates the spreading operation for all downlink physical channels except SCH, i.e. for P-CCPCH, S-CCPCH, CPICH, AICH, PICH,PDSCH, and downlink DPCH. The non-spread physical channel consists of a sequence of real-valued symbols. For all channels except AICH, the symbols can take the three values +1, -1, and 0, where 0 indicates DTX. For AICH, the symbol values depend on the exact combination of acquisition indicators to be transmitted, compare [2] Section 5.3.3.6.

Each pair of two consecutive symbols is first serial-to-parallel converted and mapped to an I and Q branch. The mapping is such that even and odd numbered symbols are mapped to the I and Q branch respectively. For all channels except AICH, symbol number zero is defined as the first symbol in each frame. For AICH, symbol number zero is defined as the first symbol in each access slot. The I and Q branches are then spread to the chip rate by the same real-valued channelization code $C_{ch,SF,m}$. The sequences of real-valued chips on the I and Q branch are then treated as a single complex-valued sequence of chips. This sequence of chips is scrambled (complex chip-wise multiplication) by a complex-valued scrambling code $S_{dl,n}$. In case of P-CCPCH, the scrambling code is applied aligned with the P-CCPCH frame boundary, i.e. the first complex chip of the spread P-CCPCH frame is multiplied with chip number zero of the scrambling code. In case of other downlink channels, the scrambling code is applied aligned with the scrambling code applied to the P-CCPCH. In this case, the scrambling code is thus not necessarily applied aligned with the frame boundary of the physical channel to be scrambled.

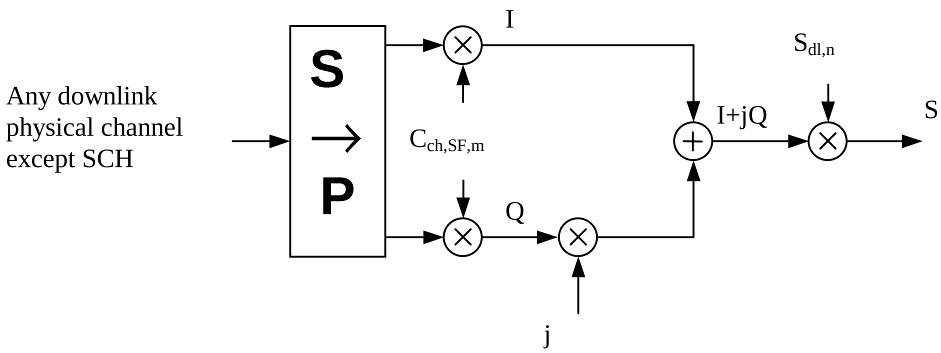

Figure 8: Spreading for all downlink physical channels except SCH

Figure 9 illustrates how different downlink channels are combined. Each complex-valued spread channel, corresponding to point S in Figure 8, is separately weighted by a weight factor G_i. The complex-valued P-SCH and S-SCH, as described in [1], section 5.3.3.4, are separately weighted by weight factors G_p and G_s. All downlink physical channels are then combined using complex addition.

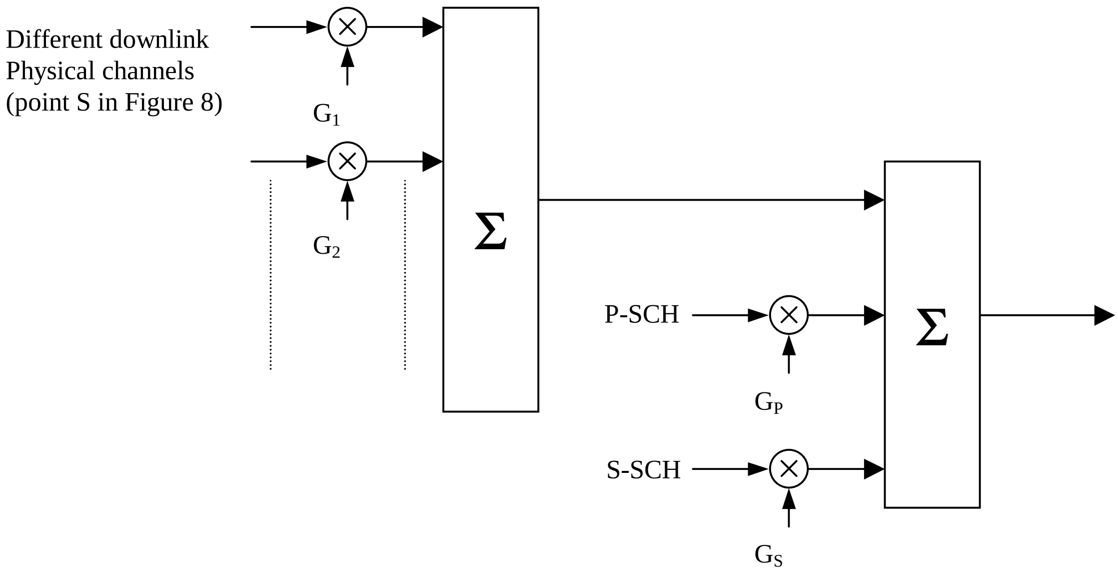

Figure 9: Spreading and modulation for SCH and P-CCPCH

5.2 Code generation and allocation

5.2.1 Channelization codes

The channelization codes of figure 8 are the same codes as used in the uplink, namely Orthogonal Variable Spreading Factor (OVSF) codes that preserve the orthogonality between downlink channels of different rates and spreading factors. The OVSF codes are defined in figure 4 in section 4.3.1.

The channelization code for the Primary CPICH is fixed to $C_{ch,256,0}$ and the channelization code for the Primary CCPCH is fixed to $C_{ch,256,1}$.The channelization codes for all other physical channels are assigned by UTRAN.

With the spreading factor 512 a specific restriction is applied. When the code word $C_{ch,512,n}$, with n=0,2,4….510, is used in soft handover, then the code word $C_{512,n+1}$ is not allocated in the Node Bs where timing adjustment is to be used. Respectively if $C_{ch,512,n}$, with n=1,3,5….511 is used, then the code word $C_{512,n-1}$ is not allocated in the Node B where timing adjustment is to be used. This restriction shall not apply for the softer handover operation or in case UTRAN is synchronised to such a level that timing adjustments in soft handover are not used with spreading factor 512.

When compressed mode is implemented by reducing the spreading factor by 2, the OVSF code used for compressed frames is:

- $C_{ch,SF/2,\lfloor n/2 \rfloor}$ if ordinary scrambling code is used
- $c_{ch,SF/2,n \bmod SF/2}$ if alternative scrambling code is used (see section 5.2.2)

where $c_{ch,SF,n}$ is the channelization code used for non-compressed frames.

In case the OVSF code on the PDSCH varies from frame to frame, the OVSF codes shall be allocated such a way that the OVSF code(s) below the smallest spreading factor will be from the branch of the code tree pointed by the smallest spreading factor used for the connection. This means that all the codes for UE for the PDSCH connection can be generated according to the OVSF code generation principle from smallest spreading factor code used by the UE on PDSCH.

In case of mapping the DSCH to multiple parallel PDSCHs, the same rule applies, but all of the branches identified by the multiple codes, corresponding to the smallest spreading factor, may be used for higher spreading factor allocation.

5.2.2 Scrambling code

A total of 2^{18}-1 = 262,143 scrambling codes, numbered 0…262,142 can be generated. However not all the scrambling codes are used. The scrambling codes are divided into 512 sets each of a primary scrambling code and 15 secondary scrambling codes.

The primary scrambling codes consist of scrambling codes n=16*i where i=0…511. The i:th set of secondary scrambling codes consists of scrambling codes 16*i+k, where k=1…15.

There is a one-to-one mapping between each primary scrambling code and 15 secondary scrambling codes in a set such that i:th primary scrambling code corresponds to i:th set of scrambling codes.

Hence, according to the above, scrambling codes k = 0, 1, …, 8191 are used. Each of these codes are associated with a left alternative scrambling code and a right alternative scrambling code, that may be used for compressed frames. The left alternative scrambling code corresponding to scrambling code k is scrambling code number k + 8192, while the right alternative scrambling code corresponding to scrambling code k is scrambling code number k + 16384. The alternative scrambling codes can be used for compressed frames. In this case, the left alternative scrambling code is used if n<SF/2 and the right alternative scrambling code is used if n≥SF/2, where $c_{ch,SF,n}$ is the channelization code used for non-compressed frames. The usage of alternative scrambling code for compressed frames is signalled by higher layers for each physical channel respectively.

The set of primary scrambling codes is further divided into 64 scrambling code groups, each consisting of 8 primary scrambling codes. The j:th scrambling code group consists of primary scrambling codes 16*8*j+16*k, where j=0..63 and k=0..7.

Each cell is allocated one and only one primary scrambling code. The primary CCPCH and primary CPICH are always transmitted using the primary scrambling code. The other downlink physical channels can be transmitted with either the primary scrambling code or a secondary scrambling code from the set associated with the primary scrambling code of the cell.

The mixture of primary scrambling code and secondary scrambling code for one CCTrCH is allowable. However, in the case of the CCTrCH of type DSCH then all the PDSCH channelisation codes that a single UE may receive shall be under a single scrambling code (either the primary or a secondary scrambling code).

The scrambling code sequences are constructed by combining two real sequences into a complex sequence. Each of the two real sequences are constructed as the position wise modulo 2 sum of 38400 chip segments of two binary *m*-sequences generated by means of two generator polynomials of degree 18. The resulting sequences thus constitute segments of a set of Gold sequences. The scrambling codes are repeated for every 10 ms radio frame. Let *x* and *y* be the two sequences respectively. The *x* sequence is constructed using the primitive (over GF(2)) polynomial $1+X^7+X^{18}$. The y sequence is constructed using the polynomial $1+X^5+X^7+X^{10}+X^{18}$.

The sequence depending on the chosen scrambling code number *n* is denoted z_n, in the sequel. Furthermore, let $x(i)$, $y(i)$ and $z_n(i)$ denote the *i*:th symbol of the sequence *x*, *y*, and z_n, respectively

The *m*-sequences *x*and *y* are constructed as:

Initial conditions:

x is constructed with x (0)=1, x(1)= x(2)=...= x (16)= x (17)=0

y(0)=y(1)= … =y(16)= y(17)=1

Recursive definition of subsequent symbols:

$x(i+18) = x(i+7) + x(i)$ modulo 2, $i=0,\ldots,2^{18}-20$,

$y(i+18) = y(i+10)+y(i+7)+y(i+5)+y(i)$ modulo 2, $i=0,\ldots,2^{18}-20$.

The n:th Gold code sequence z_n, $n=0,1,2,\ldots,2^{18}-2$, is then defined as

$z_n(i) = x((i+n) \text{ modulo } (2^{18}-1)) + y(i)$ modulo 2, $i=0,\ldots,2^{18}-2$.

These binary sequences are converted to real valued sequences Z_n by the following transformation:

$$Z_n(i) = \begin{cases} +1 & if \;\; z_n(i) = 0 \\ -1 & if \;\; z_n(i) = 1 \end{cases} \quad for \quad i = 0,1,\ldots,2^{18} - 2.$$

Finally, the n:th complex scrambling code sequence $S_{dl,n}$ is defined as:

$S_{dl,n}(i) = Z_n(i) + j\, Z_n((i+131072) \text{ modulo } (2^{18}-1))$, i=0,1,…,38399.

Note that the pattern from phase 0 up to the phase of 38399 is repeated.

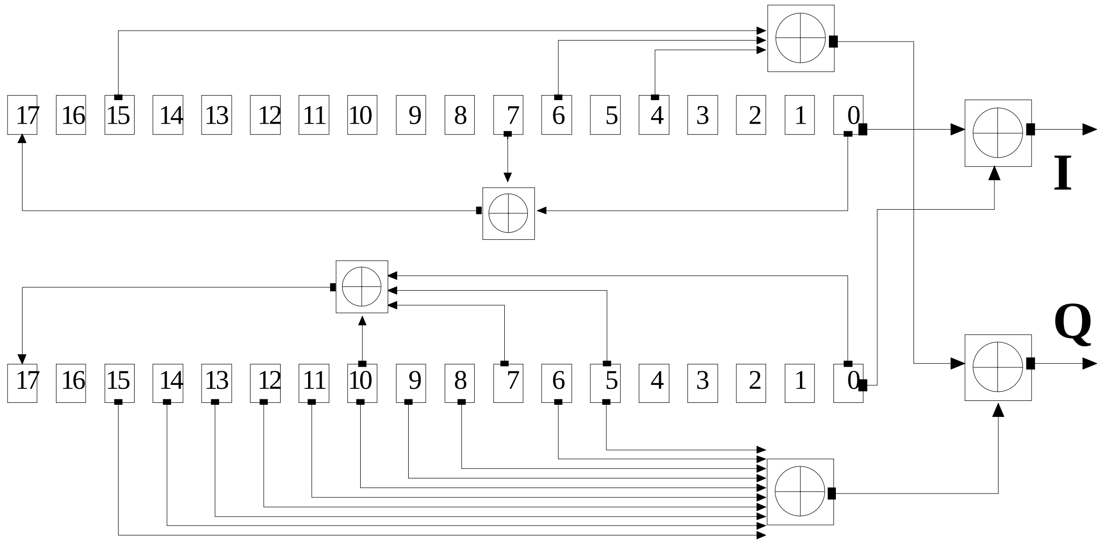

Figure 10: Configuration of downlink scrambling code generator

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or for SMG, use the format P-99-xxx

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25.213 CR 032 Current Version: 3.1.1

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

For submission to: TSG-RAN #7
list expected approval meeting # here ↑

for approval	X	strategic		*(for SMG use only)*
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:** 2000-03-03

Subject: Clean up of USTS related specifications

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: USTS is Release-00 item. Therefore USTS related specifications shall be removed in Release-99.

Clauses affected: 3.2
4.3.1.2

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 FDD mode.

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 25.101: "UE Radio transmission and Reception (FDD)".

[4] 3G TS 25.104: "UTRA (BS) FDD; Radio transmission and Reception".

3 Symbols and abbreviations

3.1 Symbols

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

$C_{ch,SF,n}$:	n:th channelisation code with spreading factor SF
$C_{pre,n,s}$:	PRACH preamble code for *n*:th preamble scrambling code and signature *s*
$C_{c\text{-}acc,n,s}$:	PCPCH access preamble code for *n*:th preamble scrambling code and signature *s*
$C_{c\text{-}cd,n,s}$:	PCPCH CD preamble code for *n*:th preamble scrambling code and signature *s*
$C_{sig,s}$:	PRACH/PCPCH signature code for signature *s*
$S_{long,n}$:	*n*:th DPCCH/DPDCH long uplink scrambling code
$S_{short,n}$:	*n*:th DPCCH/DPDCH short uplink scrambling code
$S_{r\text{-}pre,n}$:	*n*:th PRACH preamble scrambling code
$S_{r\text{-}msg,n}$:	*n*:th PRACH message scrambling code
$S_{c\text{-}acc}$:	*n*:th PCPCH access preamble scrambling code
$S_{c\text{-}cd}$:	*n*:th PCPCH CD preamble scrambling code
$S_{c\text{-}msg,n}$:	*n*:th PCPCH message scrambling code
$S_{dl,n}$:	DL scrambling code
C_{psc}:	PSC code
$C_{ssc,n}$:	n:th SSC code

3.2 Abbreviations

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

AICH	Acquisition Indicator Channel
AP	Access Preamble
BCH	Broadcast Control Channel
CCPCH	Common Control Physical Channel
CD	Collision Detection
CPCH	Common Packet Channel
CPICH	Common Pilot Channel
DCH	Dedicated Channel

DPCH	Dedicated Physical Channel
DPCCH	Dedicated Physical Control Channel
DPDCH	Dedicated Physical Data Channel
FDD	Frequency Division Duplex
Mcps	Mega Chip Per Second
OVSF	Orthogonal Variable Spreading Factor (codes)
PDSCH	Physical Dedicated Shared Channel
PICH	Page Indication Channel
PRACH	Physical Random Access Channel
PSC	Primary Synchronisation Code
RACH	Random Access Channel
SCH	Synchronisation Channel
SSC	Secondary Synchronisation Code
SF	Spreading Factor
UE	User Equipment
~~USTS~~	~~Uplink Synchronous Transmission Scheme~~

4 Uplink spreading and modulation

4.1 Overview

Spreading is applied to the physical channels. It consists of two operations. The first is the channelization operation, which transforms every data symbol into a number of chips, thus increasing the bandwidth of the signal. The number of chips per data symbol is called the Spreading Factor (SF). The second operation is the scrambling operation, where a scrambling code is applied to the spread signal.

With the channelization, data symbols on so-called I- and Q-branches are independently multiplied with an OVSF code. With the scrambling operation, the resultant signals on the I- and Q-branches are further multiplied by complex-valued scrambling code, where I and Q denote real and imaginary parts, respectively.

4.2 Spreading

4.2.1 DPCCH/DPDCH)

Figure 1 illustrates the principle of the uplink spreading of DPCCH and DPDCHs. The binary DPCCH and DPDCHs to be spread are represented by real-valued sequences, i.e. the binary value "0" is mapped to the real value +1, while the binary value "1" is mapped to the real value –1. The DPCCH is spread to the chip rate by the channelization code c_c, while the *n*:th DPDCH called $DPDCH_n$ is spread to the chip rate by the channelization code $c_{d,n}$. One DPCCH and up to six parallel DPDCHs can be transmitted simultaneously, i.e. $0 \leq n \leq 6$.

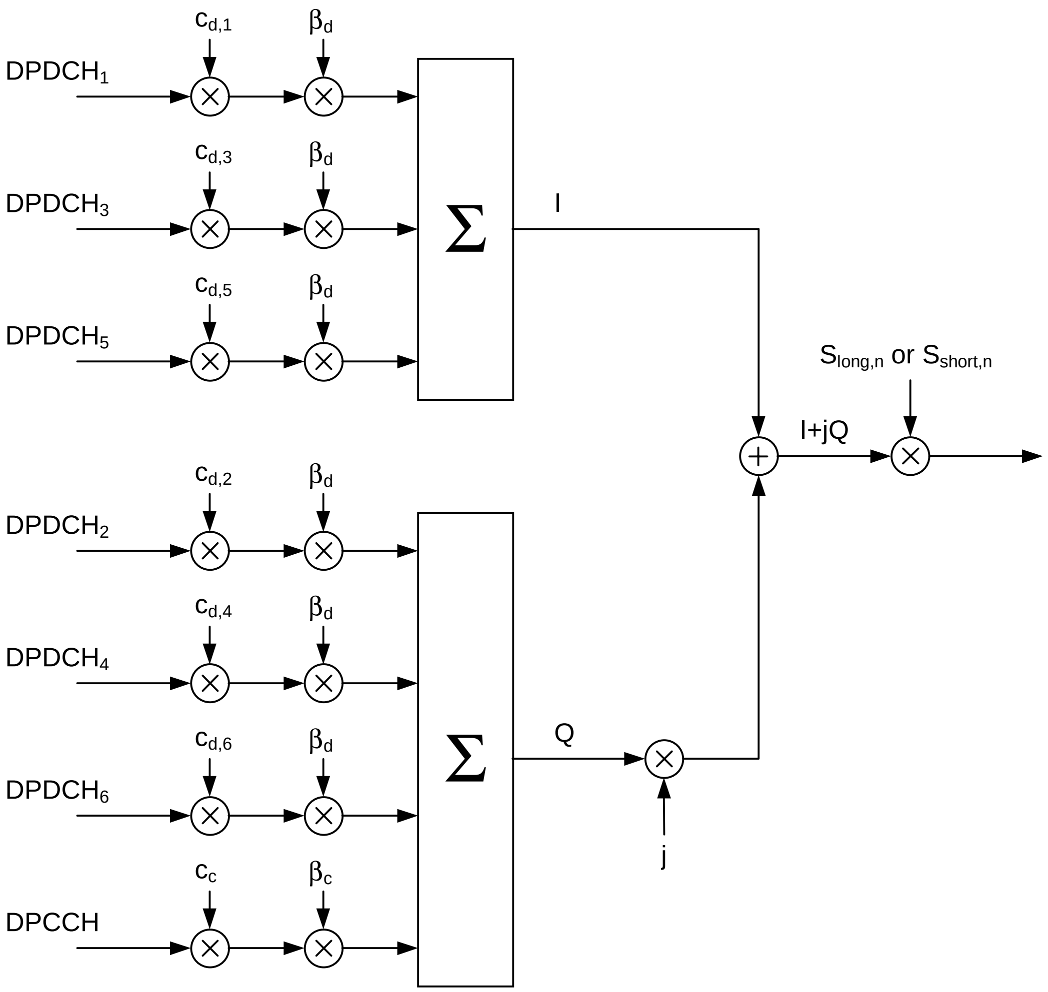

Figure 1: Spreading for uplink DPCCH and DPDCHs

After channelization, the real-valued spread signals are weighted by gain factors, β_c for DPCCH and β_d for all DPDCHs.

At every instant in time, at least one of the values β_c and β_d has the amplitude 1.0. The β-values are quantized into 4 bit words. The quantization steps are given in table 1.

Table 1: The quantization of the gain parameters

Signalling values for β_c and β_d	Quantized amplitude ratios β_c and β_d
15	1.0
14	0.9333
13	0.8666
12	0.8000
11	0.7333
10	0.6667
9	0.6000
8	0.5333
7	0.4667
6	0.4000
5	0.3333
4	0.2667
3	0.2000
2	0.1333
1	0.0667
0	Switch off

After the weighting, the stream of real-valued chips on the I- and Q-branches are then summed and treated as a complex-valued stream of chips. This complex-valued signal is then scrambled by the complex-valued scrambling code

$S_{long,n}$ or $S_{short,n}$, depending on if long or short scrambling codes are used. The scrambling code is applied aligned with the radio frames, i.e. the first scrambling chip corresponds to the beginning of a radio frame.

4.2.2 PRACH

4.2.2.1 PRACH preamble part

The PRACH preamble part consist of a complex-valued code, described in section 4.3.3.

4.2.2.2 PRACH message part

Figure 2 illustrates the principle of the spreading and scrambling of the PRACH message part, consisting of data and control parts. The binary control and data parts to be spread are represented by real-valued sequences, i.e. the binary value "0" is mapped to the real value +1, while the binary value "1" is mapped to the real value –1. The control part is spread to the chip rate by the channelization code c_c, while the data part is spread to the chip rate by the channelization code c_d.

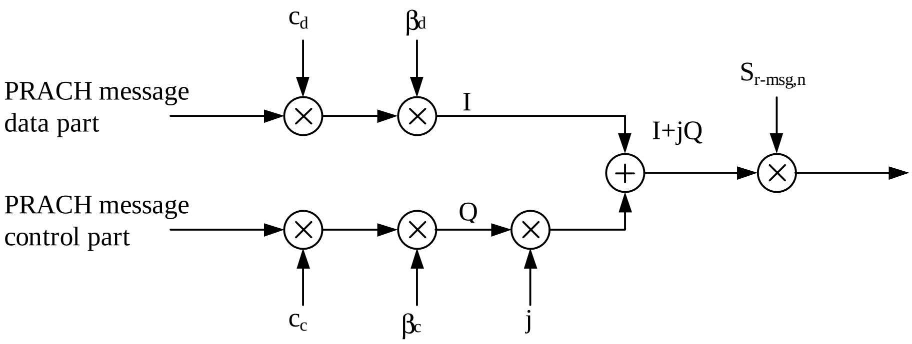

Figure 2: Spreading of PRACH message part

After channelization, the real-valued spread signals are weighted by gain factors, β_c for the control part and β_d for the data part. At every instant in time, at least one of the values β_c and β_d has the amplitude 1.0. The β-values are quantized into 4 bit words. The quantization steps are given in section 4.2.1.

After the weighting, the stream of real-valued chips on the I- and Q-branches are treated as a complex-valued stream of chips. This complex-valued signal is then scrambled by the complex-valued scrambling code $S_{r-msg,n}$. The 10 ms scrambling code is applied aligned with the 10 ms message part radio frames, i.e. the first scrambling chip corresponds to the beginning of a message part radio frame.

4.2.3 PCPCH

4.2.3.1 PCPCH preamble part

The PCPCH preamble part consist of a complex-valued code, described in section 4.3.4.

4.2.3.2 PCPCH message part

Figure 3 illustrates the principle of the spreading of the PCPCH message part, consisting of data and control parts. The binary control and data parts to be spread are represented by real-valued sequences, i.e. the binary value "0" is mapped to the real value +1, while the binary value "1" is mapped to the real value –1. The control part is spread to the chip rate by the channelization code c_c, while the data part is spread to the chip rate by the channelization code c_d.

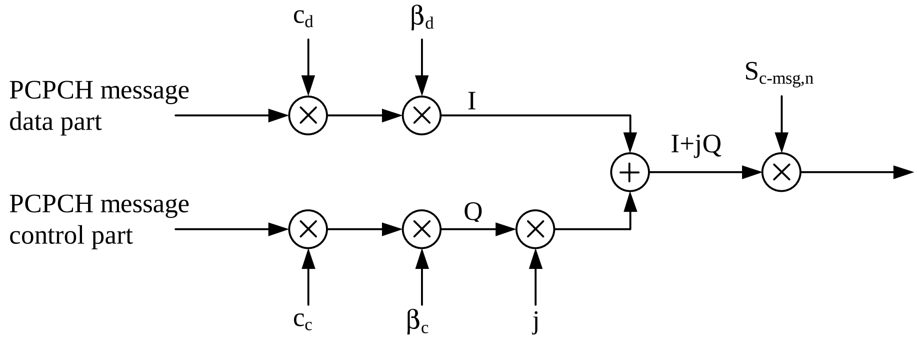

Figure 3: Spreading of PCPCH message part

After channelization, the real-valued spread signals are weighted by gain factors, β_c for the control part and β_d for the data part. At every instant in time, at least one of the values β_c and β_d has the amplitude 1.0. The β-values are quantized into 4 bit words. The quantization steps are given in section 4.2.1.

After the weighting, the stream of real-valued chips on the I- and Q-branches are treated as a complex-valued stream of chips. This complex-valued signal is then scrambled by the complex-valued scrambling code $S_{c\text{-}msg,n}$. The 10 ms scrambling code is applied aligned with the 10 ms message part radio frames, i.e. the first scrambling chip corresponds to the beginning of a message part radio frame.

4.3 Code generation and allocation

4.3.1 Channelization codes

4.3.1.1 Code definition

The channelization codes of figure 1 are Orthogonal Variable Spreading Factor (OVSF) codes that preserve the orthogonality between a user's different physical channels. The OVSF codes can be defined using the code tree of figure 4.

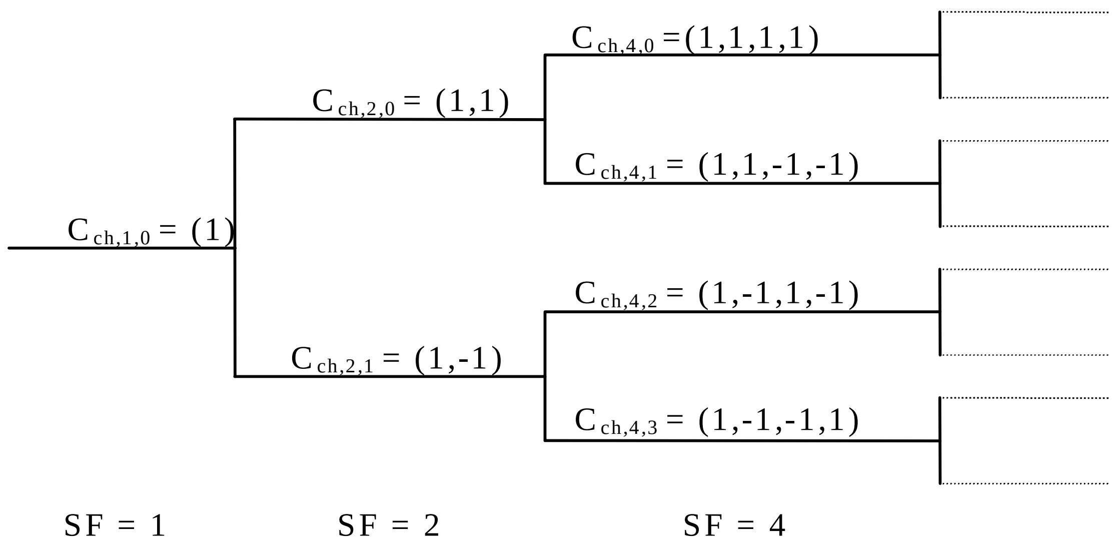

Figure 4: Code-tree for generation of Orthogonal Variable Spreading Factor (OVSF) codes

In figure 4, the channelization codes are uniquely described as $C_{ch,SF,k}$, where SF is the spreading factor of the code and k is the code number, $0 \le k \le SF-1$.

Each level in the code tree defines channelization codes of length SF, corresponding to a spreading factor of SF in figure 4.

The generation method for the channelization code is defined as:

$$C_{ch,1,0} = 1,$$

$$\begin{bmatrix} C_{ch,2,0} \\ C_{ch,2,1} \end{bmatrix} = \begin{bmatrix} C_{ch,1,0} & C_{ch,1,0} \\ C_{ch,1,0} & -C_{ch,1,0} \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$$

$$\begin{bmatrix} C_{ch,2^{(n+1)},0} \\ C_{ch,2^{(n+1)},1} \\ C_{ch,2^{(n+1)},2} \\ C_{ch,2^{(n+1)},3} \\ \vdots \\ C_{ch,2^{(n+1)},2^{(n+1)}-2} \\ C_{ch,2^{(n+1)},2^{(n+1)}-1} \end{bmatrix} = \begin{bmatrix} C_{ch,2^n,0} & C_{ch,2^n,0} \\ C_{ch,2^n,0} & -C_{ch,2^n,0} \\ C_{ch,2^n,1} & C_{ch,2^n,1} \\ C_{ch,2^n,1} & -C_{ch,2^n,1} \\ \vdots & \vdots \\ C_{ch,2^n,2^n-1} & C_{ch,2^n,2^n-1} \\ C_{ch,2^n,2^n-1} & -C_{ch,2^n,2^n-1} \end{bmatrix}$$

The leftmost value in each channelization code word corresponds to the chip transmitted first in time.

4.3.1.2 Code allocation for DPCCH/DPDCH

For the DPCCH and DPDCHs the following applies:

- The DPCCH is always spread by code $c_c = C_{ch,256,0}$.
- When only one DPDCH is to be transmitted, $DPDCH_1$ is spread by code $c_{d,1} = C_{ch,SF,k}$ where SF is the spreading factor of $DPDCH_1$ and k= SF / 4
- When more than one DPDCH is to be transmitted, all DPDCHs have spreading factors equal to 4. $DPDCH_n$ is spread by the the code $c_{d,n} = C_{ch,4,k}$, where $k = 1$ if $n \in \{1, 2\}$, $k = 3$ if $n \in \{3, 4\}$, and $k = 2$ if $n \in \{5, 6\}$.

~~In case of USTS, for the DPCCH, the UTRAN assigns a node number v_c ($0 \le v_c \le 255$) in the code-tree that corresponds to a channelization code of length 256. For a DPDCH, the UTRAN assigns a node number v_d ($0 \le v_d \le L-1$) in the code-tree that corresponds to a channelization code of length L (i.e., SF for the UE). The sub-tree below the assigned node is used for spreading of DPDCH. When more than one DPDCH is to be transmitted, all DPDCHs have spreading factors equal to 4. In this case, the UTRAN assigns node numbers v_{d1}, v_{d2}, and v_{d3} ($0 \le v_{d1}, v_{d2}$, and $v_{d3} \le 3$) that correspond to channelization codes of length 4.The DPCCH is always spread by code $C_{ch,0} = C_{ch,256,k}$, where $k=v_c$.~~

- ~~When only one DPDCH is to be transmitted, $DPDCH_1$ is spread by code $C_{ch,SF,k}$, where SF is the spreading factor of $DPDCH_1$ and $k= v_d$*SF/L.~~
- ~~When more than one DPDCH is to be transmitted, all DPDCHs have spreading factors equal to 4 (i.e., L=4). $DPDCH_n$ is spread by the code $C_{ch,n} = C_{ch,4,k}$, where $k = v_{d1}$ if $n \in \{1, 2\}$, $k = v_{d2}$ if $n \in \{3, 4\}$, and $k = v_{d3}$ if $n \in \{5, 6\}$.~~

4.3.1.3 Code allocation for PRACH message part

The preamble signature *s*, $1 \le s \le 16$, points to one of the 16 nodes in the code-tree that corresponds to channelization codes of length 16. The sub-tree below the specified node is used for spreading of the message part. The control part is spread with the channelization code c_c (as shown in section 4.2.2.2) of spreading factor 256 in the lowest branch of the sub-tree, i.e. $c_c = C_{ch,256,m}$ where m = 16(s – 1) + 15. The data part uses any of the channelization codes from spreading factor 32 to 256 in the upper-most branch of the sub-tree. To be exact, the data part is spread by channelization code $c_d = C_{ch,SF,m}$ and SF is the spreading factor used for the data part and m = SF×(s – 1)/16.