TSG-RAN Working Group 1 meeting #9
Dresden, Germany
November 30 – December 3, 1999

TSGR1#9(99)i60

Agenda item:

Source: Ericsson

Title: CR 25.213-006: Update of downlink spreading sections

Document for: Decision

This CR requests some changes to the description of downlink spreading in 25.213, Section 5.1. It also requests some changes to the description of SCH codes in 25.213, Section 5.2.3.

The following changes are requested for Section 5.1

- Figure 8 shows the spreading operation for all downlink physical channels except the SCH, i.e. also for the P-CCPCH. Based on the definition of P-CCPCH in 25.211, there seems to be no reason to have a specific description for the P-CCPCH spreading.
- The illustration of multi-code transmission in Figure 8 is removed. Spreading in case of multi-code transmission is basically identical to spreading of multiple downlink channels in general, i.e. it does not need to be described explicitly.
- Multiplexing of SCH is no longer described as time multiplex with P-CCPCH. According to 25.211, SCH is defined for the entire slot, i.e. it is not really correct to state that the P-CCPCH and SCH are time multiplexed.
- The AICH description is moved to 25.211, see related change request 25.211 CR XXX. The AICH generation deals with symbols, i.e. it does not belong to 25.213 which deals with spreading.

Changes are requested for Section 5.2.3 in order to clarify the following unclear areas:

- Connection between code number and row to use in the Hadamard matrix for generation of SSCs is incorrect, since not all rows are used in the Hadamard matrix.
- PSC and SSC is currently defined as real-valued codes that are later transmitted on both in-phase and quadrature branches. It is simpler to define the codes as being complex-valued from the beginning. This corresponds better with e.g. the PRACH/PCPCH preamble definitions.
- The mapping of 0/1 to +1/-1 is not very specific. It is proposed to describe the entire generation using the +1/-1 notation.
- Different variables are defined not where they are needed, but randomly within the section, e.g. the sequence *b* is used only for the generation of the SSC and should be described in connection with those codes and not the PSC.
- The use of the symbol $C_{sch,n}$ is unnecessary and leads to confusion. Description can be done directly without this symbol, so it is proposed to delete it.
- The text in 5.2.3.2 does not explicitly state that it is the secondary SCH sequence that is found in Table5.
- It is not explained very clearly what is shown in Table 5.

3GPP TSG RAN WG1 Meeting #9
Dresden, Germany, Nov 30 –Dec 3, 1999

Document ????9???
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

25.213	**CR**	**006**	Current Version:	3.0.0

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

For submission to:	TSG-RAN #6	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: Ericsson **Date:** 1999-10-22

Subject: Update of downlink spreading description

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:

Remove some inconsistencies between 25.213, Section 5.1 and 25.211.
- Removal of time-multiplex of SCH and P-CCPCH

Correction to 25.213, Section 5.2.3:
- Connection between code number and row to use in the Hadamard matrix for generation of SSCs is incorrect, since not all rows are used in the Hadamard matrix.

Editorial enhancements:
- No specific description for P-CCPCH spreading
- No specific description for multi-code spreading
- AICH description moved to 25.211
- The PSC and SSC are now defined as complex-valued codes directly.
- The mapping of 0/1 to +1/-1 is not very specific. It is proposed to describe the entire generation using the +1/-1 notation.
- Different variables are defined not where they are needed, but randomly within the section, e.g. the sequence *b* is used only for the generation of the SSC and should be described in connection with those codes and not the PSC.
- The use of the symbol $C_{sch,n}$ is unnecessary and leads to confusion. Description can be done directly without this symbol, so it is proposed to delete it.
- The text in 5.2.3.2 does not explicitly state that it is the secondary SCH sequence that is found in Table 5.
- It is not explained very clearly what is shown in Table 5.

Clauses affected: 3.2, 5.1, 5.2.3.1, 5.2.3.2

Other specs affected:

Other 3G core specifications	X	→ List of CRs:	25.211 CR 010
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:

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] TS 25.201: "Physical layer - general description".

[2] TS 25.211: “Physical channels and mapping of transport channels onto physical channels (FDD)”

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

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_{scramb}: scrambling code for uplink
$C_{sig,s}$: RACH signature code.
$S_{ul,n}$: UL scrambling code for desicated channels
$S_{r\text{-}pre,n}$: RACH preamble scrambling code
$S_{r\text{-}msg,n}$: RACH message scrambling code
$S_{c\text{-}acc}$: CPCH access preamble scrambling code
$S_{c\text{-}cd}$: CPCH CD preamble scrambling code
$S_{c\text{-}msg,n}$: CPCH message scrambling code
$S_{dl,n}$: DL scrambling code

C_{psc}: PSC code
$C_{ssc,n}$: n:th SSC code

3.3 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

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, 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.

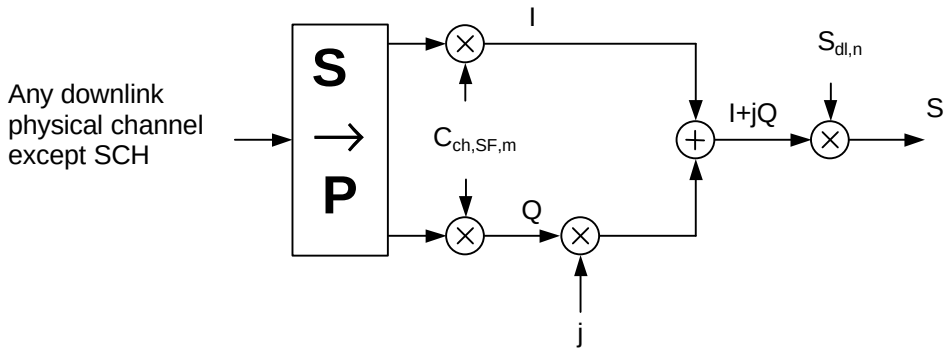

Figure 8: Spreading for all downlink physical channels except SCH

Figure 9 illsutrates 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.

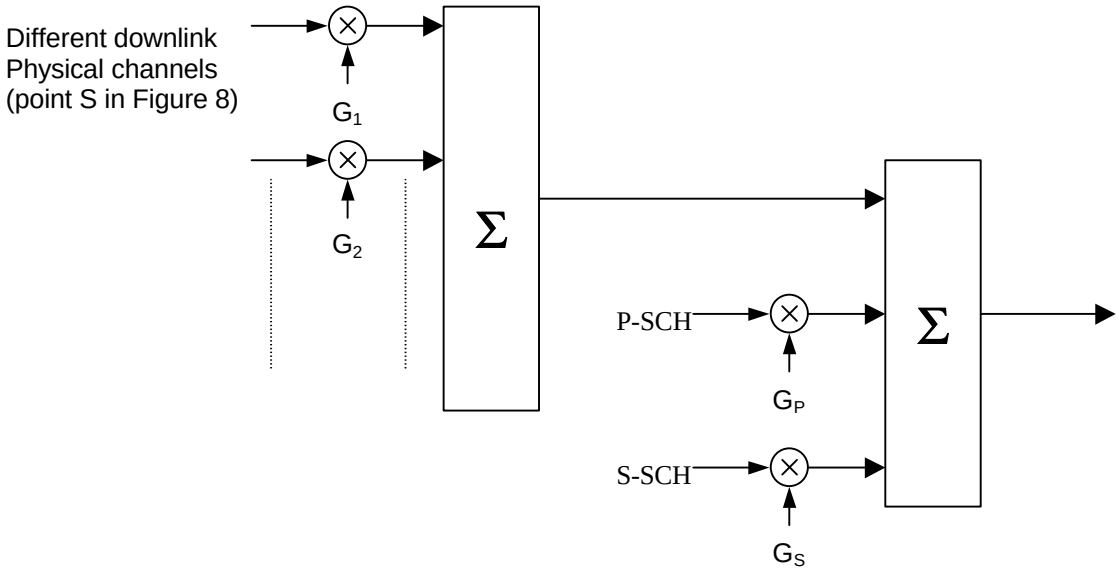

Figure 9: Spreading and modulation for SCH and P-CCPCH

5.2.3 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

$a = <x_1, x_2, x_3, \ldots, x_{16}> = <1, 1, 1, 1, 1, 1, -1, -1, 1, -1, 1, -1, 1, -1, -1, 1>$.

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

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

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

The 16 secondary synchronization codes (SSCs), $\{C_{ssc,1}, \ldots, C_{ssc,16}\}$, are complex-valued with identical real and imaginary components, and are constructed from 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

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

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, h_n in the sequel.Furthermore, let $h_n(i)$ and $z(i)$ denote the *i:*th symbol of the sequences 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

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

where $m = 16 \times (k - 1)$ 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 5 describes the sequences of SSCs used to encode the 64 different scrambling code groups. The entries in table 5 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 5: 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	1	1	2	8	9	10	15	8	10	16	2	7	15	7	16
Group 2	1	1	5	16	7	3	14	16	3	10	5	12	14	12	10
Group 3	1	2	1	15	5	5	12	16	6	11	2	16	11	15	12
Group 4	1	2	3	1	8	6	5	2	5	8	4	4	6	3	7
Group 5	1	2	16	6	6	11	15	5	12	1	15	12	16	11	2
Group 6	1	3	4	7	4	1	5	5	3	6	2	8	7	6	8
Group 7	1	4	11	3	4	10	9	2	11	2	10	12	12	9	3
Group 8	1	5	6	6	14	9	10	2	13	9	2	5	14	1	13
Group 9	1	6	10	10	4	11	7	13	16	11	13	6	4	1	16
Group 10	1	6	13	2	14	2	6	5	5	13	10	9	1	14	10
Group 11	1	7	8	5	7	2	4	3	8	3	2	6	6	4	5
Group 12	1	7	10	9	16	7	9	15	1	8	16	8	15	2	2
Group 13	1	8	12	9	9	4	13	16	5	1	13	5	12	4	8
Group 14	1	8	14	10	14	1	15	15	8	5	11	4	10	5	4
Group 15	1	9	2	15	15	16	10	7	8	1	10	8	2	16	9
Group 16	1	9	15	6	16	2	13	14	10	11	7	4	5	12	3
Group 17	1	10	9	11	15	7	6	4	16	5	2	12	13	3	14
Group 18	1	11	14	4	13	2	9	10	12	16	8	5	3	15	6
Group 19	1	12	12	13	14	7	2	8	14	2	1	13	11	8	11
Group 20	1	12	15	5	4	14	3	16	7	8	6	2	10	11	13
Group 21	1	15	4	3	7	6	10	13	12	5	14	16	8	2	11
Group 22	1	16	3	12	11	9	13	5	8	2	14	7	4	10	15
Group 23	2	2	5	10	16	11	3	10	11	8	5	13	3	13	8
Group 24	2	2	12	3	15	5	8	3	5	14	12	9	8	9	14
Group 25	2	3	6	16	12	16	3	13	13	6	7	9	2	12	7
Group 26	2	3	8	2	9	15	14	3	14	9	5	5	15	8	12
Group 27	2	4	7	9	5	4	9	11	2	14	5	14	11	16	16
Group 28	2	4	13	12	12	7	15	10	5	2	15	5	13	7	4
Group 29	2	5	9	9	3	12	8	14	15	12	14	5	3	2	15
Group 30	2	5	11	7	2	11	9	4	16	7	16	9	14	14	4
Group 31	2	6	2	13	3	3	12	9	7	16	6	9	16	13	12
Group 32	2	6	9	7	7	16	13	3	12	2	13	12	9	16	6
Group 33	2	7	12	15	2	12	4	10	13	15	13	4	5	5	10
Group 34	2	7	14	16	5	9	2	9	16	11	11	5	7	4	14
Group 35	2	8	5	12	5	2	14	14	8	15	3	9	12	15	9
Group 36	2	9	13	4	2	13	8	11	6	4	6	8	15	15	11
Group 37	2	10	3	2	13	16	8	10	8	13	11	11	16	3	5
Group 38	2	11	15	3	11	6	14	10	15	10	6	7	7	14	3
Group 39	2	16	4	5	16	14	7	11	4	11	14	9	9	7	5
Group 40	3	3	4	6	11	12	13	6	12	14	4	5	13	5	14
Group 41	3	3	6	5	16	9	15	5	9	10	6	4	15	4	10
Group 42	3	4	5	14	4	6	12	13	5	13	6	11	11	12	14
Group 43	3	4	9	16	10	4	16	15	3	5	10	5	15	6	6
Group 44	3	4	16	10	5	10	4	9	9	16	15	6	3	5	15
Group 45	3	5	12	11	14	5	11	13	3	6	14	6	13	4	4
Group 46	3	6	4	10	6	5	9	15	4	15	5	16	16	9	10
Group 47	3	7	8	8	16	11	12	4	15	11	4	7	16	3	15
Group 48	3	7	16	11	4	15	3	15	11	12	12	4	7	8	16
Group 49	3	8	7	15	4	8	15	12	3	16	4	16	12	11	11
Group 50	3	8	15	4	16	4	8	7	7	15	12	11	3	16	12

Group 51	3	10	10	15	16	5	4	6	16	4	3	15	9	6	9
Group 52	3	13	11	5	4	12	4	11	6	6	5	3	14	13	12
Group 53	3	14	7	9	14	10	13	8	7	8	10	4	4	13	9
Group 54	5	5	8	14	16	13	6	14	13	7	8	15	6	15	7
Group 55	5	6	11	7	10	8	5	8	7	12	12	10	6	9	11
Group 56	5	6	13	8	13	5	7	7	6	16	14	15	8	16	15
Group 57	5	7	9	10	7	11	6	12	9	12	11	8	8	6	10
Group 58	5	9	6	8	10	9	8	12	5	11	10	11	12	7	7
Group 59	5	10	10	12	8	11	9	7	8	9	5	12	6	7	6
Group 60	5	10	12	6	5	12	8	9	7	6	7	8	11	11	9
Group 61	5	13	15	15	14	8	6	7	16	8	7	13	14	5	16
Group 62	9	10	13	10	11	15	15	9	16	12	14	13	16	14	11
Group 63	9	11	12	15	12	9	13	13	11	14	10	16	15	14	16
Group 64	9	12	10	15	13	14	9	14	15	11	11	13	12	16	10