CR-Form-v3

CHANGE REQUEST

✍ **25.223**	**CR 17**	✍	rev **1**	✍	Current version: **3.4.0**	✍

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Proposed change affects: ✍ (U)SIM [ ] ME/UE [X] Radio Access Network [X] Core Network [ ]

Title: ✍	Inclusion of 1.28Mcps TDD in TS 25.223		
Source: ✍	Siemens, CWTS, CATT		
Work item code: ✍	LCRTDD	***Date:*** ✍	28.02.2001
Category: ✍	**B**	***Release:*** ✍	REL-4
	Use one of the following categories: ***F*** *(essential correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(Addition of feature),* ***C*** *(Functional modification of feature)* ***D*** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change: ✍	Inclusion of 1.28 Mcps TDD
Summary of change: ✍	?? The basis for this document was CR017, R1-01-0223 ?? Some editorial corrections
Consequences if not approved: ✍	

Clauses affected: ✍	New section 6, new section 7.6, new section 9, new Annex B		
Other specs affected: ✍	[X] Other core specifications [ ] Test specifications [ ] O&M Specifications	✍	25.201, 25.221, 25.222, 25.224, 25.225
Other comments: ✍			

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3 Symbols and abbreviations

3.1 Symbols

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

C_p:	PSC
C_i:	i:th secondary SCH code

3.2 Abbreviations

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

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

4 General

In the following, a separation between the data modulation and the spreading modulation has been made. The data modulation for 3.84Mcps TDD is defined in clause 5 'Data modulation for the 3.84 Mcps option', the data modulation for 1.28Mcps TDD is defined in clause 6 'Data modulation for the 1.28 Mcps option' and the spreading modulation in clause 67 'Spreading modulation'.

Table 1: Basic modulation parameters

Chip rate	Same as FDD basic chiprate: 3.84 Mchip/s	Low chiprate: 1.28 Mchip/s
Data modulation	QPSK	QPSK, 8PSK
Spreading characteristics	Orthogonal Q chips/symbol, where $Q = 2^p$, $0 <= p <= 4$	Orthogonal Q chips/symbol, where $Q = 2^p$, $0 <= p <= 4$

5 Data modulation for the 3.84 Mcps option

5.1 Symbol rate

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

6 Data modulation for the 1.28 Mcps option

6.1 Symbol rate

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

6.2 Mapping of bits onto signal point constellation

6.2.1 QPSK modulation

The mapping of bits onto the signal point constellation for QPSK modulation is the same as in the 3.84Mcps TDD cf. [5.2.1 Mapping for burst type 1 and 2].

6.2.2 8PSK modulation

The data modulation is performed to the bits from the output of the physical channel mapping procedure. In case of 8PSK modulation 3 consecutive binary bits are represented by one complex valued data symbol. Each user burst has two data carrying parts, termed data blocks:

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

N_k is the number of symbols per data field for the user k. This number is linked to the spreading factor Q_k.

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

The data modulation is 8PSK, thus the data symbols $\underline{d}_n^{(k,i)}$ are generated from 3 consecutive data bits from the output of the physical channel mapping procedure in [8]:

using the following mapping to complex symbols:

Consecutive binary bit pattern	complex symbol
$b_{1,n}^{(k,i)} \ b_{2,n}^{(k,i)} \ b_{3,n}^{(k,i)}$	$\underline{d}_n^{(k,i)}$
000	cos(11pi/8)+ jsin(11pi/8)
001	cos(9pi/8)+ jsin(9pi/8)
010	cos(5pi/8)+ jsin(5pi/8)
011	cos(7pi/8)+ jsin(7pi/8)
100	cos(13pi/8)+ jsin(13pi/8)
101	cos(15pi/8)+ jsin(15pi/8)
110	cos(3pi/8)+ jsin(3pi/8)
111	cos(pi/8)+ jsin(pi/8)

The mapping corresponds to a 8PSK modulation of the interleaved and encoded data bits $b_{l,n}^{(k,i)}$ of the table above and $\underline{d}_n^{(k,i)}$ of equation 1.

~~6~~7 Spreading modulation

~~6~~7.1 Basic spreading parameters

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

~~6~~7.2 Channelisation codes

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

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

shall be taken from the set

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

The $\mathbf{c}_{Q_k}^{(k)}$ are Orthogonal Variable Spreading Factor (OVSF) codes, allowing to mix in the same timeslot channels with different spreading factors while preserving the orthogonality. The OVSF codes can be defined using the code tree of figure 1.

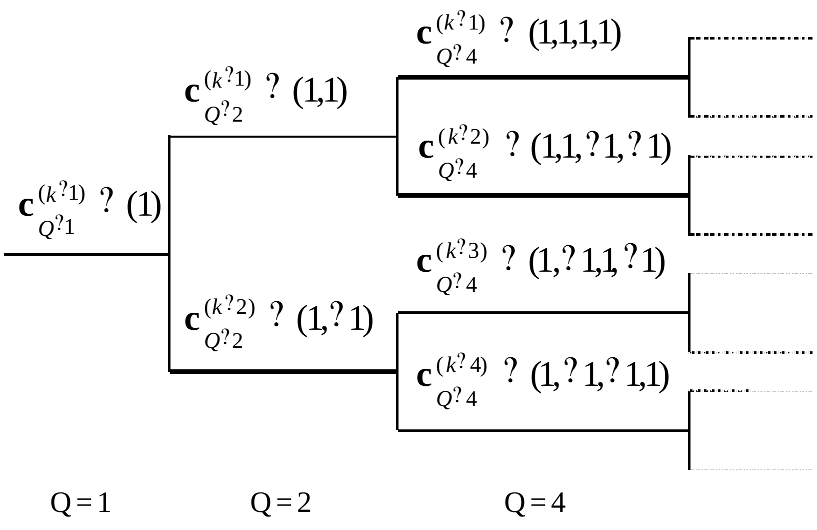

Figure 1: Code-tree for generation of Orthogonal Variable Spreading Factor (OVSF) codes for Channelisation Operation

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

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

~~6~~7.3 Scrambling codes

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

$$\underline{V}_{?} = ?1, j, -1, -j? \quad (4)$$

In equation 4 the letter j denotes the imaginary unit. A complex scrambling code $\underline{?}$ is generated from the binary scrambling codes $? ? ?_1, ?_2, ..., ?_{16} ?$ of length 16 shown in Annex A. The relation between the elements $\underline{?}$ and $?$ is given by:

$$\underline{?}_i ? (j)^i ? ?_i \qquad ?_i ? ?1, ?1? \; i = 1,...,16 \quad (5)$$

Hence, the elements $\underline{?}_i$ of the complex scrambling code $\underline{?}$ are alternating real and imaginary.

The length matching is obtained by concatenating Q_{MAX}/Q_k spread words before the scrambling. The scheme is illustrated in figure 2 and is described in more detail in subclause 6.4.

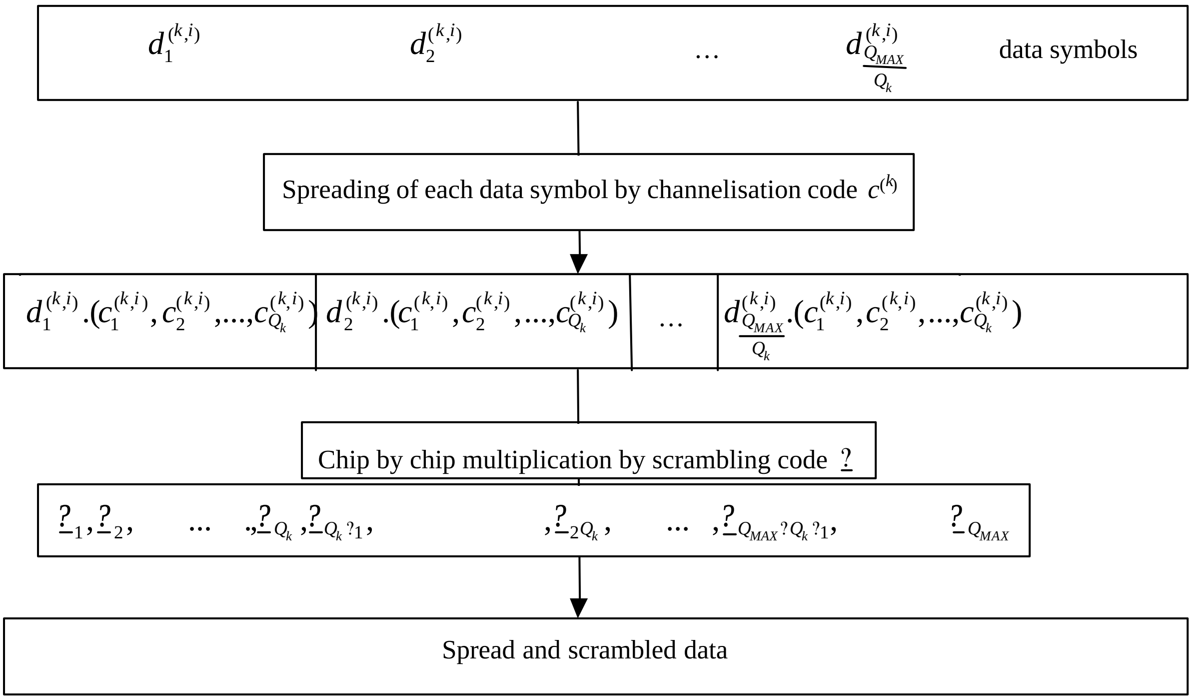

Figure 2: Spreading of data symbols

~~6~~7.4 Spread signal of data symbols and data blocks

The combination of the user specific channelisation and cell specific scrambling codes can be seen as a user and cell specific spreading code $\mathbf{s}^{(k)} ? ?s_p^{(k)}?$ with

$$s_p^{(k)} ? c^{(k)}_{1 ? ?(p ? 1) \bmod Q_k ?} \cdot \underline{?}_{1 ? ?(p ? 1) \bmod Q_{MAX} ?}, \; k=1,…,K, \; p=1,…,N_kQ_k.$$

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

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

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

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

where L_m is the number of midamble chips.

~~6.5~~7.5 Modulation for the 3.84 Mcps option

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

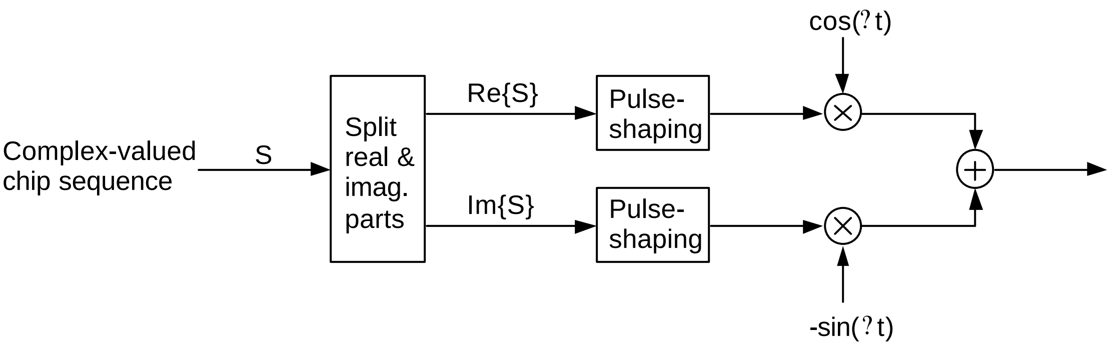

Figure 3: Modulation of complex valued chip sequences

The pulse-shaping characteristics are described in [9] and [10].

~~6~~7.5.1 Combination of physical channels in uplink

Figure 4 illustrates the principle of combination of two different physical uplink channels within one timeslot. The DPCHs to be combined belong to same CCTrCH, did undergo spreading as described in sections before and are thus represented by complex-valued sequences. First, the amplitude of all DPCHs is adjusted according to UL open loop power control as described in [10]. Each DPCH is then separately weighted by a weight factor $?_i$ and combined using complex addition. After combination of Physical Channels the gain factor $?_j$ is applied, depending on the actual TFC as described in [10].

In case of different CCTrCH, principle shown in Figure 4 applies to each CCTrCH separately.

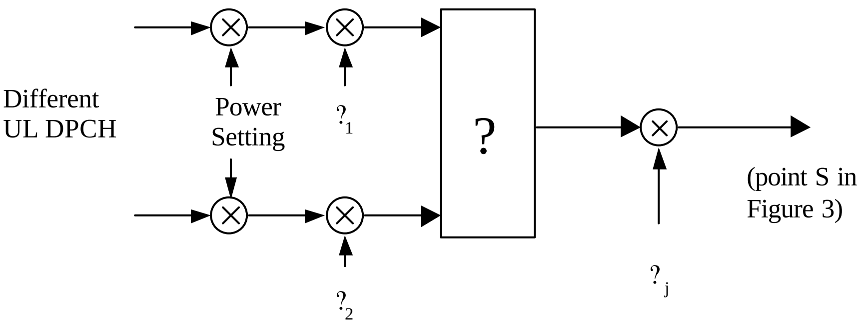

Figure 4: Combination of different physical channels in uplink

The values of weight factors $?_i$ are depending on the spreading factor SF of the corresponding DPCH:

SF of DPCH$_i$	$?_i$
16	1
8	$\sqrt{2}$
4	2
2	$2\sqrt{2}$
1	4

The possible values for gain factors $?_j$ (corresponding to *j*–th TFC) are listed in table below:

Signalling value for $?_j$	Quantized value $?_j$
15	16/8
14	15/8
13	14/8
12	13/8
11	12/8
10	11/8
9	10/8
8	9/8
7	8/8
6	7/8
5	6/8
4	5/8
3	4/8
2	3/8
1	2/8
0	1/8

~~6~~7.5.2 Combination of physical channels in downlink

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

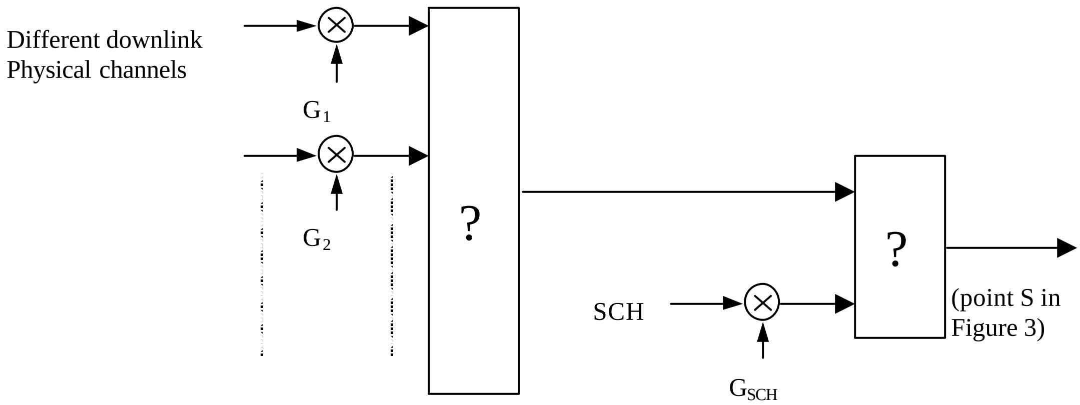

Figure 5: Combination of different physical channels in downlink in case of SCH timeslot

7.6 Modulation for the 1.28 Mcps option

The complex-valued chip sequence is modulated as shown in figure [6].

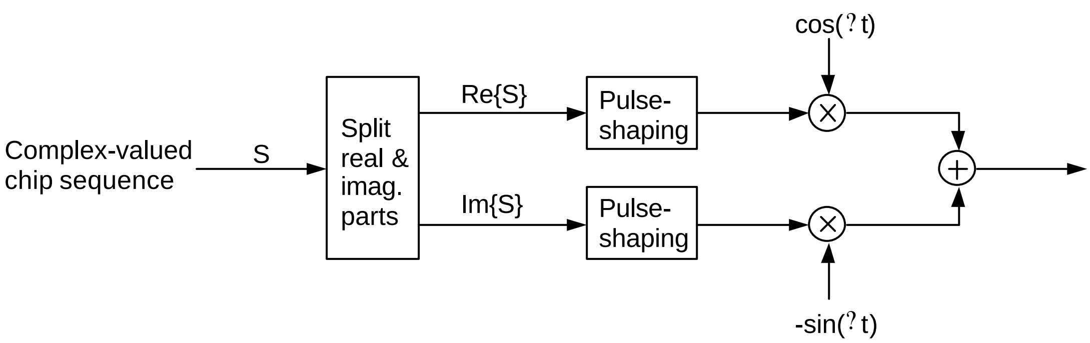

Figure [6]: Modulation of complex valued chip sequences

The pulse-shaping characteristics are described in [9] and [10].

7.6.1 Combination of physical channels in uplink

The combination of physical channels in uplink is the same as in the 3.84 Mcps TDD cf. [7.5.1 Combination of physical channels in uplink]

7.6.2 Combination of physical channels in downlink

Figure 7 illustrates how different physical downlink channels are combined within one timeslot. Each spread channel is separately weighted by a weight factor G_i.. All downlink physical channels are then combined using complex addition.

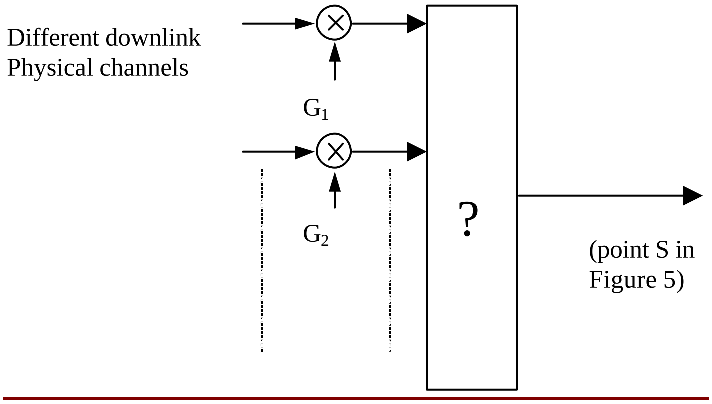

Figure 7: Combination of different physical channels in downlink

~~7~~8 Synchronisation codes for the 3.84 Mcps option

9 Synchronisation codes for the 1.28 Mcps option

9.1 The downlink pilot timeslot (DwPTS)

The contents of DwPTS is composed of 64 chips of a SYNC-DL sequence, cf.[B.1 Basic SYNC-DL sequence] and 32 chips of guard period (GP). The SYNC-DL code is not scrambled

There should be 32 different basic SYNC-DL codes for the whole system.

For the generation of the complex valued SYNC-DL codes of length 64 , the basic binary SYNC-DL codes $\mathbf{s} = \left(s_1, s_2, \ldots, s_{64}\right)$ of length 64 shown in Table 9 are used. The relation between the elements $\underline{\mathbf{s}}$ and $\mathbf{s}$ is given by:

$$\underline{s}_i = (\mathrm{j})^i \cdot s_i \qquad s_i \in \{1, -1\} \quad i = 1,\ldots,64 \qquad (1)$$

Hence, the elements $\underline{s}_i$ of the complex SYNC-DL code $\underline{\mathbf{s}}$ are alternating real and imaginary.

The SYNC-DL is QPSK modulated and the phase of the SYNC-DL is used to signal the presence of the P-CCPCH in the multi-frame of the resource units of code $c_{Q=16}^{(k=1)}$ and $c_{Q=16}^{(k=2)}$ in time slot #0.

9.1.1 Modulation of the SYNC-DL

The SYNC-DL sequences are modulated with respect to the midamble ($m^{(1)}$) in time slot #0.

Four consecutive phases (phase quadruple) of the SYNC-DL are used to indicate the presence of the P-CCPCH in the following 4 sub-frames. In case the presence of a P-CCPCH is indicated, the next following sub-frame is the first sub-frame of the interleaving period. As QPSK is used for the modulation of the SYNC-DL, the phases 45, 135, 225, and 315° are used.

The total number of different phase quadruples is 2 (S1 and S2). A quadruple always starts with an even system frame number ((SFN mod 2) =0). Table 8 is showing the quadruples and their meaning.

Table 8: Sequences for the phase modulation for the SYNC-DL

Name	Phase quadruple	Meaning
S1	135, 45, 225, 135	There is a P-CCPCH in the next 4 sub-frames
S2	315, 225, 315, 45	There is no P-CCPCH in the next 4 sub-frames

9.2 The uplink pilot timeslot (UpPTS)

The contents in UpPTS is composed of 128chips of a SYNC-UL sequence, cf. [B.2 Basic SYNC-UL sequence] and 32chips of guard period (GP) .The SYNC-UL code is not scrambled.

There should be 256 different basic SYNC-UL codes (see Table 10) for the whole system.

For the generation of the complex valued SYNC-UL codes of length 128, the basic binary SYNC-UL codes $\mathbf{s} = (s_1, s_2, \ldots, s_{128})$ of length 128 shown in Table 10 are used. The relation between the elements $\underline{\mathbf{s}}$ and $\mathbf{s}$ is given by:

$$\underline{s}_i = (j)^i \cdot s_i \qquad s_i \in \{1, -1\} \quad i = 1, \ldots, 128 \qquad (2)$$

Hence, the elements $\underline{\mathbf{s}}_i$ of the complex SYNC-UL code $\underline{\mathbf{s}}$ are alternating real and imaginary.

9.3 Code Allocation

Relationship between the SYNC-DL and SYNC-UL sequences, the scrambling codes and the midamble codes

Code Group	Associated Codes			
	SYNC-DL ID	SYNC-UL ID	Scrambling Code ID	Basic Midamble Code ID
Group 1	0	0...7	0	0
			1	1
			2	2
			3	3
Group 2	1	8...15	4	4
			5	5
			6	6
			7	7
. . .				
Group 32	31	248...255	124	124
			125	125
			126	126
			127	127

Annex B (Normative) Synchronisation sequence

B.1 Basic SYNC-DL sequence

Table 9: Basic SYNC-DL Codes

Code ID	SYNC-DL Codes of length 64
0	B3A7CC05A98688E4
1	9D559BD290606791
2	2CE7BA12A017C3A2
3	34511D20672F4712
4	9A772841474603F2
5	9109B1A5CE01F228
6	8FD429B3594501C0
7	25251354AA3F8C19
8	C9A3B8E0C043EA56
9	BA04B888E5BC1802
10	A735354299370207
11	74C3C8DA4415AE51
12	F4FD0458A0124663
13	A011D4E16C3D6064
14	BDA0661B0CAA8C68
15	8E31123F28928698
16	F095C1632E2906AB
17	B60B4A8A664071CF
18	AA094DCCE91E041A
19	C0C31CDA8A256807
20	D516964FB18C1890
21	30DE01834F4AACCE
22	8F700323BA5CAD34
23	1B50F4DEE0C1380C
24	443382164F56F2D1
25	E1E4005D49B846B4
26	040A97165330BFAA
27	C48E26881693AD78
28	D4354B2FE02361CC
29	5383AB6C8A10CE84
30	D417A730F2F12244
31	ABF0A0D905A939C4

B.2 Basic SYNC-UL Codes

Table 10: Basic SYNC-UL Codes

Code ID	SYNC-UL Codes of length 128
0	C11C20F0D1807DB8859175B798EC094A
1	91278068081EC8E74543DBC1C9AD4235
2	38F5AEE2E513DB12A663BA04160103E5
3	7AA8A0A210F12A1E4332F2EDD33011FC
4	C180EA3B9BA1774EB9611BD249C4A508
5	B072A2C839489D496B98CE9D0132FBC9
6	B2723EAC6EB01667F2B33961C8074234
7	C4144AD060F0EC095E227B92CF7C8280
8	653036A10D3054146FCF815986C63A14
9	F899CA61435D64DC07FDF04C4A0C053A
10	B56F2D6893A8051407F4C341D88DC7DC
11	DC0BE838242142EDE6413A72C88D74AA
12	22A2FD86E4086C70A4860B13C76E579F
13	A3CBC21322C97D2A02728E7875F39588
14	D4EC4F694A082CB38E3B1558A0FCC89F
15	CC891141C4E216D235C15CF5D3F9B002
16	A1993114C50B77CB0C0725D1E22FD016
17	24F73A979DE52F82E8800CCB93842A59
18	8F878FA04659842E294D8DEAB20BA2FD
19	AC90B0442D70662B028CF76A6BECDF09
20	D94A284DF64D7B0102F0E084C29C88C8
21	8603200C7596F24E865FD3815693358D
22	B466B12CF433642BD8B08F1F452E0550
23	86A3A1772C1C99FCA7DBBA0C312E34A0
24	622A1889F72A9A2C042D46F08EFEE1AC
25	BF220A362BC0D3B0D7CE400954C6CFAE
26	D28D73C52E89CF57905C502244F63616
27	AD4E1C2103697D64D8B9D4C035D90548
28	8F081A9BA12B6C6BD024531AA984D21C
29	E4092429BE82988E1E3585BF6A6AE550
30	08BD36E0A9C061782CB38B35B335CA56
31	1CDFF3CC2685D1C44F4A1059AB03F40A
32	506ED4E88FB1CECE3243F2A27A0221A4
33	846CF58A7AB613C83A24130B5778C0E2
34	A2711A99E26A0C75AC026F4CFAECE893
35	D846EEEBA2432AC05A01043C62579DCF
36	6B16B4E851CAF2121FC4CF88820C89E7
37	AA4889A78207674A74E10C6F2BE11D48
38	8534CF8145BC991052814ED5C72709EE
39	01AEF15D2290A84A607425746D9963C7

40	999188F758245D5164FE16D852942C71
41	CF71C008599287E446E30745BD56E2D2
42	248414BA0DF8CDC4711FE7C8707ED0AD
43	EB2E263EC016191C81AB714BFE4D2B30
44	862082A7482FAC1C499793A0D8CED670
45	DE2C22B2783AB75A7342608DE413840A
46	E31AA60B727F2CA2A78DAAC10665011D
47	CEF6CD06509870AC9E0177ACD550921D
48	E52C84D499FFCDC287581691471540F2
49	B33BF6551A4322504BEE0930BCA1EC68
50	555BE6886D0FC43D72315E6C6D384148
51	8444F67451EE23CE1240C90F0B52A492
52	5C290D28E84060E69D09788A261B10FF
53	337E0C35E83CD38CCC5D45804241F952
54	A7879F0D31A8982A01EE6AC4952984DC
55	A37F506508928C70A83D69A2373781B9
56	42F55208EE12909803A7CBEB19B5419E
57	57E5E268A328FCC9ED04B9E5420AC702
58	EB033AD1222F84D8642C4E3FAAD28206
59	98EE1415F026AC0E862C520451697DD0
60	6A0528AEA4B7CD6702660D81F8821E19
61	763D626A87C603BCB09E1A4C800A378F
62	EEA61897879289340C23F669D6A03762
63	A6571B3CC2D0E04F017ACC808B92DCE7
64	DDF88B52EA1831D293A803CF23C8C471
65	6CA4D333A2684140475DAB491F61C17A
66	A7D2AD23043989A13289F7C3E135580A
67	B1C752FA66B41C81904EDE27EA000E2E
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69	9C20334E1BBC596B25E151180BF99940
70	484256214F81070DD9C49A2B05A43DCE
71	401A20BCBE29B7438A7AEE44635A9E23
72	8858585C3239CBF628033FA0DF189378
73	EFA36404C1BA5118CC5F9052FD28D9C3
74	155609873D8A042D496E6477B747C4F8
75	8446077883A6D7D2549CC9742E3FD023
76	E630142B189AA209371A6F0FFDBC30A7
77	C46060535AC6DBB2095F1D7826D0CD5C
78	E00D19E48797148B28DEDA9D429362E2
79	645DE447E938485489416CAFCC1C571F
80	DA10AFBF2AE61C593A1D88584DE30598
81	BB248AEA5FD3FE210CD48FC401E1A686
82	A89F146BD9191F445301C081CB6F5625
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Annex ~~B~~ C (informative): Generalised Hierarchical Golay Sequences

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