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Postal address
F-06921 Sophia Antipolis Cedex - FRANCE

Office address
650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16
Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Internet
secretariat@etsi.fr
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Contents

Foreword

This Technical Specification has been produced by the 3GPP.

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the specification;

1 Scope

The present document describes multiplexing, channel coding and interleaving for UTRA Physical Layer TDD 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 25.212: "Multiplexing and channel coding (FDD)"

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

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

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

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

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

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

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

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

3 Abbreviations

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

CDMA	Code Division Multiple Access
P-CCPCH	Primary Common Control Physical Channel
PN	Pseudo Noise
PSCH	Physical Synchronisation Channel
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 is defined in section 5 and the spreading modulation in section 6.

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
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

5.1 Symbol rate

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

5.2 Mapping of bits onto signal point constellation

A certain number K of CDMA codes can be assigned to either a single user or to different users who are simultaneously transmitting bursts in the same time slot and the same frequency. The maximum possible number of CDMA codes, which is smaller or equal to 16, depends on the individual spreading factors, the actual interference situation and the service requirements. The applicable burst formats are shown in[7]. Each user burst has two data carrying parts, termed data blocks:

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

N_k is the number of symbols per data field for the user k. This number is linked to the spreading factor Q_k as described in table 1 of [7].

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

The data modulation is QPSK, thus the data symbols $\underline{d}_n^{(k,i)}$ are generated from two interleaved and encoded data bits

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

using the equation

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

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

6 Spreading modulation

6.1 Basic spreading parameters

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

6.2 Channelisation codes

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

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

In equation 4 the letter j denotes the imaginary unit. A complex channelisation code $\underline{\mathbf{c}}^{(k)}$ is generated from the binary codes $\mathbf{a}_{Q_k}^{(k)} = \left(a_1^{(k)}, a_2^{(k)}, \ldots, a_{Q_k}^{(k)}\right)$ of length Q_k shown in figure 2 allocated to the k^{th} user. The relation between the elements $\underline{c}_q^{(k)}$ and $\underline{a}_q^{(k)}$ is given by:

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

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

The $\mathbf{a}_{Q_k}^{(k)}$ are Orthogonal Variable Spreading Factor (OVSF) codes, allowing to mix in the same timeslot channels with different spreading factors while preserving the orthogonality. The OVSF codes can be defined using the code tree of figure 2.

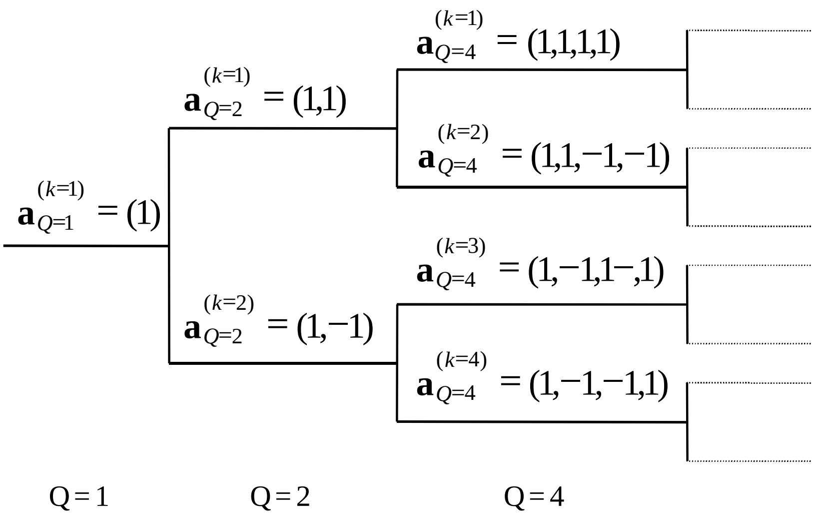

Figure 1: Code-tree for generation of Orthogonal Variable Spreading Factor (OVSF) codes for Channelisation Operation

Each level in the code tree defines a spreading factor indicated by the value of Q in the figure. All codes within the code tree cannot be used simultaneously in a given timeslot. A code can be used in a timeslot if and only if no other code on the path from the specific code to the root of the tree or in the sub-tree below the specific code is used in this timeslot.

This means that the number of available codes in a slot is not fixed but depends on the rate and spreading factor of each physical channel.

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

6.3 Scrambling codes

The spreading of data by a complex channelisation code $\mathbf{c}^{(k)}$ of length Q_k is followed by a cell specific scrambling sequence $\mathbf{v}=(v_1, v_2, \ldots v_{Q_{MAX}})$. The length matching is obtained by concatenating Q_{MAX}/Q_k spread words before the scrambling. The scheme is illustrated in figure 3 below and is described in more detail in section 6.4. The applicable scrambling codes are shown in Annex A.

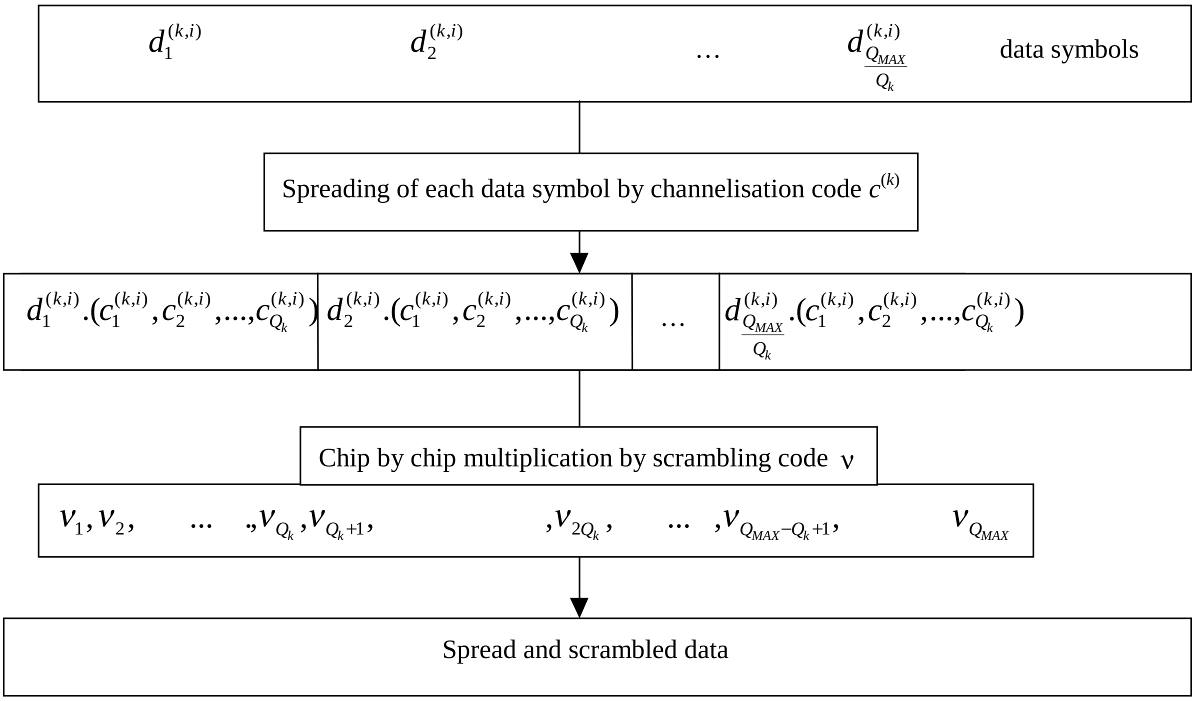

Figure 2: Spreading of data symbols

6.4 Spread signal of data symbols and data blocks

The combination of the user specific channelisation and cell specific scrambling codes can be seen as a user and cell specific spreading code $\mathbf{s}^{(k)} = \left(s_p^{(k)}\right)$ with $s_p^{(k)} = c^{(k)}_{1+[(p-1) \bmod Q_k]} \cdot v_{1+[(p-1) \bmod Q_{MAX}]}$, k=1,…,K, p=1,…,$N_k Q_k$.

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

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

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

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

where L_m is the number of midamble chips.

7 Synchronisation codes

7.1 Code Generation

The Primary code sequence, C_p is constructed as a so-called generalised hierarchical Golay sequence. The Primary SCH is furthermore chosen to have good aperiodic auto correlation properties.

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

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

The PSC code is generated by repeating sequence ‘a’ modulated by a Golay complementary sequence.

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

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

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

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

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

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

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

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

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

This code word is chosen from every 16^{th} row of the matrix H_8., which yields 16 possible codewords n = 0, 1,…,15.

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

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

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

All sums of symbols are taken modulo 2.

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

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

$C_i = C_{SCH,i}$, i=0,…,15

7.2 Code Allocation

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

- The code group that the base station belongs to (5 bits; Cases 1,2,3)

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

The modulated codes are also constructed such that their cyclic-shifts are unique, i.e. a non-zero cyclic shift less than 2 (Case 1) and 4 (Cases 2 and 3) of any of the sequences is not equivalent to some cyclic shift of any other of the sequences. Also, a non-zero cyclic shift less than 2 (Case 1) and 4 (Cases 2 and 3) of any of the sequences is not equivalent to itself with any other cyclic shift less than 8. The secondary synchronization codes are partitioned into two code sets for Case 1, four code sets for Case 2 and thirty two code sets (possibly overlapping) for Case 3. The set is used to provide the following information:

Case 1:

Table 2: Code Set Allocation for Case 1

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

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

Case 2:

Table 3: Code Set Allocation for Case 2

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

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

Case 3:

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

The following SCH codes are allocated for each code set:

Case 1

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

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

Case 2

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

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

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

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

Case 3

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

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

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

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

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

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

Code set 7: C_0, C_4, C_7

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The following subsections 7.2.1 to 7.2.3 refer to the three cases of PSCH/P-CCPCH usage as described in [7].

7.2.1 Code allocation for Case 1:

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

Table 4: Code Allocation for Case 1

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

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

7.2.2 Code allocation for Case 2:

Table 5: Code Allocation for Case 2

Code Group	Code Set	Frame 1						Frame 2						Associated t_{offset}
		Slot k			Slot k+8			Slot k			Slot k+8			
0	1	C_0	C_1	C_2	C_0	C_1	$-C_2$	$-C_0$	$-C_1$	C_2	$-C_0$	$-C_1$	$-C_2$	t_0
1	1	C_0	$-C_1$	C_2	C_0	$-C_1$	$-C_2$	$-C_0$	C_1	C_2	$-C_0$	C_1	$-C_2$	t_1
2	1	jC_0	jC_1	C_2	jC_0	jC_1	$-C_2$	$-jC_0$	$-jC_1$	C_2	$-jC_0$	$-jC_1$	$-C_2$	t_2
3	1	jC_0	$-jC_1$	C_2	jC_0	$-jC_1$	$-C_2$	$-jC_0$	jC_1	C_2	$-jC_0$	jC_1	$-C_2$	t_3
4	1	jC_0	jC_2	C_1	jC_0	jC_2	$-C_1$	$-jC_0$	$-jC_2$	C_1	$-jC_0$	$-jC_2$	$-C_1$	t_4
5	1	jC_0	$-jC_2$	C_1	jC_0	$-jC_2$	$-C_1$	$-jC_0$	jC_2	C_1	$-jC_0$	jC_2	$-C_1$	t_5
6	1	jC_1	jC_2	C_0	jC_1	jC_2	$-C_0$	$-jC_1$	$-jC_2$	C_0	$-jC_1$	$-jC_2$	$-C_0$	t_6
7	1	jC_1	$-jC_2$	C_0	jC_1	$-jC_2$	$-C_0$	$-jC_1$	jC_2	C_0	$-jC_1$	jC_2	$-C_0$	t_7
8	2	C_3	C_4	C_5	C_3	C_4	$-C_5$	$-C_3$	$-C_4$	C_5	$-C_3$	$-C_4$	$-C_5$	t_8
9	2	C_3	$-C_4$	C_5	C_3	$-C_4$	$-C_5$	$-C_3$	C_4	C_5	$-C_3$	C_4	$-C_5$	t_9
10	2	jC_3	jC_4	C_5	jC_3	jC_4	$-C_5$	$-jC_3$	$-jC_4$	C_5	$-jC_3$	$-jC_4$	$-C_5$	t_{10}
11	2	jC_3	$-jC_4$	C_5	jC_3	$-jC_4$	$-C_5$	$-jC_3$	jC_4	C_5	$-jC_3$	jC_4	$-C_5$	t_{11}
12	2	jC_3	jC_5	C_4	jC_3	jC_5	$-C_4$	$-jC_3$	$-jC_5$	C_4	$-jC_3$	$-jC_5$	$-C_4$	t_{12}
13	2	jC_3	$-jC_5$	C_4	jC_3	$-jC_5$	$-C_4$	$-jC_3$	jC_5	C_4	$-jC_3$	jC_5	$-C_4$	t_{13}
14	2	jC_4	jC_5	C_3	jC_4	jC_5	$-C_3$	$-jC_4$	$-jC_5$	C_3	$-jC_4$	$-jC_5$	$-C_3$	t_{14}
15	2	jC_4	$-jC_5$	C_3	jC_4	$-jC_5$	$-C_3$	$-jC_4$	jC_5	C_3	$-jC_4$	jC_5	$-C_3$	t_{15}
16	3	C_6	C_7	C_8	C_6	C_7	$-C_8$	$-C_6$	$-C_7$	C_8	$-C_6$	$-C_7$	$-C_8$	t_{16}
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
23	3	jC_7	$-jC_8$	C_6	jC_7	$-jC_8$	$-C_6$	$-jC_7$	jC_8	C_6	$-jC_7$	jC_8	$-C_6$	t_{20}
24	4	C_9	C_{10}	C_{11}	C_9	C_{10}	$-C_{11}$	$-C_9$	$-C_{10}$	C_{11}	$-C_9$	$-C_{10}$	$-C_{11}$	t_{24}
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
31	4	jC_{10}	$-jC_{11}$	C_9	jC_{10}	$-jC_{11}$	$-C_9$	$-jC_{10}$	jC_{11}	C_9	$-jC_{10}$	jC_{11}	$-C_9$	t_{31}

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

7.2.3 Code allocation for Case 3:

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

Table 6: Code Allocation for Case 3

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

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

7.3 Evaluation of synchronisation codes

The evaluation of information transmitted in SCH on code group and frame timing is shown in table 7, where the 32 code groups are listed. Each code group is containing 4 specific scrambling codes (cf. section 6.3), each scrambling code associated with a specific short and long basic midamble code.

Each code group is additionally linked to a specific t_{Offset}, thus to a specific frame timing. By using this scheme, the UE can derive the position of the frame border due to the position of the SCH sequence and the knowledge of t_{Offset}. The complete mapping of Code Group to Scrambling Code, Midamble Codes and t_{Offset} is depicted in table 7.

Table 7: Mapping scheme for Cell Parameters, Code Groups, Scrambling Codes, Midambles and t_{Offset}

CELL PARA-METER	Code Group	Associated Codes			Associated t_{Offset}
		Scrambling Code	Long Basic Midamble Code	Short Basic Midamble Code	
0	Group 1	Code 0	m_{PL0}	m_{SL0}	t_0
1		Code 1	m_{PL1}	m_{SL1}	
2		Code 2	m_{PL2}	m_{SL2}	
3		Code 3	m_{PL3}	m_{SL3}	
4	Group 2	Code 4	m_{PL4}	m_{SL4}	t_1
5		Code 5	m_{PL5}	m_{SL5}	
6		Code 6	m_{PL6}	m_{SL6}	
7		Code 7	m_{PL7}	m_{SL7}	
. . . .					
124	Group 32	Code 124	m_{PL124}	m_{SL124}	t_{31}
125		Code 125	m_{PL125}	m_{SL125}	
126		Code 126	m_{PL126}	m_{SL126}	
127		Code 127	m_{PL127}	m_{SL127}	

For basic midamble codes m_P cf.TS 25.221, annex A ‘Basic Midamble Codes’.

Annex A (Normative): Scrambling Codes

The applicable scrambling codes are listed in below. Code numbers are referring to table 7 ‘Mapping scheme for Cell Parameters, Code Groups, Scrambling Codes, Midambles and t_{offset}’ in section 7.2 ‘Code Allocation’.

Scrambling Code	ν_1	ν_2	ν_3	ν_4	ν_5	ν_6	ν_7	ν_8	ν_9	ν_{10}	ν_{11}	ν_{12}	ν_{13}	ν_{14}	ν_{15}	ν_{16}
Code 0	-1	1	-1	-1	-1	1	-1	-1	1	-1	1	1	-1	1	-1	-1
Code 1	1	1	1	1	1	-1	1	-1	1	-1	-1	1	1	1	-1	-1
Code 2	1	-1	1	1	1	-1	1	1	-1	1	1	1	1	-1	-1	-1
Code 3	1	1	1	-1	-1	-1	-1	1	-1	-1	1	-1	-1	-1	1	-1
Code 4	1	1	1	-1	-1	-1	-1	1	1	1	1	-1	1	1	1	-1
Code 5	-1	1	1	-1	-1	-1	1	1	1	1	1	1	1	-1	1	-1
Code 6	-1	1	-1	-1	-1	1	-1	-1	-1	1	1	1	1	-1	-1	-1
Code 7	1	-1	1	-1	-1	-1	-1	-1	1	1	-1	-1	-1	1	1	-1
Code 8	1	1	1	-1	-1	-1	1	-1	1	1	-1	1	1	1	1	-1
Code 9	1	1	-1	1	1	1	1	-1	1	1	1	-1	-1	-1	1	-1
Code 10	1	-1	1	-1	1	1	1	1	-1	-1	1	1	-1	1	1	-1
Code 11	-1	1	1	1	1	-1	-1	-1	-1	1	-1	-1	-1	1	-1	-1
Code 12	-1	-1	1	-1	-1	-1	1	-1	-1	-1	-1	1	1	1	1	-1
Code 13	1	-1	1	1	1	-1	-1	-1	1	-1	-1	-1	-1	1	-1	-1
Code 14	1	-1	-1	-1	-1	1	-1	-1	1	-1	1	1	1	-1	-1	-1
Code 15	1	1	-1	-1	-1	1	1	-1	1	-1	1	-1	-1	-1	-1	-1
Code 16	1	-1	-1	1	-1	1	-1	1	-1	-1	-1	-1	1	1	-1	-1
Code 17	1	1	1	-1	1	1	1	-1	1	1	-1	1	-1	-1	1	-1
Code 18	-1	1	1	1	-1	1	-1	-1	-1	1	-1	-1	1	-1	-1	-1
Code 19	-1	1	-1	-1	1	-1	-1	-1	-1	1	1	1	-1	1	-1	-1
Code 20	-1	-1	-1	-1	1	-1	1	-1	-1	1	1	-1	1	1	-1	-1
Code 21	1	1	1	1	-1	-1	1	1	-1	1	1	-1	1	-1	1	-1
Code 22	1	-1	-1	-1	-1	1	1	1	-1	1	-1	-1	-1	1	-1	-1
Code 23	-1	1	1	1	-1	1	1	1	1	-1	1	1	-1	1	-1	-1
Code 24	-1	-1	1	-1	1	1	1	-1	-1	-1	-1	1	-1	-1	1	-1
Code 25	1	-1	1	1	1	-1	1	1	1	-1	1	1	-1	1	-1	-1
Code 26	1	-1	-1	-1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1
Code 27	-1	1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	-1	-1
Code 28	-1	-1	-1	1	-1	-1	-1	1	-1	-1	-1	1	1	1	1	-1
Code 29	1	-1	1	1	-1	1	-1	-1	-1	1	-1	-1	-1	1	-1	-1
Code 30	-1	-1	-1	-1	-1	-1	1	1	1	-1	-1	1	1	-1	1	-1
Code 31	1	1	-1	-1	1	1	1	1	-1	1	-1	1	-1	1	1	-1
Code 32	1	-1	-1	-1	1	-1	1	1	-1	1	-1	-1	1	-1	-1	-1
Code 33	-1	-1	-1	1	1	1	1	-1	1	1	1	-1	1	1	1	-1
Code 34	1	-1	-1	-1	1	-1	-1	-1	1	-1	1	1	-1	1	-1	-1
Code 35	1	-1	1	1	-1	1	-1	-1	1	-1	-1	-1	1	-1	-1	-1
Code 36	1	1	-1	1	1	1	-1	1	-1	-1	-1	1	1	1	1	-1
Code 37	-1	-1	-1	1	-1	-1	1	-1	-1	-1	1	-1	1	1	1	-1
Code 38	-1	1	-1	-1	1	-1	1	1	1	-1	-1	-1	1	-1	-1	-1
Code 39	-1	1	1	1	1	-1	-1	-1	1	-1	-1	-1	1	-1	-1	-1
Code 40	-1	1	-1	1	-1	-1	-1	-1	-1	-1	1	1	-1	1	1	-1
Code 41	1	1	-1	1	-1	-1	1	-1	-1	-1	1	-1	-1	-1	1	-1
Code 42	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	1	-1	-1	-1
Code 43	-1	-1	1	1	-1	-1	-1	-1	-1	1	-1	1	-1	1	1	-1
Code 44	-1	-1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	1	-1

Scrambling Code	ν_1	ν_2	ν_3	ν_4	ν_5	ν_6	ν_7	ν_8	ν_9	ν_{10}	ν_{11}	ν_{12}	ν_{13}	ν_{14}	ν_{15}	ν_{16}
Code 45	-1	-1	1	-1	1	1	-1	1	1	1	1	-1	1	1	1	-1
Code 46	-1	1	1	-1	1	1	-1	-1	-1	-1	-1	-1	1	-1	1	-1
Code 47	1	-1	-1	1	1	1	-1	-1	1	1	1	1	1	-1	1	-1
Code 48	1	1	-1	1	1	1	-1	1	1	1	-1	1	-1	-1	1	-1
Code 49	-1	-1	1	1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1
Code 50	1	1	-1	1	-1	-1	1	-1	1	1	1	-1	1	1	1	-1
Code 51	1	-1	-1	1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1
Code 52	1	1	1	-1	1	1	1	-1	-1	-1	-1	1	1	1	1	-1
Code 53	-1	1	1	1	-1	-1	-1	1	-1	1	1	1	1	1	1	-1
Code 54	-1	-1	1	-1	-1	-1	1	-1	1	1	-1	1	-1	-1	1	-1
Code 55	-1	1	1	-1	-1	-1	-1	-1	1	-1	1	-1	1	1	-1	-1
Code 56	-1	1	1	1	-1	1	1	1	-1	1	1	1	1	-1	-1	-1
Code 57	-1	1	1	-1	-1	-1	1	1	-1	1	-1	1	-1	-1	-1	-1
Code 58	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	-1	1	1	-1	-1
Code 59	1	1	-1	-1	-1	-1	-1	-1	1	-1	1	-1	-1	1	1	-1
Code 60	-1	1	1	-1	1	1	1	1	-1	1	-1	1	1	1	-1	-1
Code 61	-1	-1	1	1	1	-1	-1	1	1	-1	1	-1	-1	-1	-1	-1
Code 62	-1	1	-1	-1	1	1	1	-1	1	-1	-1	-1	-1	-1	1	-1
Code 63	-1	1	-1	1	-1	-1	1	1	1	-1	-1	1	-1	-1	-1	-1
Code 64	1	-1	-1	1	-1	-1	1	1	-1	-1	-1	-1	1	-1	1	-1
Code 65	-1	-1	-1	1	1	1	1	-1	-1	-1	1	-1	-1	-1	1	-1
Code 66	-1	-1	-1	-1	1	-1	-1	1	1	1	-1	-1	1	-1	1	-1
Code 67	-1	-1	-1	1	1	1	-1	1	1	1	-1	1	1	1	1	-1
Code 68	1	-1	1	1	-1	-1	-1	1	1	-1	-1	-1	-1	-1	1	-1
Code 69	-1	-1	1	-1	1	-1	-1	-1	1	1	1	-1	-1	1	-1	-1
Code 70	1	1	-1	1	-1	-1	-1	1	-1	-1	-1	1	-1	-1	1	-1
Code 71	1	-1	-1	1	-1	-1	-1	-1	-1	1	-1	1	1	1	-1	-1
Code 72	1	1	1	1	-1	1	1	-1	1	1	-1	-1	1	-1	1	-1
Code 73	-1	1	1	1	-1	-1	-1	1	-1	1	-1	-1	-1	-1	1	-1
Code 74	1	1	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	-1	-1	-1
Code 75	1	1	-1	-1	1	-1	-1	1	-1	1	-1	1	-1	-1	-1	-1
Code 76	-1	1	-1	-1	-1	-1	-1	1	-1	1	1	1	-1	-1	1	-1
Code 77	-1	1	-1	1	1	1	1	1	-1	1	1	-1	1	1	-1	-1
Code 78	-1	1	-1	1	-1	1	1	-1	-1	-1	1	1	-1	-1	-1	-1
Code 79	-1	1	-1	1	1	1	-1	-1	-1	1	1	-1	-1	-1	-1	-1
Code 80	1	1	-1	1	-1	1	-1	-1	-1	-1	1	-1	-1	1	-1	-1
Code 81	1	1	1	1	1	-1	1	-1	-1	-1	1	1	-1	1	1	-1
Code 82	-1	1	-1	1	1	1	1	1	1	1	-1	-1	-1	1	1	-1
Code 83	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1	-1	1	1	-1
Code 84	-1	-1	1	-1	1	1	-1	1	-1	-1	1	-1	-1	-1	1	-1
Code 85	-1	1	1	-1	-1	1	-1	1	1	1	1	1	1	1	-1	-1
Code 86	-1	-1	-1	1	-1	-1	-1	1	1	1	-1	1	-1	-1	1	-1
Code 87	1	1	-1	-1	-1	1	-1	1	1	1	1	1	-1	1	1	-1
Code 88	-1	1	1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1
Code 89	-1	1	-1	-1	1	-1	1	1	-1	1	-1	-1	-1	1	-1	-1
Code 90	1	-1	-1	-1	-1	-1	-1	1	1	-1	1	1	-1	-1	1	-1
Code 91	-1	1	-1	-1	-1	-1	1	-1	1	-1	1	1	-1	-1	1	-1
Code 92	-1	1	1	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	-1	-1
Code 93	-1	-1	-1	-1	-1	1	1	-1	-1	-1	1	1	1	-1	1	-1
Code 94	1	-1	1	-1	-1	1	1	-1	1	1	-1	-1	-1	-1	-1	-1
Code 95	1	1	1	1	1	-1	-1	1	-1	-1	1	1	1	-1	1	-1
Code 96	1	1	-1	-1	-1	1	1	-1	-1	-1	-1	-1	1	-1	1	-1
Code 97	1	1	-1	-1	1	-1	-1	1	1	1	1	1	1	-1	1	-1

Scrambling Code	ν_1	ν_2	ν_3	ν_4	ν_5	ν_6	ν_7	ν_8	ν_9	ν_{10}	ν_{11}	ν_{12}	ν_{13}	ν_{14}	ν_{15}	ν_{16}
Code 98	1	1	-1	1	1	-1	1	1	1	1	1	-1	1	-1	-1	-1
Code 99	1	-1	1	-1	1	-1	-1	1	-1	-1	1	1	-1	-1	-1	-1
Code 100	1	-1	1	1	-1	-1	1	-1	-1	1	-1	-1	-1	-1	1	-1
Code 101	1	1	1	1	-1	1	-1	1	1	1	-1	-1	-1	1	1	-1
Code 102	1	-1	1	-1	1	1	1	1	-1	1	1	-1	1	1	-1	-1
Code 103	-1	-1	1	-1	-1	1	-1	-1	1	1	1	-1	1	-1	-1	-1
Code 104	1	-1	1	1	-1	1	1	1	-1	1	1	1	-1	1	-1	-1
Code 105	1	1	1	1	1	1	-1	-1	1	-1	-1	1	1	-1	1	-1
Code 106	1	1	-1	-1	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	-1
Code 107	-1	-1	-1	-1	1	1	-1	-1	-1	1	1	-1	1	-1	1	-1
Code 108	-1	-1	-1	1	-1	1	-1	-1	1	1	-1	1	1	-1	-1	-1
Code 109	-1	1	-1	1	1	-1	-1	1	1	1	-1	-1	-1	-1	-1	-1
Code 110	-1	-1	1	1	-1	1	-1	1	1	1	1	1	-1	1	1	-1
Code 111	1	1	1	-1	-1	1	1	1	1	1	-1	1	-1	1	-1	-1
Code 112	-1	-1	1	1	1	-1	1	-1	1	1	1	1	-1	1	1	-1
Code 113	1	1	-1	-1	1	-1	1	-1	1	1	1	1	-1	1	1	-1
Code 114	-1	-1	-1	1	1	-1	-1	-1	1	1	-1	1	-1	1	-1	-1
Code 115	1	-1	-1	1	1	1	1	1	1	-1	1	-1	1	1	-1	-1
Code 116	-1	1	1	1	1	-1	1	1	1	-1	1	1	1	-1	-1	-1
Code 117	1	1	1	-1	1	1	-1	1	-1	-1	1	-1	1	1	1	-1
Code 118	-1	-1	-1	-1	-1	1	-1	1	1	-1	-1	1	1	1	-1	-1
Code 119	-1	-1	-1	1	-1	1	1	1	-1	-1	1	-1	-1	1	-1	-1
Code 120	-1	-1	1	-1	1	-1	1	1	-1	-1	1	-1	-1	1	-1	-1
Code 121	-1	1	1	1	1	1	1	-1	1	-1	1	1	-1	-1	1	-1
Code 122	-1	-1	-1	1	1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1
Code 123	1	-1	1	-1	1	1	-1	-1	1	-1	-1	1	-1	-1	-1	-1
Code 124	-1	-1	1	1	1	1	1	1	1	-1	1	-1	-1	1	1	-1
Code 125	1	-1	-1	1	1	-1	1	-1	1	1	1	1	1	1	-1	-1
Code 126	1	1	1	1	-1	1	-1	1	-1	1	1	-1	1	1	-1	-1
Code 127	1	-1	1	-1	-1	-1	-1	-1	1	-1	-1	1	1	1	-1	-1

Annex B (informative): Change history

Change history					
TSG RAN#	Version	CR	Tdoc RAN	New Version	Subject/Comment
RAN_05	-	-	RP-99593	3.0.0	Approved at TSG RAN #5 and placed under Change Control
RAN_06	3.0.0	001	RP-99696	3.1.0	Primary and Secondary CCPCH in TDD
RAN_06	3.0.0	003	RP-99695	3.1.0	Alignment of Terminology Regarding Spreading for TDD Mode
RAN_06	3.0.0	004	RP-99696	3.1.0	Code allocation for Case 3
-	3.1.0	-	-	3.1.1	Change history was added by the editor

History

Document history		
V3.1.1	January 2000	Publication