3GPP TSG-RAN Working Group 1
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Agenda Item:

Source: Siemens AG

Title: Recommended Text Changes according to Decisions on PSCH/CCPCH in TDD

Document for: Decision

Scope

In this contribution we propose text changes to specification documents S1.21, S1.23 and S1.24. These changes shall reflect the decisions on Physical Synchronisation Channel (PSCH) and Common Control Physical Channels (CCPCH) in TDD mode, which have been made at last WG1 meeting #2 in Shin Yokohama.

In the text as given below the additional description is elaborated for the three cases of PCH/CCPCH schemes as adopted in last WG1 meeting #2. This results in text changes to S1.21, in text additions to S1.23 and in text changes to S1.24.

Additional information on CCPCH schemes in TDD mode can be found in TDoc TSG RAN WG1 (99)159, ‘Multiframe Structure for CCPCH in TDD Mode’.

It is recommended to adopt the text from beyond to the according specification documents.

7.4 The Physical Synchronisation Channel (PSCH)

[Editors Note : The detailed scheme of CCPCH pointing by SCH in Case 3) is FFS.]

The PSCH is similar to the FDD SCH, where the code group of a cell can be derived when decoding the FDD synchronisation channel. In TDD mode additional information, received from higher layers on SCH transport channel, is transmitted to the UE in PSCH in case 3 from below.

In order not to limit the UL/DL asymmetry the PSCH is mapped on one or two DL slots per frame only.

There are three cases of PSCH and CCPCH allocation as follows:

1) Case 1) PSCH and CCPCH allocated in TS#k, k=0….15

2) Case 2) PSCH in two TS and CCPCH in the same two TS: TS#k and TS#k+8, k=0…7

3) Case 3) PSCH in two TS, TS#k and TS#k+8, k=0…7, and the primary CCPCH TS#i, i=0…15, pointed by PSCH. Pointing is determined via the SCH from higher layers.

These three cases are addressed by higher layers using the SCCH in TDD Mode. The position of PSCH (value of k) in frame can change on a long term basis in any case.

Figure 12 is ~~one~~ an example for transmission of PSCH, k=0, of Case 2 or Case 3. ~~In this case, the PSCH uses system-wide always the same two DL slots, which are slot 0 and slot 8.~~

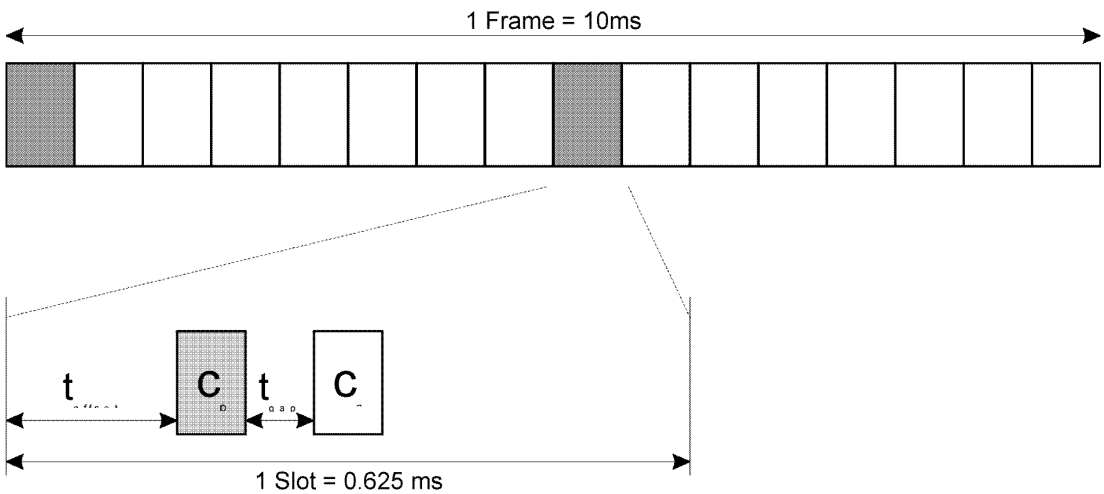

Figure 12 Scheme for Physical Synchronisation channel PSCH consisting of one primary sequence Cp and one secondary sequence Cs in slot k and k+8 (example for k=0 in Case 2 or Case 3)

As depicted in Figure 12, the PSCH consists of a primary and secondary code sequence with 256 chips length. The used sequences Cp and Cs are the same as in FDD-Mode, see~~[2]~~ S1.23, chapter '7 Synchronisation Codes'.

The time offset tgap is the time between the primary synchronisation code and the secondary synchronisation code. It provides enough time for calculations and a better interference distribution, since the codes do not superimpose. The exact value is to be determined.

Due to mobile to mobile interference, it is mandatory for public TDD systems to keep synchronisation between base stations. As a consequence of this, a capture effect concerning PSCH, see explanation below, can arise. The time offset toffset enables the system to overcome the capture effect.

When searching for synchronisation engaging Cp a situation as outlined in Figure 13 may occur. The correlations, which are shown separately in the figure, superimpose at the mobile's receiver. The introduction of toffset will ease the detection of cell 3. Since different cells use different time offsets, the time offset toffset enables the receiver to detect even cells with low correlation peaks, as there is additional separation in time-domain. The cell's specific time offset toffset is obtained by decoding the SCH.

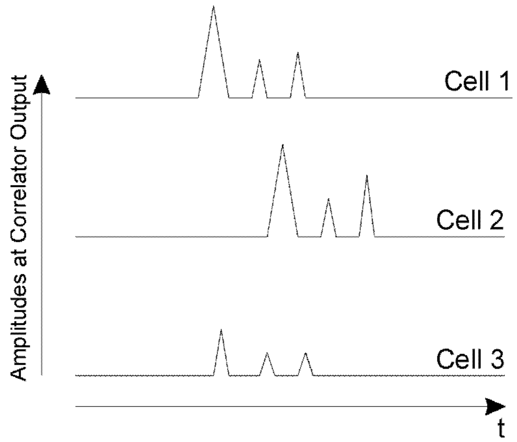

Figure 13 Sample for capturing effect whilst detecting synchronised Base Stations

7 Synchronisation codes

7.1 Code Generation

The code generation for synchronisation codes is handled in the same way as in FDD Mode. Thus we refer to S1.13, chapter '7.2.3 Synchronisation Codes'. From this procedure we obtain one primary synchronisation code $C_p = C_{SCH,0}$ and seventeen different secondary synchronisation codes $C_{S,i} = C_{SCH,i}$ with i=1…17.

To avoid misunderstandings when documents are reorganised in the future, we repeat the actual content of this chapter below using small font.

The Primary and Secondary code words, C_p and $\{C_1,\ldots,C_{17}\}$ are constructed as the position wise addition modulo 2 of a Hadamard sequence and a fixed so called hierarchical sequence. The [Primary SCH] [1st search code] is furthermore chosen to have good aperiodic auto correlation properties.
< *Editor's note: There is a choice on the terminology. Also, the text in the 2nd [ ] needs to be verified*>
The hierarchical sequence y sequence is constructed from two constituent sequences x_1 and x_2 of length n_1 and n_2 respectively using the following formula:
$y(i) = x_2(i \bmod n_2) + x_1(i \operatorname{div} n_2) \text{ modulo } 2,\ i = 0 \ldots (n_1 * n_2) - 1$
The constituent sequences x_1 and x_2 are chosen to be identical and to be the following length 16 (i.e. $n_1 = n_2 = 16$) sequence:
$x_1 = x_2 = <0, 0, 1, 1, 1, 1, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0>$
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).
The Hadamard sequence *h* depends on the chosen code number *n* and is denoted h_n in the sequel.
[This code number is chosen from every 8th low of the matrix H_8. Therefore, there are 32 possible code numbers out of which 17 are used.]
<*Editor's note: Only ARIB input specifies this code group out of which 17 codes are chosen but it has to do with fast Hadamard transformation*>
Furthermore, let $h_n(i)$ and $y(i)$ denote the *i*:th symbol of the sequence h_n and *y*, respectively.
$h(i)$ is identical to $C_{2^8,i'}$ where i' is the bit-reversed number of the 8-bit binary representation of i.
The definition of the *n*:th [SCH][search] code word follows (the left most index correspond to the chip transmitted first in each slot):
$C_{SCH,n} = < h_n(0)+y(0), h_n(1)+y(1), h_n(2)+y(2), \ldots, h_n(255)+y(255) >$,
All sums of symbols are taken modulo 2.
Before modulation and transmission these binary code words are converted to real valued sequences by the transformation '0' -> '+1', '1' -> '-1'.
The [Primary SCH][1st search] and [Secondary SCH][2nd search] code words are defined in terms of $C_{SCH,n}$ and the definition of C_p and $\{C_1,\ldots,C_{17}\}$ now follows as:
$C_p = C_{SCH,0}$
and
$C_i = C_{SCH,i}$, i=1,…,17
The definitions of C_p and $\{C_1,\ldots,C_{17}\}$ are such that a 32 point fast Hadamard transform can be utilised for detection.
<*Editor's note: choice has to be made between for example primary SCH code and 1st search code.*>

7.2 Code Allocation

Sequences of 8 secondary SCH codes, thus composed of $C_{S,i}$ from chapter Code Generation above, are used to transmit information on the PSCH. In general the information on the code group of a cell and on the frame timing (see S1.24, Section '6.6.1 Cell Search') is transmitted in the PSCH. According to S1.21 section '7.4 The Physical Synchronisation Channel (PSCH)', there is case (3) where additional information from SCH transport channel is to be transmitted in the PSCH.

The sequences of secondary SCH codes are constructed such that their cyclic-shifts are unique, i.e. a non-zero cyclic shift less than 8 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 8 of any of the sequences is not equivalent to itself with any other cyclic shift less than 8. This property is used to uniquely determine the transmitted sequence in the receiver.

The evaluation of transmitted information on code group and frame timing is shown in table 9, where the 32 code groups are listed. Each code group is containing 4 specific scrambling codes, 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}. Positioning of the secondary SCH codes is depicted in the last line of table 10 and 11.

The complete mapping of Code Group to Scrambling Code, Midamble Codes and t_{Offset} is depicted in table 9, cf. also S1.31.

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}	

Table 9 Mapping scheme for Cell Parameters, Code Groups, Scrambling Codes, Midambles and t_{Offset}.
For basic midamble codes m_P cf.S1.21, section '7.2.3.1 & 7.2.3.2 Midamble Sequences'.
For CELL PARAMETERS also cf. S1.31 (S1.25).

The following subchapters Code allocation for case 1 and 2 and Code allocation for case 3 are referring to the three cases of PSCH/CCPCH usage as described in S1.21 section 7.4.

7.2.1 Code allocation for case 1 and 2

In table 10 the 32 sequences used in the cases 1 and 2 of PSCH/CCPCH scheme are listed. Again, these are used to encode the 32 different code groups.

It should be mentioned that the sequences used here can be derived from FDD sequences by puncturing every 2^{nd} position, thus a UE can use same database for FDD and TDD.

Code Group	Secondary SCH Code Position								Associated t_{Offset}
	#1	#2	#3	#4	#5	#6	#7	#8	
Group1	C_1	C_2	C_6	C_{15}	C_8	C_7	C_3	C_{11}	t_0
Group2	C_1	C_9	C_{10}	C_{13}	C_{11}	C_3	C_2	C_{16}	t_1
Group 3	C_1	C_{16}	C_{14}	C_{11}	C_{14}	C_{16}	C_1	C_4	t_2
Group 4	C_1	C_6	C_1	C_9	C_{17}	C_{12}	C_{17}	C_9	t_3
Group 5	C_1	C_{13}	C_5	C_7	C_3	C_8	C_{16}	C_{14}	t_4
Group 6	C_1	C_3	C_9	C_5	C_6	C_4	C_{15}	C_2	t_5
Group 7	C_1	C_{10}	C_{13}	C_3	C_9	C_{17}	C_{14}	C_7	t_6
Group 8	C_1	C_{17}	C_{17}	C_1	C_{12}	C_1	C_{13}	C_{12}	t_7
Group 9	C_1	C_7	C_4	C_{16}	C_{15}	C_9	C_{12}	C_{17}	t_8
Group 10	C_1	C_{14}	C_8	C_{14}	C_1	C_5	C_{11}	C_5	t_9
Group 11	C_1	C_4	C_{12}	C_{12}	C_4	C_1	C_{10}	C_{10}	t_{10}
Group 12	C_1	C_{11}	C_{16}	C_{10}	C_7	C_{14}	C_9	C_{15}	t_{11}
Group 13	C_1	C_1	C_3	C_8	C_{10}	C_{10}	C_8	C_3	t_{12}
Group 14	C_1	C_8	C_7	C_6	C_{13}	C_6	C_7	C_8	t_{13}
Group 15	C_1	C_{15}	C_{11}	C_4	C_{16}	C_2	C_6	C_{13}	t_{14}
Group 16	C_1	C_5	C_{15}	C_2	C_2	C_{15}	C_5	C_1	t_{15}
Group 17	C_1	C_{12}	C_2	C_{17}	C_5	C_{11}	C_4	C_6	t_{16}
Group 18	C_2	C_{11}	C_{14}	C_4	C_{10}	C_1	C_{15}	C_8	t_{17}
Group 19	C_2	C_1	C_1	C_2	C_{13}	C_{14}	C_{14}	C_{13}	t_{18}
Group 20	C_2	C_8	C_5	C_{17}	C_{16}	C_{10}	C_{13}	C_1	t_{19}
Group 21	C_2	C_{15}	C_9	C_{15}	C_2	C_6	C_{12}	C_6	t_{20}
Group 22	C_2	C_5	C_{13}	C_{13}	C_5	C_2	C_{11}	C_{11}	t_{21}
Group 23	C_2	C_{12}	C_{17}	C_{11}	C_8	C_{15}	C_{10}	C_{16}	t_{22}
Group 24	C_2	C_2	C_4	C_9	C_{11}	C_{11}	C_9	C_4	t_{23}
Group 25	C_2	C_9	C_8	C_7	C_{14}	C_7	C_8	C_9	t_{24}
Group 26	C_2	C_{16}	C_{12}	C_5	C_{17}	C_3	C_7	C_{14}	t_{25}
Group 27	C_2	C_6	C_{16}	C_3	C_3	C_{16}	C_6	C_2	t_{26}
Group 28	C_2	C_{13}	C_3	C_1	C_6	C_{12}	C_5	C_7	t_{27}
Group 29	C_2	C_3	C_7	C_{16}	C_9	C_8	C_4	C_{12}	t_{28}
Group 30	C_2	C_{10}	C_{11}	C_{14}	C_{12}	C_4	C_3	C_{17}	t_{29}
Group 31	C_2	C_{17}	C_{15}	C_{12}	C_{15}	C_{17}	C_2	C_5	t_{30}
Group 32	C_2	C_7	C_2	C_{10}	C_1	C_{13}	C_1	C_{10}	t_{31}
Frame position	Frame #1		Frame #2		Frame #3		Frame #4		

Table 10 Spreading Code allocation for Secondary SCH Code, case 2) of PSCH/CCPCH scheme

7.2.2 Code allocation for case 3

In table 11 the 256 sequences used in case 3 of PSCH/CCPCH scheme are listed. In addition to the information on code group three bits from SCH transport channel are transmitted to the UE with these codes.

<Editors note: The usage of CCPCH pointing is for further study (cf. TDoc R1#2(99) 74)>

Code Group	Secondary PSCH Code at Position								Additional Bits from SCH Transport Channel	Associated t_{Offset}
	#1	#2	#3	#4	#5	#6	#7	#8		
Group 1	C2	C14	C6	C8	C4	C9	C17	C15	000	t_0
	C2	C4	C10	C6	C7	C5	C16	C3	001	
	C3	C3	C5	C10	C12	C12	C10	C5	010	
	C3	C10	C9	C8	C15	C8	C9	C10	011	
	C3	C17	C13	C6	C1	C4	C8	C15	100	
	C3	C7	C17	C4	C4	C17	C7	C3	101	
	C3	C14	C4	C2	C7	C13	C6	C8	110	
	C3	C4	C8	C17	C10	C9	C5	C13	111	
Group 2	C3	C11	C12	C15	C13	C5	C4	C1	000	t_1
	C3	C1	C16	C13	C16	C1	C3	C6	001	
	C3	C8	C3	C11	C2	C14	C2	C11	010	
	C3	C15	C7	C9	C5	C10	C1	C16	011	
	C3	C5	C11	C7	C8	C6	C17	C4	100	
	C3	C12	C15	C5	C11	C2	C16	C9	101	
	C3	C2	C2	C3	C14	C15	C15	C14	110	
	C3	C9	C6	C1	C17	C11	C14	C2	111	
Group 3	C3	C16	C10	C16	C3	C7	C13	C7	000	t_2
	C3	C6	C14	C14	C6	C3	C12	C12	001	
	C3	C13	C1	C12	C9	C16	C11	C17	010	
	C4	C12	C13	C16	C14	C6	C5	C2	011	
	C4	C2	C17	C14	C17	C2	C4	C7	100	
	C4	C9	C4	C12	C3	C15	C3	C12	101	
	C4	C16	C8	C10	C6	C11	C2	C17	110	
	C4	C6	C12	C8	C9	C7	C1	C5	111	
Group 4	C4	C13	C16	C6	C12	C3	C17	C10	000	t_3
	C4	C3	C3	C4	C15	C16	C16	C15	001	
	C4	C10	C7	C2	C1	C12	C15	C3	010	
	C4	C17	C11	C17	C4	C8	C14	C8	011	
	C4	C7	C15	C15	C7	C4	C13	C13	100	
	C4	C14	C2	C13	C10	C17	C12	C1	101	
	C4	C4	C6	C11	C13	C13	C11	C6	110	
	C4	C11	C10	C9	C16	C9	C10	C11	111	
Group 5	C4	C1	C14	C7	C2	C5	C9	C16	000	t_4
	C4	C8	C1	C5	C5	C1	C8	C4	001	
	C4	C15	C5	C3	C8	C14	C7	C9	010	
	C4	C5	C9	C1	C11	C10	C6	C14	011	
	C5	C4	C4	C5	C16	C17	C17	C16	100	
	C5	C11	C8	C3	C2	C13	C16	C4	101	
	C5	C1	C12	C1	C5	C9	C15	C9	110	
	C5	C8	C16	C16	C8	C5	C14	C14	111	
Group 6	C5	C15	C3	C14	C11	C1	C13	C2	000	t_5
	C5	C5	C7	C12	C14	C14	C12	C7	001	
	C5	C12	C11	C10	C17	C10	C11	C12	010	
	C5	C2	C15	C8	C3	C6	C10	C17	011	
	C5	C9	C2	C6	C6	C2	C9	C5	100	
	C5	C16	C6	C4	C9	C15	C8	C10	101	
	C5	C6	C10	C2	C12	C11	C7	C15	110	
	C5	C13	C14	C17	C15	C7	C6	C3	111	
Group7	C5	C3	C1	C15	C1	C3	C5	C8	000	t_6
	C5	C10	C5	C13	C4	C16	C4	C13	001	
	C5	C17	C9	C11	C7	C12	C3	C1	010	
	C5	C7	C13	C9	C10	C8	C2	C6	011	
	C5	C14	C17	C7	C13	C4	C1	C11	100	
	C6	C13	C12	C11	C1	C11	C12	C13	101	
	C6	C3	C16	C9	C4	C7	C11	C1	110	

	C6	C10	C3	C7	C7	C3	C10	C6	111	
Group 8	C6	C17	C7	C5	C10	C16	C9	C11	000	t_7
	C6	C7	C11	C3	C13	C12	C8	C16	001	
	C6	C14	C15	C1	C16	C8	C7	C4	010	
	C6	C4	C2	C16	C2	C4	C6	C9	011	
	C6	C11	C6	C14	C5	C17	C5	C14	100	
	C6	C1	C10	C12	C8	C13	C4	C2	101	
	C6	C8	C14	C10	C11	C9	C3	C7	110	
	C6	C15	C1	C8	C14	C5	C2	C12	111	
Group 9	C6	C5	C5	C6	C17	C1	C1	C17	000	t_8
	C6	C12	C9	C4	C3	C14	C17	C5	001	
	C6	C2	C13	C2	C6	C10	C16	C10	010	
	C6	C9	C17	C17	C9	C6	C15	C15	011	
	C6	C16	C4	C15	C12	C2	C14	C3	100	
	C6	C6	C8	C13	C15	C15	C13	C8	101	
	C7	C5	C3	C17	C3	C5	C7	C10	110	
	C7	C12	C7	C15	C6	C1	C6	C15	111	
Group 10	C7	C2	C11	C13	C9	C14	C5	C3	000	t_9
	C7	C9	C15	C11	C12	C10	C4	C8	001	
	C7	C16	C2	C9	C15	C6	C3	C13	010	
	C7	C6	C6	C7	C1	C2	C2	C1	011	
	C7	C13	C10	C5	C4	C15	C1	C6	100	
	C7	C3	C14	C3	C7	C11	C17	C11	101	
	C7	C10	C1	C1	C10	C7	C16	C16	110	
	C7	C17	C5	C16	C13	C3	C15	C4	111	
Group 11	C7	C7	C9	C14	C16	C16	C14	C9	000	t_{10}
	C7	C14	C13	C12	C2	C12	C13	C14	001	
	C7	C4	C17	C10	C5	C8	C12	C2	010	
	C7	C11	C4	C8	C8	C4	C11	C7	011	
	C7	C1	C8	C6	C11	C17	C10	C12	100	
	C7	C8	C12	C4	C14	C13	C9	C17	101	
	C7	C15	C16	C2	C17	C9	C8	C5	110	
	C8	C14	C11	C6	C5	C16	C2	C7	111	
Group 12	C8	C4	C15	C4	C8	C12	C1	C12	000	t_{11}
	C8	C11	C2	C2	C11	C8	C17	C17	001	
	C8	C1	C6	C17	C14	C4	C16	C5	010	
	C8	C8	C10	C15	C17	C17	C15	C10	011	
	C8	C15	C14	C13	C3	C13	C14	C15	100	
	C8	C5	C1	C11	C6	C9	C13	C3	101	
	C8	C12	C5	C9	C9	C5	C12	C8	110	
	C8	C2	C9	C7	C12	C1	C11	C13	111	
Group 13	C8	C9	C13	C5	C15	C14	C10	C1	000	t_{12}
	C8	C16	C17	C3	C1	C10	C9	C6	001	
	C8	C6	C4	C1	C4	C6	C8	C11	010	
	C8	C13	C8	C16	C7	C2	C7	C16	011	
	C8	C3	C12	C14	C10	C15	C6	C4	100	
	C8	C10	C16	C12	C13	C11	C5	C9	101	
	C8	C17	C3	C10	C16	C7	C4	C14	110	
	C8	C7	C7	C8	C2	C3	C3	C2	111	
Group 14	C9	C6	C2	C12	C7	C10	C14	C4	000	t_{13}
	C9	C13	C6	C10	C10	C6	C13	C9	001	
	C9	C3	C10	C8	C13	C2	C12	C14	010	
	C9	C10	C14	C6	C16	C15	C11	C2	011	
	C9	C17	C1	C4	C2	C11	C10	C7	100	
	C9	C7	C5	C2	C5	C7	C9	C12	101	
	C9	C14	C9	C17	C8	C3	C8	C17	110	
	C9	C4	C13	C15	C11	C16	C7	C5	111	
Group 15	C9	C11	C17	C13	C14	C12	C6	C10	000	t_{14}
	C9	C1	C4	C11	C17	C8	C5	C15	001	

	C9	C8	C8	C9	C3	C4	C4	C3	010	
	C9	C15	C12	C7	C6	C17	C3	C8	011	
	C9	C5	C16	C5	C9	C13	C2	C13	100	
	C9	C12	C3	C3	C12	C9	C1	C1	101	
	C9	C2	C7	C1	C15	C5	C17	C6	110	
	C9	C9	C11	C16	C1	C1	C16	C11	111	
Group 16	C9	C16	C15	C14	C4	C14	C15	C16	000	t_{15}
	C10	C15	C10	C1	C9	C4	C9	C1	001	
	C10	C5	C14	C16	C12	C17	C8	C6	010	
	C10	C12	C1	C14	C15	C13	C7	C11	011	
	C10	C2	C5	C12	C1	C9	C6	C16	100	
	C10	C9	C9	C10	C4	C5	C5	C4	101	
	C10	C16	C13	C8	C7	C1	C4	C9	110	
	C10	C6	C17	C6	C10	C14	C3	C14	111	
Group 17	C10	C13	C4	C4	C13	C10	C2	C2	000	t_{16}
	C10	C3	C8	C2	C16	C6	C1	C7	001	
	C10	C10	C12	C17	C2	C2	C17	C12	010	
	C10	C17	C16	C15	C5	C15	C16	C17	011	
	C10	C7	C3	C13	C8	C11	C15	C5	100	
	C10	C14	C7	C11	C11	C7	C14	C10	101	
	C10	C4	C11	C9	C14	C3	C13	C15	110	
	C10	C11	C15	C7	C17	C16	C12	C3	111	
Group 18	C10	C1	C2	C5	C3	C12	C11	C8	000	t_{17}
	C10	C8	C6	C3	C6	C8	C10	C13	001	
	C11	C7	C1	C7	C11	C15	C4	C15	010	
	C11	C14	C5	C5	C14	C11	C3	C3	011	
	C11	C4	C9	C3	C17	C7	C2	C8	100	
	C11	C11	C13	C1	C3	C3	C1	C13	101	
	C11	C1	C17	C16	C6	C16	C17	C1	110	
	C11	C8	C4	C14	C9	C12	C16	C6	111	
Group 19	C11	C15	C8	C12	C12	C8	C15	C11	000	t_{18}
	C11	C5	C12	C10	C15	C4	C14	C16	001	
	C11	C12	C16	C8	C1	C17	C13	C4	010	
	C11	C2	C3	C6	C4	C13	C12	C9	011	
	C11	C9	C7	C4	C7	C9	C11	C14	100	
	C11	C16	C11	C2	C10	C5	C10	C2	101	
	C11	C6	C15	C17	C13	C1	C9	C7	110	
	C11	C13	C2	C15	C16	C14	C8	C12	111	
Group 20	C11	C3	C6	C13	C2	C10	C7	C17	000	t_{19}
	C11	C10	C10	C11	C5	C6	C6	C5	001	
	C11	C17	C14	C9	C8	C2	C5	C10	010	
	C12	C16	C9	C13	C13	C9	C16	C12	011	
	C12	C6	C13	C11	C16	C5	C15	C17	100	
	C12	C13	C17	C9	C2	C1	C14	C5	101	
	C12	C3	C4	C7	C5	C14	C13	C10	110	
	C12	C10	C8	C5	C8	C10	C12	C15	111	
Group 21	C12	C17	C12	C3	C11	C6	C11	C3	000	t_{20}
	C12	C7	C16	C1	C14	C2	C10	C8	001	
	C12	C14	C3	C16	C17	C15	C9	C13	010	
	C12	C4	C7	C14	C3	C11	C8	C1	011	
	C12	C11	C11	C12	C6	C7	C7	C6	100	
	C12	C1	C15	C10	C9	C3	C6	C11	101	
	C12	C8	C2	C8	C12	C16	C5	C16	110	
	C12	C15	C6	C6	C15	C12	C4	C4	111	
Group 22	C12	C5	C10	C4	C1	C8	C3	C9	000	t_{21}
	C12	C12	C14	C2	C4	C4	C2	C14	001	
	C12	C2	C1	C17	C7	C17	C1	C2	010	
	C12	C9	C5	C15	C10	C13	C17	C7	011	
	C13	C8	C17	C2	C15	C3	C11	C9	100	

	C13	C15	C4	C17	C1	C16	C10	C14	101	
	C13	C5	C8	C15	C4	C12	C9	C2	110	
	C13	C12	C12	C13	C7	C8	C8	C7	111	
Group 23	C13	C2	C16	C11	C10	C4	C7	C12	000	t_{22}
	C13	C9	C3	C9	C13	C17	C6	C17	001	
	C13	C16	C7	C7	C16	C13	C5	C5	010	
	C13	C6	C11	C5	C2	C9	C4	C10	011	
	C13	C13	C15	C3	C5	C5	C3	C15	100	
	C13	C3	C2	C1	C8	C1	C2	C3	101	
	C13	C10	C6	C16	C11	C14	C1	C8	110	
	C13	C17	C10	C14	C14	C10	C17	C13	111	
Group 24	C13	C7	C14	C12	C17	C6	C16	C1	000	t_{23}
	C13	C14	C1	C10	C3	C2	C15	C6	001	
	C13	C4	C5	C8	C6	C15	C14	C11	010	
	C13	C11	C9	C6	C9	C11	C13	C16	011	
	C13	C1	C13	C4	C12	C7	C12	C4	100	
	C14	C17	C8	C8	C17	C14	C6	C6	101	
	C14	C7	C12	C6	C3	C10	C5	C11	110	
	C14	C14	C16	C4	C6	C6	C4	C16	111	
Group 25	C14	C4	C3	C2	C9	C2	C3	C4	000	t_{24}
	C14	C11	C7	C17	C12	C15	C2	C9	001	
	C14	C1	C11	C15	C15	C11	C1	C14	010	
	C14	C8	C15	C13	C1	C7	C17	C2	011	
	C14	C15	C2	C11	C4	C3	C16	C7	100	
	C14	C5	C6	C9	C7	C16	C15	C12	101	
	C14	C12	C10	C7	C10	C12	C14	C17	110	
	C14	C2	C14	C5	C13	C8	C13	C5	111	
Group 26	C14	C9	C1	C3	C16	C4	C12	C10	000	t_{25}
	C14	C16	C5	C1	C2	C17	C11	C15	001	
	C14	C6	C9	C16	C5	C13	C10	C3	010	
	C14	C13	C13	C14	C8	C9	C9	C8	011	
	C14	C3	C17	C12	C11	C5	C8	C13	100	
	C14	C10	C4	C10	C14	C1	C7	C1	101	
	C15	C9	C16	C14	C2	C8	C1	C3	110	
	C15	C16	C3	C12	C5	C4	C17	C8	111	
Group 27	C15	C6	C7	C10	C8	C17	C16	C13	000	t_{26}
	C15	C13	C11	C8	C11	C13	C15	C1	001	
	C15	C3	C15	C6	C14	C9	C14	C6	010	
	C15	C10	C2	C4	C17	C5	C13	C11	011	
	C15	C17	C6	C2	C3	C1	C12	C16	100	
	C15	C7	C10	C17	C6	C14	C11	C4	101	
	C15	C14	C14	C15	C9	C10	C10	C9	110	
	C15	C4	C1	C13	C12	C6	C9	C14	111	
Group 28	C15	C11	C5	C11	C15	C2	C8	C2	000	t_{27}
	C15	C1	C9	C9	C1	C15	C7	C7	001	
	C15	C8	C13	C7	C4	C11	C6	C12	010	
	C15	C15	C17	C5	C7	C7	C5	C17	011	
	C15	C5	C4	C3	C10	C3	C4	C5	100	
	C15	C12	C8	C1	C13	C16	C3	C10	101	
	C15	C2	C12	C16	C16	C12	C2	C15	110	
	C16	C1	C7	C3	C4	C2	C13	C17	111	
Group 29	C16	C8	C11	C1	C7	C15	C12	C5	000	t_{28}
	C16	C15	C15	C16	C10	C11	C11	C10	001	
	C16	C5	C2	C14	C13	C7	C10	C15	010	
	C16	C12	C6	C12	C16	C3	C9	C3	011	
	C16	C2	C10	C10	C2	C16	C8	C8	100	
	C16	C9	C14	C8	C5	C12	C7	C13	101	
	C16	C16	C1	C6	C8	C8	C6	C1	110	
	C16	C6	C5	C4	C11	C4	C5	C6	111	

Group 30	C16	C13	C9	C2	C14	C17	C4	C11	000	t_{29}
	C16	C3	C13	C17	C17	C13	C3	C16	001	
	C16	C10	C17	C15	C3	C9	C2	C4	010	
	C16	C17	C4	C13	C6	C5	C1	C9	011	
	C16	C7	C8	C11	C9	C1	C17	C14	100	
	C16	C14	C12	C9	C12	C14	C16	C2	101	
	C16	C4	C16	C7	C15	C10	C15	C7	110	
	C16	C11	C3	C5	C1	C6	C14	C12	111	
Group 31	C17	C10	C15	C9	C6	C13	C8	C14	000	t_{30}
	C17	C17	C2	C7	C9	C9	C7	C2	001	
	C17	C7	C6	C5	C12	C5	C6	C7	010	
	C17	C14	C10	C3	C15	C1	C5	C12	011	
	C17	C4	C14	C1	C1	C14	C4	C17	100	
	C17	C11	C1	C16	C4	C10	C3	C5	101	
	C17	C1	C5	C14	C7	C6	C2	C10	110	
	C17	C8	C9	C12	C10	C2	C1	C15	111	
Group 32	C17	C15	C13	C10	C1	C15	C17	C3	000	t_{31}
	C17	C5	C17	C8	C16	C11	C16	C8	001	
	C17	C12	C4	C6	C2	C7	C15	C13	010	
	C17	C2	C8	C4	C5	C3	C14	C1	011	
	C17	C9	C12	C2	C8	C16	C13	C6	100	
	C17	C16	C16	C17	C11	C12	C12	C11	101	
	C17	C6	C3	C15	C14	C8	C11	C16	110	
	C17	C13	C7	C13	C17	C4	C10	C4	111	
Frame position	Frame #1		Frame #2		Frame #3		Frame #4			

Table 11 Spreading Code allocation for Secondary SCH Code, case 3) of PSCH/CCPCH scheme

6.6 Synchronisation and Cell Search Procedures

6.6.1 Cell Search

<Editors Note: It is approved according to TDoc TSGR1-(99)075 to have the following basic parameters:

- Length 256 chips primary and secondary synchronisation sequences
- SF of CCPCH <=16
- Usage of t_{off} and t_{gap}
- CCPCH pointing is for further study (cf. TDoc R1#2(99) 74)

>

During the initial cell search, the UE searches for a cell. It then determines the midamble, the downlink ~~spreading~~ scrambling code and frame synchronisation of that cell. The initial cell search uses the Physical S~~s~~ynchronisation C~~c~~hannel (PSCH) described in S1.21. Generation of synchronisation codes is described in S1.23.

This initial cell search is carried out in three steps:

Step 1: Slot synchronisation

During the first step of the initial cell search procedure the UE uses the primary synchronisation code C_P to acquire slot synchronisation to the strongest cell. Furthermore, frame synchronisation with the uncertainty of 1 out of 2 is obtained in this step. A single matched filter (or any similar device) is used for this purpose, that is matched to the primary synchronisation code c_p which is common to all cells. The procedure is according to the description for the FDD mode in S1.14.

Step 2: Frame synchronisation and code-group identification

The Step 2 is described for Case 2) (cf. S1.21, chapter '7.4 The Physical Synchronisation Channel'), where PSCH and CCPCH are in Timeslot k and k+8 with k=0…7.

~~During the second step of the initial cell search procedure, the UE uses the secondary synchronisation code to find frame synchronisation and identify the code and midamble group of the cell as well as the BCH structure and the time offset t_{offset}(see S1.21). This is done by correlating the received signal at the positions of the Secondary Synchronisation Code with all possible Secondary Synchronisation Codes. After four frames a sequence of eight codes is available providing all necessary information described above. The same Secondary Synchronisation Codes as in FDD are used for this purpose.~~

During the second step of the initial cell search procedure, the UE uses the sequence of Secondary Synchronisation Codes $C_{S,i}$ to find frame synchronisation and identify one of 32 code groups. Each code group is linked to a specific t_{Offset}, thus to a specific frame timing, and is containing 4 specific scrambling codes. Each scrambling code is associated with a specific short and long basic midamble code.

The detection of secondary synchronisation sequence is done by correlating the received signal at the positions of the Secondary Synchronisation Code with all possible sequences of Secondary Synchronisation Codes, similar to FDD Mode. After four frames a sequence of eight codes is available providing all necessary information described above. Nevertheless, it should be noted that due to the high coding gain already three codes show the sequence unambiguously, i.e. a UE can determine the whole sequence when three codes have been received. The Codes and sequences used for secondary SCH are depicted in table 9 of S1.23, chapter '7 Synchronisation Codes'.

Step 3: Scrambling ~~Spreading~~ code identification

The Step 3 is described for Case 2) (cf. S1.21, chapter '7.4 The Physical Synchronisation Channel'), where PSCH and CCPCH are in Timeslot k and k+8 with k=0…7.

During the third and last step of the initial cell-search procedure, the UE determines the exact basic midamble code and the accompanying ~~spreading~~ scrambling code used by the found cell. They are identified through correlation over the CCPCH with all four midambles of the code group identified in the second step, thus third step is a one out of four decision. Cf. also table 9 in chapter '7.2 Code Allocation' of S1.23, where this step can bee seen as deriving the CELL PARAMETER when already knowing the Code Group.

This step is taking into account that the CCPCH containing the BCH is transmitted using the first spreading code ($a_{Q=16}^{(h=1)}$ in figure 2 of S1.23 section '6.2 Spreading Codes') and using the first midamble $\mathbf{m}^{(1)}$ (derived from basic midamble code $\mathbf{m}_P$, cf. S1.21 section '7.2.3 Training sequences for spread bursts'). Thus CCPCH code and midamble can be immediately derived when knowing scrambling code and basic midamble code.