3GPP TSG RAN WG1 (Radio) Meeting #10
Beijing, China. 18-21JAN 2000

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25.221 CR 003r2 Current Version: V3.1.0

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

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Proposed change affects: *(at least one should be marked with an X)*	(U)SIM		ME	X	UTRAN / Radio	X	Core Network	

Source: Texas Instruments **Date:** 13 Jan 2000

Subject: Cycling of cell parameters

Work item: TS25.221

Category:				**Release:**	
	F	Correction		Phase 2	
	A	Corresponds to a correction in an earlier release		Release 96	
(only one category	B	Addition of feature		Release 97	
shall be marked	C	Functional modification of feature	X	Release 98	
with an X)	D	Editorial modification		Release 99	X
				Release 00	

Reason for change: Improvement in performance by increased diversity and reduction of false paths.

Clauses affected: 5.3.4

Other specs affected:				
	Other 3G core specifications	X	→ List of CRs:	25.223-CR002r3, 25.224-CR003r2
	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:

5.3.4 The physical synchronisation channel (PSCH)

In TDD mode code group of a cell can be derived from the synchronisation channel. Additional information, received from higher layers on SCH transport channel, is also transmitted to the UE in PSCH in case 3 from below. In order not to limit the uplink/downlink asymmetry the PSCH is mapped on one or two downlink slots per frame only.

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

Case 1) PSCH and P-CCPCH allocated in TS#k, k=0….14

Case 2) PSCH allocated in two TS: TS#k and TS#k+8, k=0…6; P-CCPCH allocated in TS#k.

Case 3) PSCH allocated in two TS, TS#k and TS#k+8, k=0…6, and the P-CCPCH allocated in TS#i, i=0…6, pointed by PSCH. Pointing is determined via the SCH from the 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.

Due to this PSCH scheme, the position of PCCPCH is known from the PSCH.

Figure 15 is an example for transmission of PSCH, k=0, of Case 2 or Case 3.

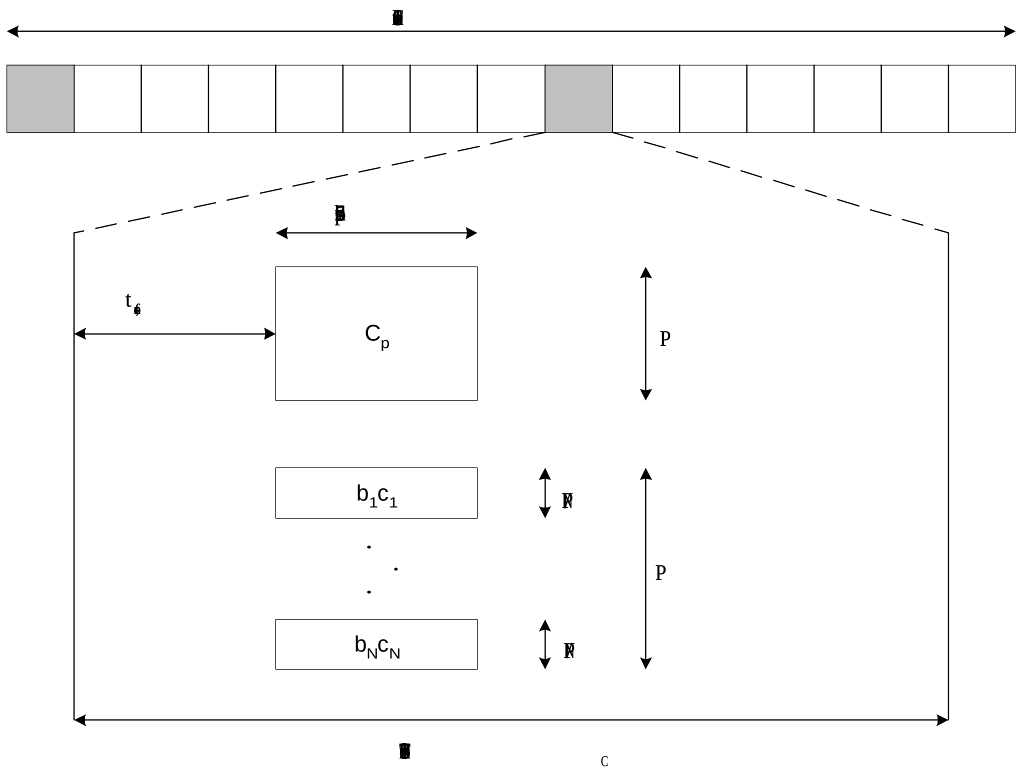

Figure 15: Scheme for Physical Synchronisation channel PSCH consisting of one primary sequence C_p and N=3 parallel secondary sequences in slot k and k+8

(example for k=0 in Case 2 or Case 3)

As depicted in figure 15, the PSCH consists of a primary and three secondary code sequences with 256 chips length. The primary and secondary code sequences are defined in [8] chapter 7 'Synchronisation codes'. The secondary codes are transmitted either in the I channel or the Q channel, depending on the code group.

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 can arise. The time offset t_{offset} enables the system to overcome the capture effect.

The time offset t_{offset} is one of 32 values, depending on the cell parameter, thus on the code group of the cell, cf. 'table 7 Mapping scheme for Cell Parameters, Code Groups, Scrambling Codes, Midambles and t_{offset}' in [8]. Note that the cell parameter will change from frame to frame, cf. 'Table 8 Alignment of cell parameter cycling and system frame number' in [8], but the cell will belong to only one code group and thus have one time offset t_{offset}. The exact value for t_{offset}, regarding column 'Associated t_{offset}' in table 7 in [8] is given by:

$$t_{offset,n} = n \cdot T_c \left\lfloor \frac{2560 - 96 - 256}{31} \right\rfloor$$
$$= n \cdot 71 T_c \; ; \quad n = 0, \ldots, 31$$

Please note that $\lfloor x \rfloor$ denotes the largest integer number less or equal to x and that T_c denotes the chip duration.

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25.223	**CR**	**002r3**	Current Version:	V3.10

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

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Proposed change affects: *(at least one should be marked with an X)*	(U)SIM		ME	X	UTRAN / Radio	X	Core Network	

Source:	Texas Instruments	**Date:**	13 Jan 2000
Subject:	Cycling of cell parameters		
Work item:	TS25.223		

Category:	F	Correction		**Release:**	Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature			Release 97	
shall be marked	C	Functional modification of feature	X		Release 98	
with an X)	D	Editorial modification			Release 99	X
					Release 00	

Reason for change:	Improvement in performance by increased diversity and reduction of false paths.
Clauses affected:	7.2, 7.3

Other specs affected:	Other 3G core specifications	X	→ List of CRs:	25.221-CR003r2, 25.224-CR003r2
	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:	

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].

Note that in the Tables 4-6 corresponding to Cases 1,2, and 3, respectively, Frame 1 implies the frame with an odd SFN and Frame 2 implies the frame with an even SFN.

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’.

Each cell shall cycle through two sets of cell parameters in a code group with the cell parameters changing each frame. Table 8 shows how the cell parameters are cycled according to the SFN.

Table 8 Alignment of cell parameter cycling and SFN

Initial Cell Parameter Assignment	**Code Group**	**Cell Parameter used when SFN mod 2 = 0**	**Cell Parameter used when SFN mod 2 = 1**
0	Group 1	0	1
1		1	0
2		2	3
3		3	2
4	Group 2	4	5
5		5	4
6		6	7
7		7	6
. . . .			
124	Group 32	124	125
125		125	124
126		126	127
127		127	126

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Subject:	Cycling of cell parameters		
Work item:	TS25.224		

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shall be marked	C	Functional modification of feature	X		Release 98	
with an X)	D	Editorial modification			Release 99	X
					Release 00	

Reason for change:	Improvement in performance by increased diversity and reduction of false paths.
Clauses affected:	4.4.1

Other specs affected:	Other 3G core specifications	X	→ List of CRs:	25.221-CR003r2, 25.223-CR002r3
	Other GSM core specifications		→ List of CRs:	
	MS test specifications		→ List of CRs:	
	BSS test specifications		→ List of CRs:	
	O&M specifications		→ List of CRs:	

Other comments:	

4.4.1 Cell Search

During the initial cell search, the UE searches for a cell. It then determines the midamble, the downlink scrambling code and frame synchronisation of that cell. The initial cell search uses the Physical Synchronisation Channel (PSCH) described in [8]. The generation of synchronisation codes is described in [10].

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 which is common to all cells.

Step 2: Frame synchronisation and code-group identification

During the second step of the initial cell search procedure, the UE uses the modulated Secondary Synchronisation Codes to find frame synchronisation and identify one out 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.

In Cases 2 and 3 it is required to detect the position of the next synchronization slots. To detect the position of the next synchronization slots, the primary synchronization code is correlated with the received signal at offsets of 7 and 8 time slots from the position of the primary code that was detected in Step 1.

Then, the received signal at the positions of the synchronization codes is correlated with the primary synchronization Code C_p and the secondary synchronization codes $\{C_0,\ldots,C_{15}\}$. Note that the correlations can be performed coherently over M time slots, where at each slot a phase correction is provided by the correlation with the primary code. The minimal number of time slots is M=1, and the performance improves with increasing M.

Step 3: Scrambling code identification

During the third and last step of the initial cell-search procedure, the UE determines the exact basic midamble code and the accompanying scrambling code used by the found cell. They are identified through correlation over the P-CCPCH with all four midambles of the code group identified in the second step . Thus the third step is a one out of four decision. This step is taking into account that the P-CCPCH containing the BCH is transmitted using the first channelization code ($a_{Q=16}^{(h=1)}$ in [10]) and using the first midamble $\mathbf{m}^{(1)}$ (derived from basic midamble code $\mathbf{m}_P$ in [8]). Thus P-CCPCH code and midamble can be immediately derived when knowing scrambling code and basic midamble code. <u>Note that the cell parameters change from frame to frame, cf. 'Table 8 Alignment of cell parameter cycling and system frame number' in [10].</u>