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

Document R1-99K68
e.g. for 3GPP use the format TP-99xxx or for SMG, use the format P-99-xxx

CHANGE REQUEST

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25.222	**CR**	**015**	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:	TAG-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	UTRAN / Radio	Core Network
	X	X	

Source: Siemens, LGIC **Date:** 1999-12-02

Subject: TFCI coding and mapping in TDD

Work item:

Category: *(only one category shall be marked with an X)*

F	Correction	X
A	Corresponds to a correction in an earlier release	
B	Addition of feature	
C	Functional modification of feature	
D	Editorial modification	

Release:

Phase 2	
Release 96	
Release 97	
Release 98	
Release 99	X
Release 00	

Reason for change:
Description of TFCI coding for normal and short length cases is quite different and does not specify coding process completely. Also dependency on OVSF sequences defined externally which should be removed.
Remove narrative text in 4.3.1
Change 4.3.1.1 to more specification-like form
Add 4.3.1.2.1, 4.3.1.2.2 section headings to make clearer different rules
Change order of basis vectors and input bit positions in tables 4.3.1-1 and 4.3.1-2 to correspond with changes in FDD TFCI coding.
Added new section 4.3.1.3 to specify TFCI mapping.

Clauses affected: 4.2.13, 4.3.1, 4.3.1.1, 4.3.1.2, 4.3.1.3

Other specs affected:

Other 3G core specifications		→ List of CRs:	
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: Due to a limitation of MS-Word the original 4.3.1-1 cannot be deleted in markup mode.

4.2.13 Transport format detection

Transport format detection can be performed both with and without Transport Format Combination Indicator (TFCI). If a TFCI is transmitted, the receiver detects the transport format combination from the TFCI. When no TFCI is transmitted, so called blind transport format detection may be~~is~~ used, i.e. the receiver side uses the possible transport format combinations as a priori information.

4.2.13.1 Blind transport format detection

Blind transport format detection may be performed in the receiver by trying all possible combinations of the transport format.

4.2.13.2 Explicit transport format detection based on TFCI

4.2.13.2.1 Transport Format Combination Indicator (TFCI)

The Transport Format Combination Indicator (TFCI) informs the receiver of the transport format combination of the CCTrCHs . As soon as the TFCI is detected, the transport format combination, and hence the individual transport channels' transport formats are known, and decoding of the transport channels can be performed.

4.3 Coding for layer 1 control

4.3.1 Coding of transport format combination indicator (TFCI)

~~The number of TFCI bits is variable and is set at the beginning of the call via higher layer signalling.~~ Encoding of the TFCI bits depends on the number of them. If there are 6-10 bits of TFCI the channel encoding is done as described in section 4.3.1.1. Also specific coding of less than 6 bits is possible as explained in section 4.3.1.2~~3~~. ~~For improved TFCI detection reliability repetition is used to increase the number of TFCI bits. Additionally, with any TFCI coding scheme it is assumed that in the receiver combining of two successive TFCI words will be performed if the shortest transmission time interval of any TrCH is at least 20 ms.~~

4.3.1.1 ~~Default TFCI word~~Coding of long TFCI lengths

The TFCI bits are encoded using a (32, 10) sub-code of the second order Reed-Muller code. The coding procedure is as shown in figure 4.3.3.1-1.

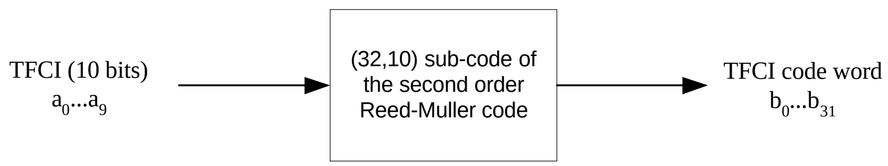

Figure 4.3.3.1-1: Channel coding of TFCI bits

TFCI is encoded by the (32,10) sub-code of second order Reed-Muller code. The code words of the (32,10) sub-code of second order Reed-Muller code are linear combination of some among 10 basis sequences~~: all 1's, 5 OVSF codes ($C_5(1)$, $C_5(2)$, $C_5(4)$, $C_5(8)$, $C_5(16)$), and 4 masks (Mask1, Mask2, Mask3, Mask4)~~. The basis~~4 mask~~ sequences are as follows in table 4.3.1-1.

Table 4.3.1-1: Basis~~Mask~~ sequences for (32,10) TFCI code

I	$M_{i,0}$	$M_{i,1}$	$M_{i,2}$	$M_{i,3}$	$M_{i,4}$	$M_{i,5}$	$M_{i,6}$	$M_{i,7}$	$M_{i,8}$	$M_{i,9}$
0	1	1	0	0	0	0	0	0	0	0
1	1	0	1	0	0	0	1	0	0	0
2	1	1	1	0	0	0	0	0	0	1
3	1	0	0	1	0	0	1	0	1	1
4	1	1	0	1	0	0	0	0	0	1
5	1	0	1	1	0	0	0	0	1	0
6	1	1	1	1	0	0	0	1	0	0
7	1	0	0	0	1	0	0	1	1	0
8	1	1	0	0	1	0	1	1	1	0
9	1	0	1	0	1	0	1	0	1	1
10	1	1	1	0	1	0	0	0	1	1
11	1	0	0	1	1	0	0	1	1	0
12	1	1	0	1	1	0	0	1	0	1
13	1	0	1	1	1	0	1	0	0	1
14	1	1	1	1	1	0	1	1	1	1
15	1	1	0	0	0	1	1	1	0	0
16	1	0	1	0	0	1	1	1	0	1
17	1	1	1	0	0	1	1	0	1	0
18	1	0	0	1	0	1	0	1	1	1
19	1	1	0	1	0	1	0	1	0	1
20	1	0	1	1	0	1	0	0	1	1
21	1	1	1	1	0	1	0	1	1	1
22	1	0	0	0	1	1	0	1	0	0
23	1	1	0	0	1	1	1	1	0	1
24	1	0	1	0	1	1	1	0	1	0
25	1	1	1	0	1	1	1	0	0	1
26	1	0	0	1	1	1	0	0	1	0
27	1	1	0	1	1	1	1	1	0	0
28	1	0	1	1	1	1	1	1	1	0
29	1	1	1	1	1	1	1	1	1	1
30	1	0	0	0	0	0	0	0	0	0
31	1	0	0	0	0	1	1	0	0	0

~~Mask 1~~	~~00101000011000111111000001110111~~
~~Mask 2~~	~~00000001110011010110110111000111~~
~~Mask 3~~	~~00001010111110010001101100101011~~
~~Mask 4~~	~~00011100001101110010111101010001~~

For TFCI~~information~~ bits a_0 , a_1 , a_2 , a_3 , a_4 , a_5 , a_6 , a_7 , a_8 , a_9 (a_0 is LSB and a_9 is MSB), the ~~encoder structure is as follows in figure 4-7.~~output code word bits b_i are given by:

$$b_i = \sum_{n=0}^{9} (a_n \times M_{i,n}) \bmod 2$$

where i=0…31. N_{TFCI}=32.

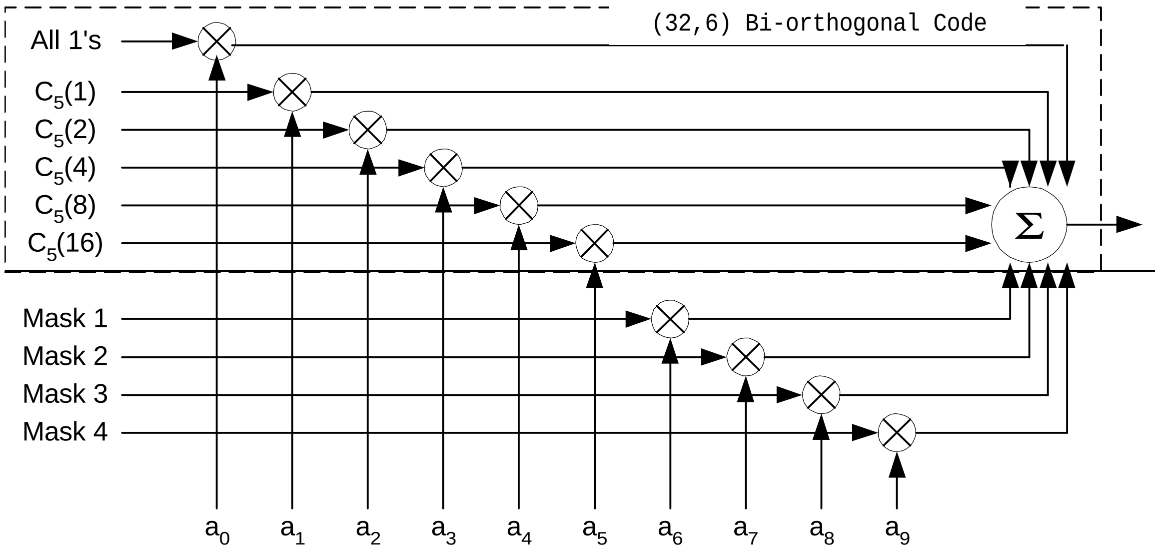

Figure 4-7: Encoder structure for (32,10) sub-code of second order Reed-Muller code

4.3.1.2 Coding of short TFCI lengths

4.3.1.2.1 Coding very short TFCIs by repetition

If the number of TFCI bits is 1 or 2, then repetition will be used for coding. In this case each bit is repeated to a total of 43 times giving 4-bit transmission (N_{TFCI}=4) for a single TFCI bit and 8-bit transmission (N_{TFCI}=8) for 2 TFCI bits. In the case of two TFCI bits denoted b_0 and b_1 the TFCI word shall be { $b_0, b_1, b_0, b_1, b_0, b_1, b_0, b_1$ }.

4.3.1.2.2 Coding short TFCIs using bi-orthogonal codes

If the number of TFCI bits is in the range of 3 to 5, then one word of the biorthogonal (16,5) block code will be used.

The code words of the biorthogonal (16, 5) code are from two mutually biorthogonal sets, $S_{C_4} = \{C_4(0), C_4(1),..., C_4(15)\}$ and its binary complement, $\bar{S}_{C_4} = \{\bar{C}_4(0), \bar{C}_4(1),..., \bar{C}_4(15)\}$. Words of set S_{C_4} are from the level 4 of the code three, which is generated, using the short code generation method defined in TS 25.223. The mapping of information bits to code words is shown in the table 4.3.1-2.

Table 4.3.1-2: Mapping of information bits to code words for biorthogonal (16, 5) code

Information bits	Code word
00000	$C_4(0)$
00001	$\overline{C_4(0)}$
00010	$C_4(1)$
...	...
11101	$\overline{C_4(14)}$
11110	$C_4(15)$
11111	$\overline{C_4(15)}$

If the number of TFCI bits is in the range 3 to 5 the TFCI bits are encoded using a (16, 5) bi-orthogonal (or first order Reed-Muller) code. The coding procedure is as shown in figure 4-8.

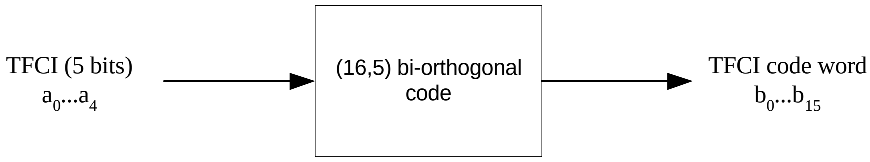

Figure 4-8: Channel coding of short length TFCI bits

The code words of the (16,5) bi-orthogonal code are linear combinations of 5 basis sequences as defined in table 4.3.1-2 below.

Table 4.3.1-2: Basis sequences for (16,5) TFCI code

i	$M_{i,0}$	$M_{i,1}$	$M_{i,2}$	$M_{i,3}$	$M_{i,4}$
0	1	1	0	0	0
1	1	0	1	0	0
2	1	1	1	0	0
3	1	0	0	1	0
4	1	1	0	1	0
5	1	0	1	1	0
6	1	1	1	1	0
7	1	0	0	0	1
8	1	1	0	0	1
9	1	0	1	0	1
10	1	1	1	0	1
11	1	0	0	1	1
12	1	1	0	1	1
13	1	0	1	1	1
14	1	1	1	1	1
15	1	0	0	0	0

For TFCI information bits a_0 , a_1 , a_2 , a_3 , a_4 (a_0 is LSB and a_4 is MSB), the), the output code word bits b_j are given by:

$$b_i = \sum_{n=0}^{4} (a_n \times M_{i,n}) \bmod 2$$

where i=0…15. N_{TFCI}=16.

4.3.1.3 Mapping of TFCI word

The mapping of the TFCI word to the TFCI bit positions in a timeslot shall be as follows.

Denote the number of bits in the TFCI word by N_{TFCI}, denote the code word bits by b_k where k=0… N_{TFCI}-1.

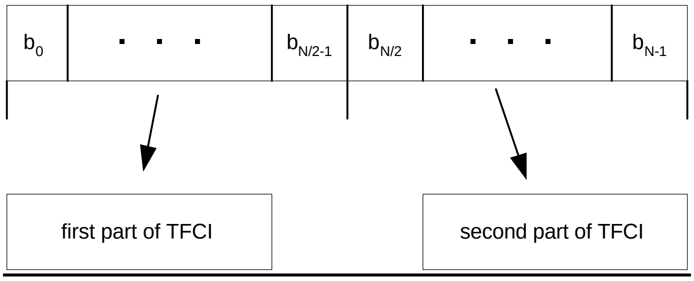

Figure 4-9: Mapping of TFCI word bits to timeslot

The locations of the first and second parts of the TFCI in the timeslot is defined in [7].

If the shortest transmission time interval of any constituent TrCH is at least 20 ms the successive TFCI words in the frames in the TTI shall be identical. If TFCI is transmitted on multiple timeslots in a frame each timeslot shall have the same TFCI word.