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

***Document*** ***R1-99K67***
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# CHANGE REQUEST

*Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.*

| | | | | |
|---|---|---|---|---|
| **25.212** | **CR** | **028** | 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: | TSG-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:** (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
*(at least one should be marked with an X)*

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

**Subject:** TFCI coding and mapping including compressed mode

**Work item:**

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

**Reason for change:**
Description of TFCI coding in split mode is currently quite different from TFCI coding in normal mode and does not specify coding/puncturing process completely. Also depends on OVSF sequences defined externally which should be removed.
- Editorial change in 4.3, BTFD, TFCI **or single TF** are possible.
- change 4.3.3 to more specification-like form.
- change 4.3.4 to more specification-like form.
- change 4.3.5.1 to show bit positions of 'b' more clearly.
- Inclusion of TFCI mapping and repetition in compressed and normal mode
- Inclusion of change of order of basic sequences

**Clauses affected:**
4.3, 4.3.3, 4.3.4, 4.3.5.1,4.3.5.2, 4.3.5.3, 4.3.5.4.1, 4.2.5.4.1.1, 4.2.5.4.1.2, 4.3.5.4.2, 4.2.5.4.2.1, 4.2.5.4.2.2, in other words, the entire section 4.3
Note that sections starting 4.**2** were incorrectly numbered in v300 (should be 4.**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 table 7 cannot be deleted in markup mode. This CR incorporates CR015 and the part relating to TFCI mapping for compressed mode from CR005. It adds the complete description of the mapping for compressed mode. Additionally the entire TFCI coding and mapping procedures have been redrafted to both include compressed mode and present the already existing pieces in a coherent way. This was not the case before, as the description evolved by several independant additions.

# 4.3 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 detects the transport format combination using some information, e.g. received power ratio of DPDCH to DPCCH, CRC check results.

For uplink, the blind transport format detection is an operator option. For downlink, the blind transport format detection can be applied with convolutional coding, the maximum number of different transport formats and maximum data rates allowed shall be specified.

## 4.3.1 Blind transport format detection

Examples of blind transport format detection methods are given in Annex A.

## 4.3.2 Explicit transport format detection based on 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.

## 4.3.3 Coding of Transport-F~~f~~ormat-C~~c~~ombination I~~i~~ndicator (TFCI)

~~The number of TFCI bits is variable and is set at the beginning of the call via higher layer signalling. For improved TFCI detection reliability, in downlink, repetition is used by increasing the number of TFCI bits within a slot.~~

The TFCI bits are encoded using a (32~~0~~, 10) ~~punctured~~ sub-code of the second order Reed-Muller code. The coding procedure is as shown in figure 10.

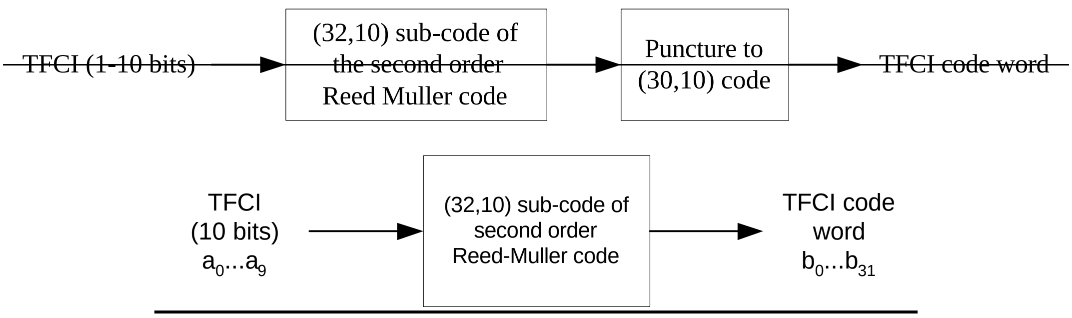



**Figure 10: Channel coding of TFCI bits**

If the TFCI consist of less than 10 bits, it is padded with zeros to 10 bits, by setting the most significant bits to zero. ~~The receiver can use the information that not all 10 bits are used for the TFCI, thereby reducing the error rate in the TFCI decoder.~~ The length of the TFCI code word is 32~~0~~ bits. ~~Thus there are 2 bits of (encoded) TFCI in every slot of the radio frame.~~

~~Firstly, 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 10 basis sequences~~: all 1's, 5 OVSF codes ($C_{32,1}$, $C_{32,2}$, $C_{32,4}$, $C_{32,8}$, $C_{32,16}$), and 4 masks (Mask1, Mask2, Mask3, Mask4)~~. The ~~4 mask~~ basis sequences are as in the following table 7.

**Table 7: Basis~~Mask~~ sequences for (32,10) TFCI code**

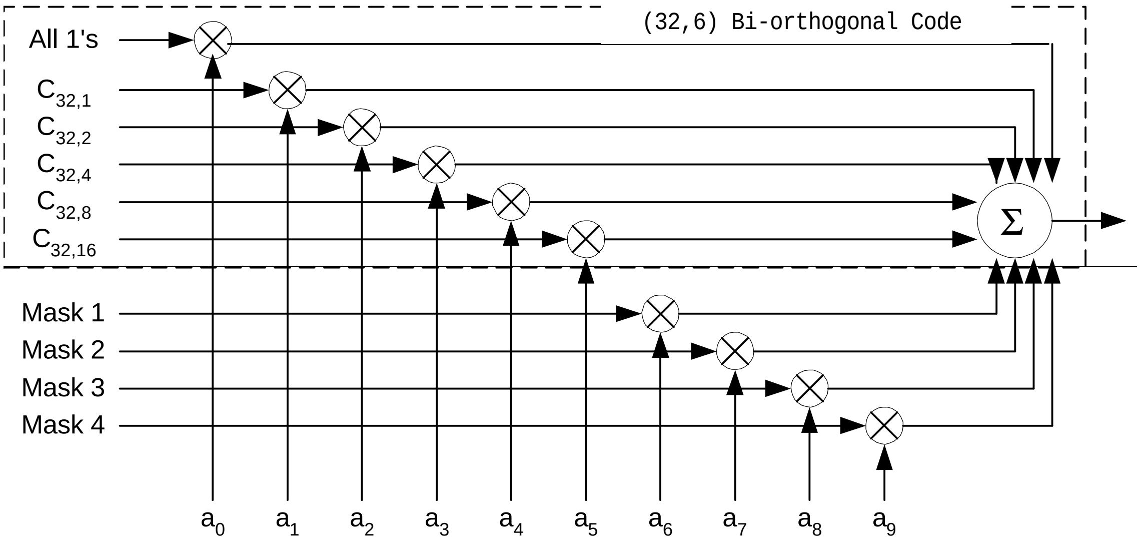
| i | $M_{i,0}$ | $M_{i,1}$ | $M_{i,2}$ | $M_{i,3}$ | $M_{i,4}$ | $M_{i,5}$ | $M_{i,6}$ | $M_{i,7}$ | $M_{i,8}$ | $M_{i,9}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 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~~ | ~~00001010111111001000110110010 1011~~ |
| ~~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 following figure 11~~ 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.




~~**Figure 11: Encoder structure for (32,10) sub-code of second order Reed-Muller code**~~

~~Then, the code words of the (32,10) sub-code of second order Reed-Muller code are punctured into length 30 by puncturing 1st and 17th bits.~~ The <u>output</u>~~remaining~~ bits are denoted by $b_k$, $k$ = 0, 1, 2, …, <u>31.</u>~~29 ($k$ = 29 corresponds to the MSB bit).~~

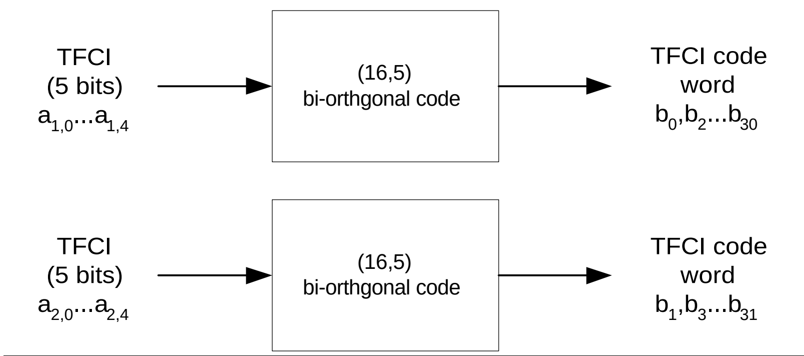
In downlink, when the SF <u><</u>~~is lower then~~ 128 the encoded ~~and punctured~~ TFCI code words are repeated ~~four times~~ yielding 8 encoded TFCI bits per slot<u> in normal mode and 16 encoded TFCI bits per slot in compressed mode</u>. Mapping of repeated bits to slots is explained in section 4.3.5.

### 4.3.4 Operation of Transport-<u>F</u>~~f~~ormat-<u>C</u>~~c~~ombination <u>I</u>~~i~~ndicator (TFCI) in Split Mode

In the case of DCH in Split Mode, the UTRAN shall operate with as follows:

- If one of the links is associated with a DSCH, the TFCI code word may be split in such a way that the code word relevant for TFCI activity indication is not transmitted from every cell. The use of such a functionality shall be indicated by higher layer signalling.

<u>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 11.</u>




<u>**Figure 11: Channel coding of split mode TFCI bits**</u>

<u>The code words of the (16,5) bi-orthogonal code are linear combinations of 5 basis sequences as defined in table 8 below.</u>

**Table 8: 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 |

~~TFCI information is encoded by biorthogonal (16, 5) block code. The code words of the biorthogonal (16, 5) code are from two mutually biorthogonal sets, $S_{C_{16}} = \{C_{16,0}, C_{16,1}, \ldots, C_{16,15}\}$ and its binary complement, $\bar{S}_{C_{16}} = \{\bar{C}_{16,0}, \bar{C}_{16,1}, \ldots, \bar{C}_{16,15}\}$. Code words of set $S_{C_{16}}$ are from the level 16 of the code three of OVSF codes defined in document TS 25.213. The mapping of information bits to code words is shown in the table 8.~~

**~~Table 8: Mapping of information bits to code words for biorthogonal (16, 5) code~~**

| ~~Information bits~~ | ~~Code word~~ |
|---|---|
| ~~00000~~ | ~~$C_{16,0}$~~ |
| ~~00001~~ | ~~$\bar{C}_{16,0}$~~ |
| ~~00010~~ | ~~$C_{16,1}$~~ |
| ~~...~~ | ~~...~~ |
| ~~11101~~ | ~~$\bar{C}_{16,14}$~~ |
| ~~11110~~ | ~~$C_{16,15}$~~ |
| ~~11111~~ | ~~$\bar{C}_{16,15}$~~ |

~~Biorthogonal code words, $C_{16,i}$ and $\bar{C}_{16,i}$, are then punctured into length 15 by puncturing the 1st bit.~~

For TFCI information bits for DCH $a_{1,0}$, $a_{1,1}$, $a_{1,2}$, $a_{1,3}$, $a_{1,4}$ ($a_{1,0}$ is LSB and $a_{1,4}$ is MSB) and for DSCH $a_{2,0}$, $a_{2,1}$, $a_{2,2}$, $a_{2,3}$, $a_{2,4}$ ($a_{2,0}$ is LSB and $a_{2,4}$ is MSB), the output code word bits $b_{\cancel{j,i}0}$, $b_1$, ..., $b_{31}$, are given by:

$$b_{2i} = \sum_{n=0}^{4} (a_{1,n} \times M_{i,n}) \bmod 2; \qquad b_{2i+1} = \sum_{n=0}^{4} (a_{2,n} \times M_{i,n}) \bmod 2$$

where i=0…15, j=0,1.

The output bits are denoted by $b_k$, $k = 0, 1, 2, \ldots, 31$.

~~The bits in the code words are denoted by $b_{j,k}$, where subscript $j$ indicates the code word and subscript $k$ indicates bit position in the code word ($k$ =14 corresponds to the MSB bit).~~

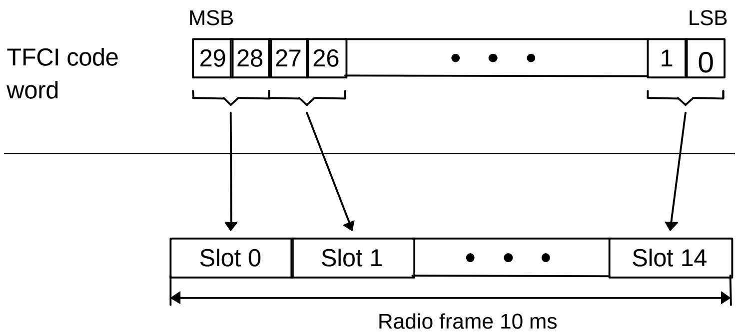
## 4.3.5 Mapping of TFCI words

### 4.3.5.1 Mapping of TFCI word in non compressed mode

~~As only one code word for TFCI is needed no channel interleaving for the encoded bits are done. Instead, t~~The bits of the code word are directly mapped to the slots of the radio frame~~ as depicted in the figure 12~~. Within a slot the bit with lower index ~~more significant bit~~ is transmitted before the ~~less significant~~ bit with higher index. The coded bits $b_k$, are mapped to the transmitted TFCI bits $d_k$, according to the following formula:

$d_k = b_{k \bmod 32}$

For uplink physical channels regardless of the SF and downlink physical channels, if SF≥128, $k = 0, 1, 2, \ldots, 29$. Note that this means that bits $b_{30}$ and $b_{31}$ are not transmitted.




~~**Figure 12: Mapping of TFCI code words to the slots of the radio frame**~~

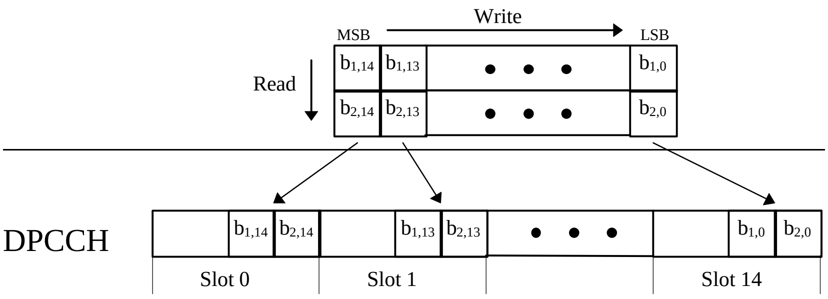
For downlink physical channels whose SF≤~~ is lower than~~ 128, $k = 0, 1, 2, \ldots, 119$. Note that this means that bits $b_0$ to $b_{23}$ are transmitted four times and bits $b_{24}$ to $b_{31}$ are transmitted three times.~~bits of the TFCI code words are repeated and mapped to slots as shown in the table 9. Code word bits are denoted as $b_k^l$, where subscript $k$, indicates bit position in the code word ($k$ =29 is the MSB bit) and superscript $l$ indicates bit repetition. In each slot transmission order of the bits is from left to right in the table 9.~~

**~~Table 9: Mapping order of repetition encoded TFCI code word bits into slots.~~**

| ~~Slot~~ | ~~TFCI code word bits~~ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ~~0~~ | ~~$b_{29}^{1}$~~ | ~~$b_{29}^{2}$~~ | ~~$b_{29}^{3}$~~ | ~~$b_{29}^{4}$~~ | ~~$b_{28}^{1}$~~ | ~~$b_{28}^{2}$~~ | ~~$b_{28}^{3}$~~ | ~~$b_{28}^{4}$~~ |
| ~~1~~ | ~~$b_{27}^{1}$~~ | ~~$b_{27}^{2}$~~ | ~~$b_{27}^{3}$~~ | ~~$b_{27}^{4}$~~ | ~~$b_{26}^{1}$~~ | ~~$b_{26}^{2}$~~ | ~~$b_{26}^{3}$~~ | ~~$b_{26}^{4}$~~ |
| ~~2~~ | ~~$b_{25}^{1}$~~ | ~~$b_{25}^{2}$~~ | ~~$b_{25}^{3}$~~ | ~~$b_{25}^{4}$~~ | ~~$b_{24}^{1}$~~ | ~~$b_{24}^{2}$~~ | ~~$b_{24}^{3}$~~ | ~~$b_{24}^{4}$~~ |
| ~~3~~ | ~~$b_{23}^{1}$~~ | ~~$b_{23}^{2}$~~ | ~~$b_{23}^{3}$~~ | ~~$b_{23}^{4}$~~ | ~~$b_{22}^{1}$~~ | ~~$b_{22}^{2}$~~ | ~~$b_{22}^{3}$~~ | ~~$b_{22}^{4}$~~ |
| ~~4~~ | ~~$b_{21}^{1}$~~ | ~~$b_{21}^{2}$~~ | ~~$b_{21}^{3}$~~ | ~~$b_{21}^{4}$~~ | ~~$b_{20}^{1}$~~ | ~~$b_{20}^{2}$~~ | ~~$b_{20}^{3}$~~ | ~~$b_{20}^{4}$~~ |
| ~~5~~ | ~~$b_{19}^{1}$~~ | ~~$b_{19}^{2}$~~ | ~~$b_{19}^{3}$~~ | ~~$b_{19}^{4}$~~ | ~~$b_{18}^{1}$~~ | ~~$b_{18}^{2}$~~ | ~~$b_{18}^{3}$~~ | ~~$b_{18}^{4}$~~ |
| ~~6~~ | ~~$b_{17}^{1}$~~ | ~~$b_{17}^{2}$~~ | ~~$b_{17}^{3}$~~ | ~~$b_{17}^{4}$~~ | ~~$b_{16}^{1}$~~ | ~~$b_{16}^{2}$~~ | ~~$b_{16}^{3}$~~ | ~~$b_{16}^{4}$~~ |
| ~~7~~ | ~~$b_{15}^{1}$~~ | ~~$b_{15}^{2}$~~ | ~~$b_{15}^{3}$~~ | ~~$b_{15}^{4}$~~ | ~~$b_{14}^{1}$~~ | ~~$b_{14}^{2}$~~ | ~~$b_{14}^{3}$~~ | ~~$b_{14}^{4}$~~ |
| ~~8~~ | ~~$b_{13}^{1}$~~ | ~~$b_{13}^{2}$~~ | ~~$b_{13}^{3}$~~ | ~~$b_{13}^{4}$~~ | ~~$b_{12}^{1}$~~ | ~~$b_{12}^{2}$~~ | ~~$b_{12}^{3}$~~ | ~~$b_{12}^{4}$~~ |
| ~~9~~ | ~~$b_{11}^{1}$~~ | ~~$b_{11}^{2}$~~ | ~~$b_{11}^{3}$~~ | ~~$b_{11}^{4}$~~ | ~~$b_{10}^{1}$~~ | ~~$b_{10}^{2}$~~ | ~~$b_{10}^{3}$~~ | ~~$b_{10}^{4}$~~ |
| ~~10~~ | ~~$b_{9}^{1}$~~ | ~~$b_{9}^{2}$~~ | ~~$b_{9}^{3}$~~ | ~~$b_{9}^{4}$~~ | ~~$b_{8}^{1}$~~ | ~~$b_{8}^{2}$~~ | ~~$b_{8}^{3}$~~ | ~~$b_{8}^{4}$~~ |
| ~~11~~ | ~~$b_{7}^{1}$~~ | ~~$b_{7}^{2}$~~ | ~~$b_{7}^{3}$~~ | ~~$b_{7}^{4}$~~ | ~~$b_{6}^{1}$~~ | ~~$b_{6}^{2}$~~ | ~~$b_{6}^{3}$~~ | ~~$b_{6}^{4}$~~ |
| ~~12~~ | ~~$b_{5}^{1}$~~ | ~~$b_{5}^{2}$~~ | ~~$b_{5}^{3}$~~ | ~~$b_{5}^{4}$~~ | ~~$b_{4}^{1}$~~ | ~~$b_{4}^{2}$~~ | ~~$b_{4}^{3}$~~ | ~~$b_{4}^{4}$~~ |
| ~~13~~ | ~~$b_{3}^{1}$~~ | ~~$b_{3}^{2}$~~ | ~~$b_{3}^{3}$~~ | ~~$b_{3}^{4}$~~ | ~~$b_{2}^{1}$~~ | ~~$b_{2}^{2}$~~ | ~~$b_{2}^{3}$~~ | ~~$b_{2}^{4}$~~ |
| ~~14~~ | ~~$b_{1}^{1}$~~ | ~~$b_{1}^{2}$~~ | ~~$b_{1}^{3}$~~ | ~~$b_{1}^{4}$~~ | ~~$b_{0}^{1}$~~ | ~~$b_{0}^{2}$~~ | ~~$b_{0}^{3}$~~ | ~~$b_{0}^{4}$~~ |

### ~~4.3.5.2 Mapping of TFCI word in Split Mode~~

~~After channel encoding of the two 5 bit TFCI words there are two code words of length 15 bits. They are mapped to DPCCH as shown in the figure 13. Note that $b_{1,k}$ and $b_{2,k}$ denote the bit $k$ of code word 1 and code word 2, respectively.~~




**~~Figure 13: Mapping of TFCI code words to the slots of the radio frame in Split Mode~~**

~~For downlink physical channels whose SF is lower than 128, bits of the extended TFCI code words are repeated and mapped to slots as shown in the table 10. Code word bits are denoted as $b_{j,k}^{l}$, where subscript $j$ indicates the code word, subscript $k$ indicates bit position in the code word ($k$=14 is the MSB bit) and superscript $l$ indicates bit repetition. In each slot transmission order of the bits is from left to right in the table 10.~~

**~~Table 10: Mapping order of repetition encoded TFCI code word bits to slots in Split Mode~~**

| ~~Slot~~ | ~~TFCI code word bits in split mode~~ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ~~0~~ | $b^1_{1,14}$ | $b^2_{1,14}$ | $b^3_{1,14}$ | $b^4_{1,14}$ | $b^1_{2,14}$ | $b^2_{2,14}$ | $b^3_{2,14}$ | $b^4_{2,14}$ |
| ~~1~~ | $b^1_{1,13}$ | $b^2_{1,13}$ | $b^3_{1,13}$ | $b^4_{1,13}$ | $b^1_{2,13}$ | $b^2_{2,13}$ | $b^3_{2,13}$ | $b^4_{2,13}$ |
| ~~2~~ | $b^1_{1,12}$ | $b^2_{1,12}$ | $b^3_{1,12}$ | $b^4_{1,12}$ | $b^1_{2,12}$ | $b^2_{2,12}$ | $b^3_{2,12}$ | $b^4_{2,12}$ |
| ~~3~~ | $b^1_{1,11}$ | $b^2_{1,11}$ | $b^3_{1,11}$ | $b^4_{1,11}$ | $b^1_{2,11}$ | $b^2_{2,11}$ | $b^3_{2,11}$ | $b^4_{2,11}$ |
| ~~4~~ | $b^1_{1,10}$ | $b^2_{1,10}$ | $b^3_{1,10}$ | $b^4_{1,10}$ | $b^1_{2,10}$ | $b^2_{2,10}$ | $b^3_{2,10}$ | $b^4_{2,10}$ |
| ~~5~~ | $b^1_{1,9}$ | $b^2_{1,9}$ | $b^3_{1,9}$ | $b^4_{1,9}$ | $b^1_{2,9}$ | $b^2_{2,9}$ | $b^3_{2,9}$ | $b^4_{2,9}$ |
| ~~6~~ | $b^1_{1,8}$ | $b^2_{1,8}$ | $b^3_{1,8}$ | $b^4_{1,8}$ | $b^1_{2,8}$ | $b^2_{2,8}$ | $b^3_{2,8}$ | $b^4_{2,8}$ |
| ~~7~~ | $b^1_{1,7}$ | $b^2_{1,7}$ | $b^3_{1,7}$ | $b^4_{1,7}$ | $b^1_{2,7}$ | $b^2_{2,7}$ | $b^3_{2,7}$ | $b^4_{2,7}$ |
| ~~8~~ | $b^1_{1,6}$ | $b^2_{1,6}$ | $b^3_{1,6}$ | $b^4_{1,6}$ | $b^1_{2,6}$ | $b^2_{2,6}$ | $b^3_{2,6}$ | $b^4_{2,6}$ |
| ~~9~~ | $b^1_{1,5}$ | $b^2_{1,5}$ | $b^3_{1,5}$ | $b^4_{1,5}$ | $b^1_{2,5}$ | $b^2_{2,5}$ | $b^3_{2,5}$ | $b^4_{2,5}$ |
| ~~10~~ | $b^1_{1,4}$ | $b^2_{1,4}$ | $b^3_{1,4}$ | $b^4_{1,4}$ | $b^1_{2,4}$ | $b^2_{2,4}$ | $b^3_{2,4}$ | $b^4_{2,4}$ |
| ~~11~~ | $b^1_{1,3}$ | $b^2_{1,3}$ | $b^3_{1,3}$ | $b^4_{1,3}$ | $b^1_{2,3}$ | $b^2_{2,3}$ | $b^3_{2,3}$ | $b^4_{2,3}$ |
| ~~12~~ | $b^1_{1,2}$ | $b^2_{1,2}$ | $b^3_{1,2}$ | $b^4_{1,2}$ | $b^1_{2,2}$ | $b^2_{2,2}$ | $b^3_{2,2}$ | $b^4_{2,2}$ |
| ~~13~~ | $b^1_{1,1}$ | $b^2_{1,1}$ | $b^3_{1,1}$ | $b^4_{1,1}$ | $b^1_{2,1}$ | $b^2_{2,1}$ | $b^3_{2,1}$ | $b^4_{2,1}$ |
| ~~14~~ | $b^1_{1,0}$ | $b^2_{1,0}$ | $b^3_{1,0}$ | $b^4_{1,0}$ | $b^1_{2,0}$ | $b^2_{2,0}$ | $b^3_{2,0}$ | $b^4_{2,0}$ |

## 4.3.5.2~~3~~ Mapping of TFCI in compressed mode

The mapping of the TFCI bits in compressed mode is different for uplink, downlink with SF≥128 and downlink with SF<128. ~~is dependent on the transmission time reduction method. Denote the TFCI bits by $c_0, c_1, c_2, c_3, c_4, \ldots, c_C$, where:~~

- ~~$c_k = b_k$, $C = 29$, when there are 2 TFCI bit in each slot.~~
- ~~$c_0 = b^4_0, c_1 = b^3_0, c_2 = b^2_0, c_3 = b^1_0, c_4 = b^4_1, c_5 = b^3_1, \ldots, c_{119} = b^1_{14}$, when there are 8 TFCI bits in each slot.~~
- ~~$c_0 = b_{2,0}, c_1 = b_{1,0}, c_3 = b_{2,1}, c_4 = b_{1,1}, \ldots, c_{29} = b_{1,14}$, in split mode when there are 2 TFCI bits in each slot.~~
- ~~$c_0 = b^4_{2,0}, c_1 = b^3_{2,0}, c_2 = b^2_{2,0}, c_3 = b^1_{2,0}, c_4 = b^4_{1,0}, c_5 = b^3_{1,0}, \ldots, c_{119} = b^1_{1,14}$, in split mode when there are 8 TFCI bits in each slot.~~

~~The TFCI mapping for each transmission method is given in the sections below.~~

### ~~4.3.5.4.1 Compressed mode method A~~

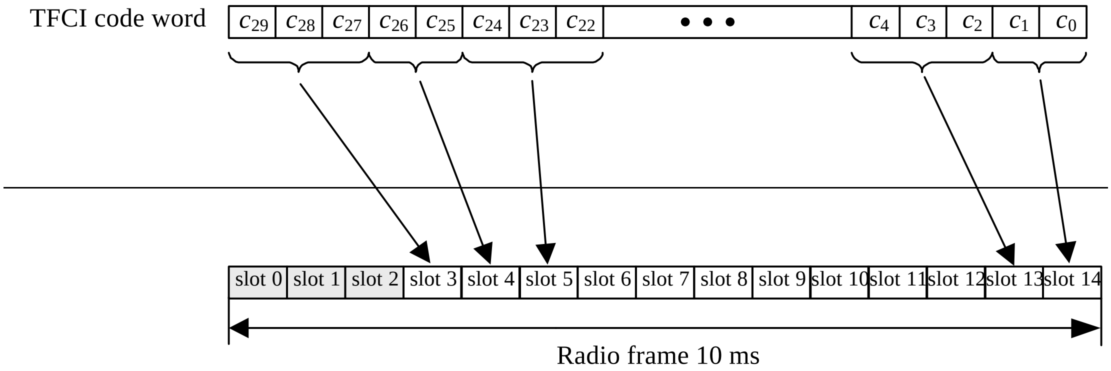
~~For compressed mode by method A, all the TFCI bits are mapped to the remaining slots. The number of bits per slot in uncompressed mode is denoted by $Z$ and $Z = (C + 1)/15$. The mapping to slots for different TGLs are defined below.~~

#### ~~4.2.5.4.1.1 TGL of 3 slots~~

~~Slot number $3 + 2x$ contain bits $c_{C-(\frac{5}{2}Z)x}, c_{C-(\frac{5}{2}Z)x-1}, \ldots, c_{C-(\frac{5}{2}Z)x-(\frac{3}{2}Z-1)}$, where $x = 0, 1, 2, 3, 4, 5$~~

~~Slot number 4 + 2*x* contain bits~~ $c_{C-\frac{3}{2}Z-(\frac{5}{2}Z)x}, c_{C-\frac{3}{2}Z-(\frac{5}{2}Z)x-1}, \ldots, c_{C-\frac{3}{2}Z-(\frac{5}{2}Z)x-(Z-1)}$~~, where *x* = 0, 1, 2, 3, 4, 5~~

~~The case when *C* = 29 is illustrated in figure 14.~~



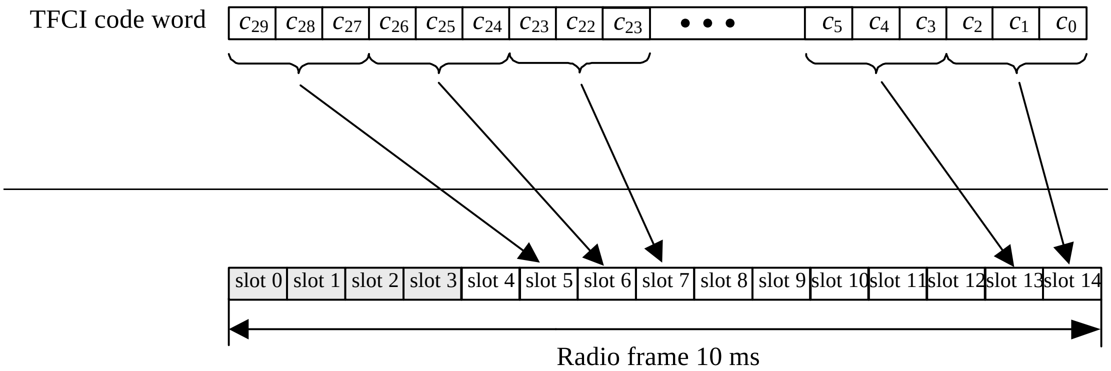

**~~Figure 14: Mapping of TFCI code with TGL of 3 slots.~~**

#### ~~4.2.5.4.1.2 TGL of 4 slots~~

~~Slot number 4 does not contain any TFCI bits.~~

~~Slot number 5 + *x* contain bits~~ $c_{C-(\frac{3}{2}Z)x}, c_{C-(\frac{3}{2}Z)x-1}, \ldots, c_{C-(\frac{3}{2}Z)x-(\frac{3}{2}Z-1)}$~~, where *x* = 0, 1, 2, 3, …, 9~~

~~The case when *C* = 29 is illustrated in figure 15.~~




**~~Figure 15: Mapping of TFCI code with TGL of 4 slots~~**

### 4.3.5.~~4~~2.1~~2~~ Uplink ~~C~~compressed mode~~ method B~~

### ~~4.2.5.4.2.1 Uplink~~

For uplink compressed ~~mode by method B the frame~~mode, the slot format is changed so that no TFCI bits are lost. The different ~~frame~~slot formats in compressed mode ~~can~~do not match the exact number of TFCI bits for all possible TGLs. Repetition of the TFCI bits is therefore used.

Denote the number of bits available in the TFCI fields of one compressed radio frame by *D*~~, the repeated bits by $d_k$,~~ and the number of bits in the TFCI field in a slot by $N_{TFCI}$. Denote by *E* the first bit to be repeated, ~~Let~~ $E=N_{first}N_{TFCI}$~~$E=30-1-$~~

~~($N_{first}N_{TFCI}$)mod 30~~. If $N_{last}\neq 14$, then $E$ corresponds to the number of the first TFCI bit in the slot directly after the TG. The following relations then define the mapping~~repetition~~.

$d_k = b_{k \bmod 32}$

where $k$ = 0, 1, 2, …, min (31, D-1).

If D > 32, the remaining positions are filled by repetition (in reversed order):

$d_{D-k-1} = b_{(E+k) \bmod 32}$

where $k$ = 0, …, D-33.

$$\cancel{d_{D-31} = c_{E \bmod 30}, d_{D-32} = c_{(E-1) \bmod 30}, d_{D-33} = c_{(E-2) \bmod 30}, \ldots, d_0 = c_{(E-(D-31)) \bmod 30}}$$

~~The bits are mapped to the slots in descending order starting with the original bits and followed by the repeated ones, i.e. $c_{29}$ is sent as first bit in the TFCI field of the first transmitted slot and $d_0$ as last bit in the TFCI field of the last transmitted slot.~~

#### ~~4.2.5.4.2.2 Downlink~~

#### 4.3.5.2.2 Downlink compressed mode

~~<Editor's note: Detailed description for downlink is FFS>~~

For downlink compressed mode, the slot format is changed so that no TFCI bits are lost. The different slot formats in compressed mode do not match the exact number of TFCI bits for all possible TGLs. DTX is therefore used if the number of TFCI fields exceeds the number of TFCI bits. The block of fields, where DTX is used, starts on the first field after the gap. If there are fewer TFCI fields after the gap than DTX bits, the last fields before of the gap are also filled with DTX.

Denote the number of bits available in the TFCI fields of one compressed radio frame by $D$ and the number of bits in the TFCI field in a slot by $N_{TFCI}$. Denote by $E$ the first bit to be repeated, $E=N_{first}N_{TFCI}$. If $N_{last}\neq 14$, then $E$ corresponds to the number of the first TFCI bit in the slot directly after the TG. Denote the total number of TFCI bits to be transmitted by $N_{tot}$. If SF ≥ 128 then $N_{tot}$ = 32, else $N_{tot}$ = 128. The following relations then define the mapping:

$d_k = b_{(k \bmod 32)}$

where $k$ = 0, 1, 2, …, min (E, $N_{tot}$)-1 and, if E< $N_{tot}$,

$d_{k+D-Ntot} = b_{(k \bmod 32)}$

where $k$ = E, ..., $N_{tot}$ -1.

DTX bits are sent on $d_k$ where $k$ = min (E, $N_{tot}$), ..., min (E, $N_{tot}$) +D - $N_{tot}$ -1.