3GPP TSG RAN WG1 (Radio) Meeting #8
New York, USA, 12-15 OCT 1999

Document R1-99H20
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

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 003 Current Version: V 3.0.0

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

For submission to:		for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑		for information		non-strategic		

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

Source: ETRI **Date:** 14 Oct 1999

Subject: TFCI word repetition in downlink

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			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: TFCI word repetition obtains some gains of time-diversity for the downlink channels whose SF is less than 128.

Clauses affected: 4.3.5 of TS25.212

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:

TSG-RAN Working Group 1 meeting #8
NewYork, U.S.A.

TSGR1#8(99)H20

October 12 – 15, 1999

Agenda item: 15
Source: ETRI
Title: **CR to 25.212 for TFCI word repetition in downlink**
Document for: **Approval**

1. Introduction

In the meeting #7, ETRI proposed to repeat TFCI code word bits word-by-word, instead of symbol repetition, for downlink channels whose SF are less than 128[1]. Also ETRI presented the simulation results for comparing the performances of two repetition schemes in Ad Hoc 4 meeting of WG1 meeting #8[2].

From the results of Ad Hoc 4 meeting, it was accepted as TFCI repetition in downlink channels whose SF are less than 128. In this contribution, we will provide the Change Request to 25.212 for TFCI word repetition in downlink.

2. Contents of changes

The contents of changes are minor in TS 25.212 V3.0.0.

- The contents in two tables (Table 9 in section 4.3.5.1 and Table 10 in section 4.3.5.2) for TFCI code word bits are re-ordered for downlink channels whose SF are less than 128.
- Order rule of TFCI bits and the condition for each case are changed in section 4.3.5.3 TFCI mapping rule in compressed mode.
- Minor editorial change: "For downlink physical channels whose SF is lower than 128, bits of the TFCI code words are repeated word-by-word and mapped to slots as shown in the Table 9 (and 10)."

3. Conclusion

ETRI proposes that the bits of the extended TFCI code words are repeated word-by-word for downlink physical channels whose SF is lower than 128. The word repetition of TFCI code word bits can obtain the time-diversity gains in TFCI decoding, over the symbol repetition. Also the only minor changes are required for replacing the symbol repetition by the word repetition in the current specification, TS 25.212.

References

[1] TSGR R1-99c82 "TFCI Repetition and Interleaving", ETRI.
[2] TSGR R1-99g30 "Simulation results of TFCI repetition and its text proposal", ETRI.
[3] TSG RAN#5(99)588, TS 25.212 V3.0.0 Multiplexing and channel coding(FDD), 3GPP TSG RAN WG1

----------------------------------- Text Proposal ---------------------

4.3.5 Mapping of TFCI words

4.3.5.1 Mapping of TFCI word

As only one code word for TFCI is needed no channel interleaving for the encoded bits are done. Instead, the bits of the code word are directly mapped to the slots of the radio frame as depicted in the Figure 1. Within a slot the more significant bit is transmitted before the less significant bit.

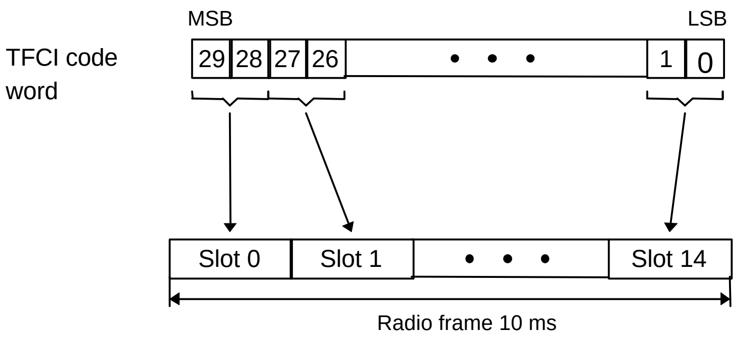

Figure 1: Mapping of TFCI code words to the slots of the radio frame

For downlink physical channels whose SF is lower than 128, bits of the TFCI code words are repeated word-by-word and mapped to slots as shown in the Table 1. 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 1.

Table 1: 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~~

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

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 2. Note that $b_{1,k}$ and $b_{2,k}$ denote the bit k of code word 1 and code word 2, respectively.

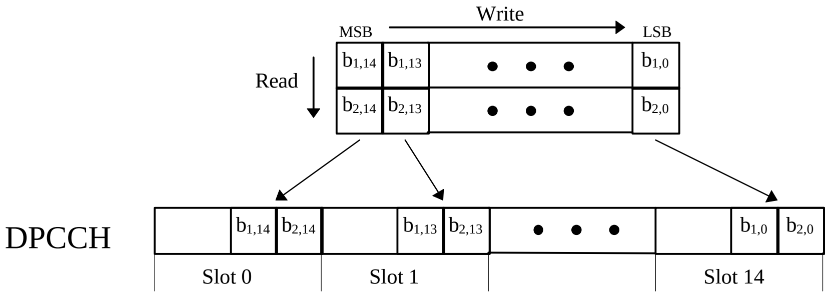

Figure 2: Mapping of TFCI code words to the slots of the radio frame in Split Mode

For downlink physical channels whose SF is lower than 128, bits of the extended TFCI code words are repeated word-by-word and mapped to slots as shown in the Table 2. Code word bits are denoted as $b^l_{j,k}$, 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 2.

Table 2: 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	$b^1_{1,0}$	$b^2_{1,0}$	$b^3_{1,0}$	$b^4_{1,0}$	$b^1_{2,0}$	$b^2_{2,0}$	$b^3_{2,0}$	$b^4_{2,0}$

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

4.3.5.3 Mapping of TFCI in compressed mode

The mapping of the TFCI bits in compressed mode is dependent on the transmission time reduction method. Denote the TFCI bits by c_0, c_1, c_2, c_3, c_4, …, c_C, where:

- $c_k = b_k$, C = 29, when there are ~~2~~ 30 TFCI bits in each ~~slot~~frame.

~~$c_0 = b_0^4, c_1 = b_0^3, c_2 = b_0^2, c_3 = b_0^1, c_4 = b_1^4, c_5 = b_1^3, \ldots, c_{119} = b_{14}^1$, when there are 8 TFCI bits in each slot.~~

$c_{30\cdot(4-l)+k} = b_k^l$, C=119, when there are ~~8~~ 120 TFCI bits in each frame~~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.~~

- $c_{2k+(j \bmod 2)} = b_{j,k}$, C=29, in split mode when there are ~~2~~ 30 TFCI bits in each ~~slot~~frame.

~~$c_0 = b_{2,0}^4, c_1 = b_{2,0}^3, c_2 = b_{2,0}^2, c_3 = b_{2,0}^1, c_4 = b_{1,0}^4, c_5 = b_{1,0}^3, \ldots, c_{119} = b_{1,14}^1$, in split mode when there are 8 TFCI bits in each slot.~~

- $c_0 = b_{2,0}^4, c_1 = b_{2,1}^4, \ldots, c_3 = b_{2,3}^4, c_4 = b_{1,0}^4, c_5 = b_{1,1}^4, \ldots, c_7 = b_{1,3}^4, c_8 = b_{2,4}^4, \ldots, c_{119} = b_{1,14}^1$, in split mode when there are 120 TFCI bits in each frame.

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

4.3.5.3.1 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.

4.3.5.3.1.1 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 + 2x 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 3.

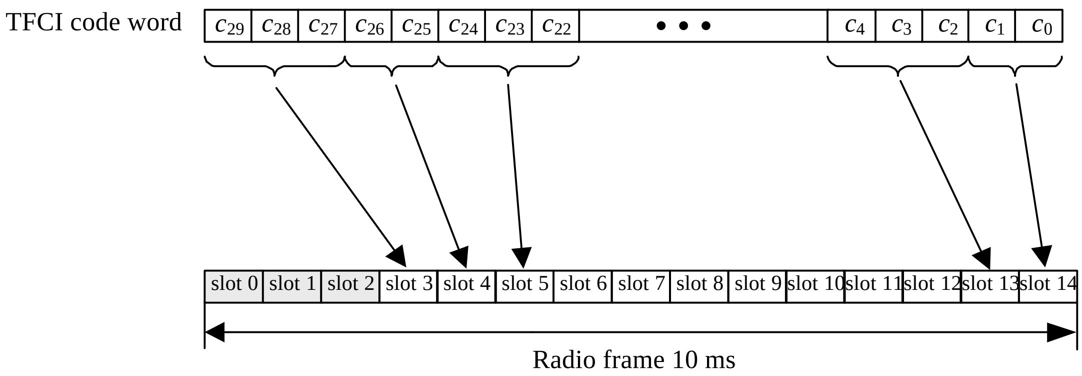

Figure 3: Mapping of TFCI code with TGL of 3 slots.

4.3.5.3.1.2 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 4.

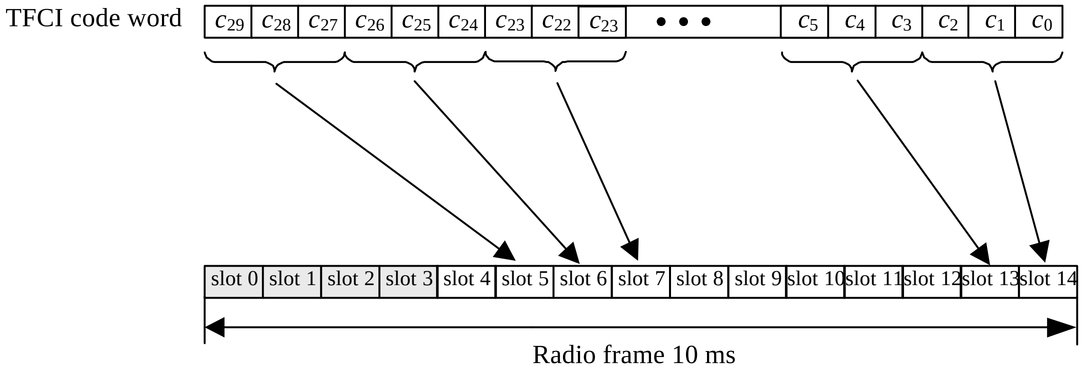

Figure 4: Mapping of TFCI code with TGL of 4 slots.