TSG-RAN Meeting #6 *TSGRP#6(99)694*
Nice, France, 13 – 15 December 1999

Title: **Agreed CRs of category "C" (Modification) and "F" (Correction) to TS 25.222**

Source: **TSG-RAN WG1**

Agenda item: **5.1.3**

Spec	CR	Rev	Phase	Subject	Cat	Version-Current	Version-New	Doc
25.222	001	3	R99	Correction of rate matching parameters for	F	3.0.0	3.1.0	R1-99j98
25.222	002	1	R99	Clarification of bit separation and collection	F	3.0.0	3.1.0	R1-99k07
25.222	003	-	R99	Changing the initial offset value for convolutional	C	3.0.0	3.1.0	R1-99j12
25.222	007	-	R99	Update of rate matching rule for TDD	F	3.0.0	3.1.0	R1-99i94
25.222	009	1	R99	Modified physical channel mapping scheme	C	3.0.0	3.1.0	R1-99l37
25.222	013	-	R99	Introduction of TFCI for S-CCPCH in TDD mode	C	3.0.0	3.1.0	R1-99k57
25.222	015	-	R99	TFCI coding and mapping in TDD	F	3.0.0	3.1.0	R1-99k68

NOTE: The source of this document is TSG-RAN WG1. The source shown on each CR cover sheet is the originating organisation.

3GPP TSG RAN WG1#9
Dresden, Germany 30 Nov - 03 Dec 1999

Document R1-99j97

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

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25.212	**CR**	**001rev3**	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:	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	X	UTRAN / Radio	X	Core Network	

Source: Siemens, LGIC **Date:** 30.11.99

Subject: Correction of rate matching parameters for repetition after 1st Interleaving in 25.212

Work item:

Category:				**Release:**		
	F	Correction	X		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			Release 98	
with an X)	D	Editorial modification			Release 99	X
					Release 00	

Reason for change: For rate matching after first interleaving the formula was erroneous for high repetition rates.

Clauses affected: 4.2.7 Rate matching
4.2.7.1.2 Determination of parameters needed for calculating the rate matching pattern

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: Identical change should be introduced in 25.222 as well.
Revision 2: Editorial revision due to new CR-form and official version 3.0.0
Revision 3: Update of definition of q and $S(n_i)$ in section 4.2.7

4.2.7 Rate matching

Rate matching means that bits on a transport channel are repeated or punctured. Higher layers assign a rate-matching attribute for each transport channel. This attribute is semi-static and can only be changed through higher layer signalling. The rate-matching attribute is used when the number of bits to be repeated or punctured is calculated.

The number of bits on a transport channel can vary between different transmission time intervals. In the downlink the transmission is interrupted if the number of bits is lower than maximum. When the number of bits between different transmission time intervals in uplink is changed, bits are repeated or punctured to ensure that the total bit rate after second multiplexing is identical to the total channel bit rate of the allocated dedicated physical channels.

Notation used in section 4.2.7 and subsections:

N_{ij}: For uplink: Number of bits in a radio frame before rate matching on TrCH *i* with transport format combination *j* .

For downlink : An intermediate calculation variable (not a integer but a multiple of 1/8).

N_{il}^{TTI} : Number of bits in a transmission time interval before rate matching on TrCH *i* with transport format *l*. Used in downlink only.

ΔN_{ij} : For uplink: If positive - number of bits that should be repeated in each radio frame on TrCH *i* with transport format combination *j*.

If negative - number of bits that should be punctured in each radio frame on TrCH *i* with transport format combination *j*.

For downlink : An intermediate calculation variable (not integer but a multiple of 1/8).

ΔN_{il}^{TTI} : If positive - number of bits to be repeated in each transmission time interval on TrCH *i* with transport format *j*.

If negative - number of bits to be punctured in each transmission time interval on TrCH *i* with transport format *j*.

Used in downlink only.

RM_i: Semi-static rate matching attribute for transport channel *i*. Signalled from higher layers.

PL: Puncturing limit for uplink. This value limits the amount of puncturing that can be applied in order to avoid multicode or to enable the use of a higher spreading factor. Signalled from higher layers.

$N_{data,j}$: Total number of bits that are available for the CCTrCH in a radio frame with transport format combination *j*.

I: Number of TrCHs in the CCTrCH.

Z_{ij}: Intermediate calculation variable.

F_i: Number of radio frames in the transmission time interval of TrCH *i*.

n_i: Radio frame number in the transmission time interval of TrCH *i* ($0 \le n_i < F_i$).

q: Average puncturing or repetition distance (normalised to only show the remaining rate matching on top of an integer number of repetitions). Used in uplink only.

$I_F(n_i)$: The inverse interleaving function of the 1st interleaver (note that the inverse interleaving function is identical to the interleaving function itself for the 1st interleaver). Used in uplink only.

$S(n_i)$: The shift of the puncturing or repetition pattern for radio frame n_i. Used in uplink only.

$TF_i(j)$: Transport format of TrCH *i* for the transport format combination *j*.

4.2.7.1.2 Determination of parameters needed for calculating the rate matching pattern

The number of bits to be repeated or punctured, ΔN_{ij}, within one radio frame for each TrCH *i* is calculated with equation 1 for all possible transport format combinations *j* and selected every radio frame. $N_{data,j}$ is given from section 4.2.7.1.1. In compressed mode $N_{data,j}$ is replaced by $N^{cm}_{data,j}$ in Equation 1. $N^{cm}_{data,j}$ is given from the following relation:

$N^{cm}_{data,j} = 2N_{data,j} - N_{TGL}$, where

$$N_{TGL} = \begin{cases} \frac{TGL}{15} 2N_{data,j}, & \text{if } N_{first} + TGL \le 15 \\ \frac{15 - N_{first}}{15} 2N_{data,j}, & \text{in first frame if } N_{first} + TGL > 15 \\ \frac{TGL - (15 - N_{first})}{15} 2N_{data,j}, & \text{in second frame if } N_{first} + TGL > 15 \end{cases}$$

N_{first} and TGL are defined in section 4.4.

If $\Delta N_{ij} = 0$ then the output data of the rate matching is the same as the input data and the rate matching algorithm of section 4.2.7.4 does not need to be executed.

Otherwise, for determining e_{ini}, e_{plus}, e_{minus}, and N the following parameters are needed (regardless if the radio frame is compressed or not):

For convolutional codes,

$R = \Delta N_{ij} \bmod N_{ij}$ -- note: in this context $\Delta N_{ij} \bmod N_{ij}$ is in the range of 0 to N_{ij}-1 i.e. -1 mod 10 = 9.

if $R \neq 0$ and $2R \le N_{ij}$

then $q = \lceil N_{ij} / R \rceil$

else

$q = \lceil N_{ij} / (R - N_{ij}) \rceil$

endif

-- note: q is a signed quantity.

~~$q = \lfloor N_{ij} / (|\Delta N_{ij}|) \rfloor$~~

if q is even

then $q' = q \pm gcd(\lfloor q \rfloor, F_i)/F_i$ -- where gcd ($\lfloor q \rfloor$, F_i) means greatest common divisor of $\lfloor q \rfloor$ and F_i

-- note that q' is not an integer, but a multiple of 1/8

else

q' = q

endif

for x = 0 to F_i-1

$S(I_F(\lceil x*q' \rceil \bmod F_i)) = (\lceil x*q' \rceil \text{ div } F_i)$

end for

TSG-RAN Working Group 1(Radio) meeting #9 ***TSGR1#9(99) k07***

30 November – 3 December 1999, Dresden, Germany

Source : Samsung and LGIC

Title : Revised CR to 25.222 for clarification of bit separation and collection

Document for : Approval

1 Introduction

Bit separation and bit collection are currently not sufficiently described in 25.222. We proposed the modifications in TSGR1#8(99)f28, which were agreed in the WG1 meeting in NY. But, it is proposed that instead of making the limited changes proposed in f28, the section should be rewritten with notations more similar to the rest of 25.222. The changes proposed in this document are listed below.

Entire section 4.2.7	The following notation is currently used for the number of bits before rate matching: $N = N_i = N_{ij}$ It is proposed that N is replaced by X_i so that it is possible to distinguish between different TrCHs. Similarly, it is proposed that ΔN is replaced by ΔN_i.
Entire section 4.2.7	Index b is introduced to indicate systematic or parity bits.
Section 4.2.7.1.1 / 4.2.7.1.2	Divided into subsections to ease understanding. (Note that current text does not define rate matching for uncoded TrCHs.)
Section 4.2.7.2	Completely rewritten. A new notation is introduced for the bits. The section is divided into subsections. Clearly states what happens when N_{ij} is not a multiple of three (the last 1 or 2 bits can not be punctured).

2 Text Proposal

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

***Document* R1-99K07**
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

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25.222 CR 002r1 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: Samsung and LGIC **Date:** 1999-11-22

Subject: Clarification of bit separation and collection

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: Current description of bit separation and collection can easily be misinterpreted.

Clauses affected: 4.2.7

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: It would be desired that the specification of rate matching section be consistent in notations and the way of description throughout the entire TS 25.222 and be aligned with that of TS 25.212.

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<--------- double-click here for help and instructions on how to create a CR.

4.2.7 Rate matching

Rate matching means that bits on a TrCH are repeated or punctured. Higher layers assign a rate-matching attribute for each TrCH. This attribute is semi-static and can only be changed through higher layer signalling. The rate-matching attribute is used when the number of bits to be repeated or punctured is calculated.

The number of bits on a TrCH can vary between different transmission time intervals. When the number of bits between different transmission time intervals is changed, bits are repeated to ensure that the total bit rate after ~~second~~TrCH multiplexing is identical to the total channel bit rate of the allocated dedicated physical channels.

Notation used in section 4.2.7 and subsections:

N_{ij}: Number of bits in a radio frame before rate matching on TrCH *i* with transport format combination *j* .

ΔN_{ij} : If positive – number of bits to be repeated in each radio frame on TrCH *i* with transport format combination *j*.

If negative – number of bits to be punctured in each radio frame on TrCH *i* with transport format combination *j*.

RM_i: Semi-static rate matching attribute for TrCH *i*. Signalled from higher layers.

PL: Puncturing limit for uplink. This value limits the amount of puncturing that can be applied in order to minimise the number of dedicated physical channels. Signalled from higher layers.

$N_{data,j}$: Total number of bits that are available for a CCTrCH in a radio frame with transport format combination j.

I: Number of TrCHs in a CCTrCH.

Z_{mj}: Intermediate calculation variable.

F_i: Number of radio frames in the transmission time interval of TrCH *i*.

n_i: Radio frame number in the transmission time interval of TrCH *i* ($0 \le n_i < F_i$).

Q: Average puncturing distance.

$I_F(n_i)$: The inverse interleaving function of the 1st interleaver (note that the inverse interleaving function is identical to the interleaving function itself for the 1st interleaver).

$S(n_i)$: The shift of the puncturing pattern for radio frame n_i.

$TF_i(j)$: Transport format of TrCH i for the transport format combination j.

TFS(i): The set of transport format indexes *l* for TrCH i.

e_{ini} Initial value of variable *e* in the rate matching pattern determination algorithm of section 4.2.7.3.

e_{plus} Increment of variable *e* in the rate matching pattern determination algorithm of section 4.2.7.3.

e_{minus} Decrement of variable *e* in the rate matching pattern determination algorithm of section 4.2.7.3.

~~*X*~~*b*: Indicates systematic and parity bits
b=1: Systematic bit. *X(t)* in section 4.2.3.2.1.
Y: *b*=2: 1st parity bit (from the upper Turbo constituent encoder). *Y(t)* in section 4.2.3.2.1.
Y': *b*=3: 2nd parity bit (from the lower Turbo constituent encoder). *Y'(t)* in section 4.2.3.2.1.

~~NOTE: Time index t in 4.2.3.2.1 is omitted for simplify the rate matching description~~

4.2.7.1 Determination of rate matching parameters

The following relations are used when calculating the rate matching pattern:

$$Z_{0,j} = 0$$

$$Z_{ij} = \left\lfloor \frac{\sum_{m=1}^{i} RM_m \cdot N_{mj}}{\sum_{m=1}^{I} RM_m \cdot N_{mj}} \cdot N_{data,j} \right\rfloor \quad \text{for all i = 1 .. I}$$

$$\Delta N_{ij} = Z_{ij} - Z_{i-1,j} - N_{ij} \quad \text{for all i = 1 .. I}$$

Puncturing can be used to minimise the required transmission capacity. The maximum amount of puncturing that can be applied is signalled from higher layers and denoted by PL. The possible values for N_{data} in depend on the number of dedicated physical channels and on their characteristics (spreading factor, length of midamble and TFCI, usage of TPC and multiframe structure), respectively. The supported set of N_{data} , denoted SET0, depends on the UE capabilities.

$N_{data,\,j}$ for the transport format combination j is determined by executing the following algorithm:

SET1 = { N_{data} in SET0 such that $N_{data} - PL \cdot \sum_{x=1}^{I} \frac{RM_x}{\min_{1\le y\le I}\{RM_y\}} \cdot N_{x,j}$ is non negative }

$N_{data,\,j}$ = min SET1

The number of bits to be repeated or punctured, ΔN_{ij}, within one radio frame for each TrCH i is calculated with the relations given at the beginning of this section for all possible transport format combinations j and selected every radio frame.

If $\Delta N_{ij} = 0$ then the output data of the rate matching is the same as the input data and the rate matching algorithm of section 4.2.7.3 does not need to be executed.

Otherwise, the rate matching pattern is calculated with the algorithm described in section 4.2.7.3. For this algorithm the parameters e_{ini}, e_{plus}, e_{minus}, and X_i~~N~~ are needed, which are calculated according to the ~~following~~ equations in section 4.2.7.1.1 and 4.2.7.1.2.~~:~~

~~For convolutional codes,~~

4.2.7.1.1 Uncoded and convolutionally encoded TrCHs

a = 2

$\Delta N_i = \Delta N_{i,j}$

X_i~~N~~ $= N_{i,j}$

q= $\lfloor X_i$~~N~~ $/(|\Delta N_i|)\rfloor$

If q is even

then q' = q – gcd(q, F_i)/F_i -- where gcd (q, F_i) means greatest common divisor of q and F_i

-- note that q' is not an integer, but a multiple of 1/8

else

q' = q

endif

for x = 0 to F_i-1

S(I_F ($\lceil$x*q'$\rceil$ mod F_i)) = ($\lceil$x*q'$\rceil$ div F_i)–

End for

$e_{ini} = (a \cdot S(n_i) \cdot |\Delta N_i| + X_i N) \bmod (a \cdot X_i N)$, if $e_{ini} = 0$ then $e_{ini} = a \cdot X_i N$.

$e_{plus} = a \cdot X_i N$

$e_{minus} = a \cdot |\Delta N_i|$

puncturing for $\Delta N_i < 0$, repetitionating otherwise.

4.2.7.1.2 Turbo encoded TrCHs

For turbo codes, if repetition is to be performed, such as $\Delta N_{i,j} > 0$, parameters for turbo codes are the same as parameter for convolutional codes. If repetition is to be performed on turbo encoded TrCHs, i.e. $\Delta N_{i,j} > 0$, the parameters in section 4.2.7.1.1 are used.

If puncturing is to be performed, the parameters are as followsbelow shall be used. Index *b* is used to indicate systematic (*b*=1), 1st parity (*b*=2), and 2nd parity bit (*b*=3).

a = 2 when *b*=2for Y sequence, and

a = 1 when *b*=3for Y' sequence.

$$\Delta N_i = \begin{cases} \lfloor \Delta N_{i,j}/2 \rfloor, & b=2 \\ \lceil \Delta N_{i,j}/2 \rceil, & b=3 \end{cases} \quad \Delta N = \begin{cases} \lfloor \Delta N_{i,j}/2 \rfloor & \text{for Y sequence} \\ \lceil \Delta N_{i,j}/2 \rceil & \text{for Y' sequence} \end{cases}$$

$N\ X_i = \lfloor N_{i,j}/3 \rfloor$,

$q = \lfloor N\ X_i / |\Delta N_i| \rfloor$

if($q \leq 2$)

for x=0 to F_i-1

S[I_F[(3x+b-1) mod F_i]] = x mod 2;if(Y sequence)

S[I_F[(3x+1) mod F_i]] = x mod 2;

if(Y' sequence)

S[I_F [(3x+2) mod F_i]] = x mod 2;

end for

else

if q is even

then $q' = q - gcd(q, F_i)/F_i$ -- where $gcd(q, F_i)$ means greatest common divisor of q and F_i

-- note that q' is not an integer, but a multiple of 1/8

else $q' = q$

endif

for x=0 to F_i –1

$r = \lceil x*q' \rceil \bmod F_i$;

S[I_F[(3r+b-1) mod F_i]] = ⌈ x*q' ⌉ div F_i;if(Y sequence)

S[I_F[(3r+1) mod F_i]] = ⌈ x*q' ⌉ div F_i;

if(Y' sequence)

S[I_F[(3r+2) mod F_i]] = ⌈ x*q' ⌉ div F_i;

endfor

endif

For each radio frame, the rate-matching pattern is calculated with the algorithm in section 4.2.7.3, where:

~~N~~X_i is as above,

$e_{ini} = (a \cdot S(n_i) \cdot |\Delta N_i| + X_i) \bmod (a \cdot X_i)$, if $e_{ini} = 0$ then $e_{ini} = a \cdot X_i$.

$e_{plus} = a \cdot X_i$

$e_{minus} = a \cdot |\Delta N_i|$

~~puncturing for ΔN<0, repeating otherwise.~~

4.2.7.2 Bit separation and collection for rate matching

The systematic bits (excluding bits for trellis termination) of turbo encoded TrCHs shall not be punctured. The systematic bit, first parity bit, and second parity bit in the bit sequence input to the rate matching block are therefore separated from each other. Puncturing is only applied to the parity bits and systematic bits used for trellis termination.

The bit separation function is transparent for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition. The bit separation and bit collection are illustrated in figures 4-5 and 4-6.

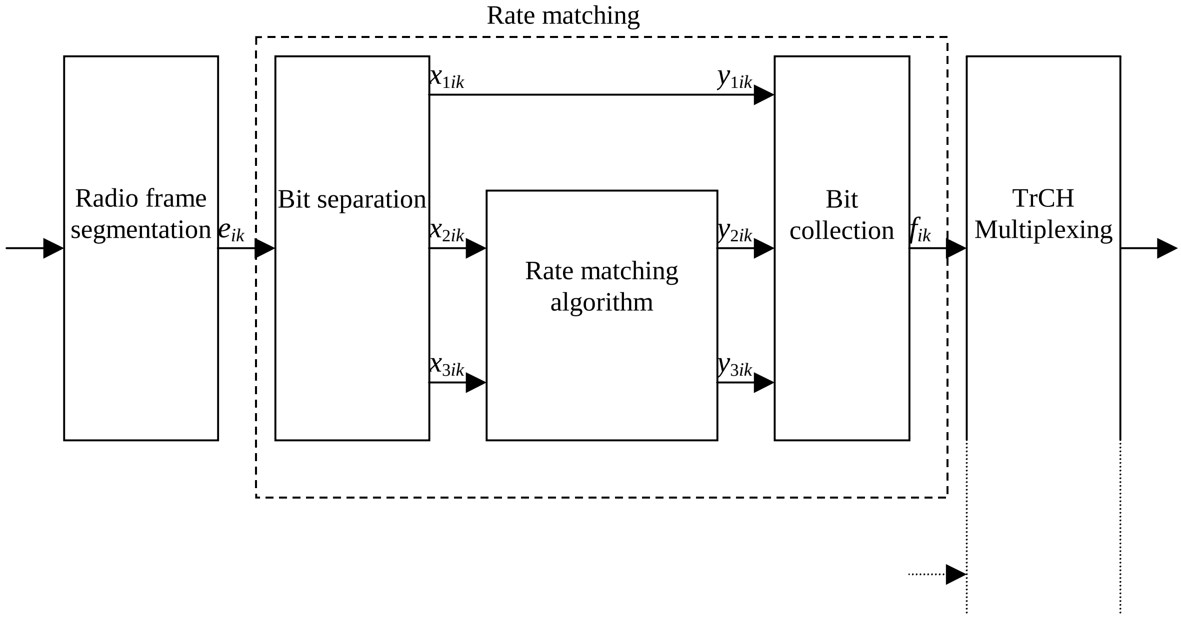


Figure 4-5: Puncturing of turbo encoded TrCHs

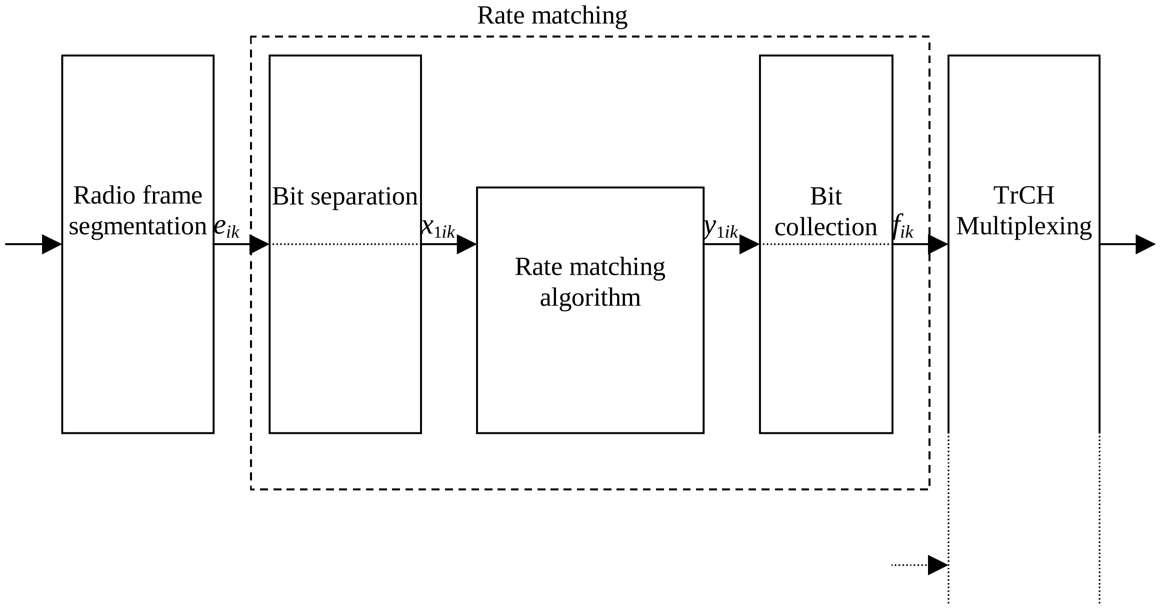


Figure 4-6: Rate matching for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition.

The bit separation is dependent on the 1st interleaving and offsets are used to define the separation for different TTIs. The offsets α_b for the systematic (b=1) and parity bits ($b \in \{2, 3\}$) are listed in table 4.2.7-1.

Table 4.2.7-1: TTI dependent offset needed for bit separation

TTI (ms)	α_1	α_2	α_3
10, 40	0	1	2
20, 80	0	2	1

The bit separation is different for different radio frames in the TTI. A second offset is therefore needed. The radio frame number for TrCH i is denoted by n_i. and the offset by β_{n_i}.

Table 4.2.7-2: Radio frame dependent offset needed for bit separation

TTI (ms)	β_0	β_1	β_2	β_3	β_4	β_5	β_6	β_7
10	0	NA	NA	NA	NA	NA	NA	NA
20	0	1	NA	NA	NA	NA	NA	NA
40	0	1	2	0	NA	NA	NA	NA
80	0	1	2	0	1	2	0	1

4.2.7.2.1 Bit separation

The bits input to the rate matching are denoted by $e_{i1}, e_{i2}, e_{i3}, \ldots, e_{iN_i}$, where i is the TrCH number and N_i is the number of bits input to the rate matching block. Note that the transport format combination number j for simplicity has been left out in the bit numbering, i.e. N_i=N_{ij}. The bits after separation are denoted by $x_{bi1}, x_{bi2}, x_{bi3}, \ldots, x_{biX_i}$. For turbo encoded TrCHs with puncturing, b indicates systematic, first parity, or second parity bit. For all other cases b is defined to be 1. X_i is the number of bits in each separated bit sequence. The relation between e_{ik} and x_{bik} is given below.

For turbo encoded TrCHs with puncturing:

$$x_{1,i,k} = e_{i,3(k-1)+1+(\alpha_1+\beta_{n_i}) \bmod 3} \qquad k = 1, 2, 3, \ldots, X_i \qquad X_i = \lfloor N_i /3 \rfloor$$

$x_{1,i,\lfloor N_i/3 \rfloor + k} = e_{i,3\lfloor N_i/3 \rfloor + k}$ $k = 1, \ldots, N_i \bmod 3$ Note: When (N_i mod 3) = 0 this row is not needed.

$x_{2,i,k} = e_{i,3(k-1)+1+(\alpha_2+\beta_{n_i}) \bmod 3}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = \lfloor N_i/3 \rfloor$

$x_{3,i,k} = e_{i,3(k-1)+1+(\alpha_3+\beta_{n_i}) \bmod 3}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = \lfloor N_i/3 \rfloor$

For uncoded TrCHs, convolutionally encoded TrCHs, and turbo encoded TrCHs with repetition:

$x_{1,i,k} = e_{i,k}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = N_i$

4.2.7.2.2 Bit collection

The bits x_{bik} are input to the rate matching algorithm described in section 4.2.7.3. The bits output from the rate matching algorithm are denoted $y_{bi1}, y_{bi2}, y_{bi3}, \ldots, y_{biY_i}$.

Bit collection is the inverse function of the separation. The bits after collection are denoted by $z_{bi1}, z_{bi2}, z_{bi3}, \ldots, z_{biY_i}$. After bit collection, the bits indicated as punctured are removed and the bits are then denoted by $f_{i1}, f_{i2}, f_{i3}, \ldots, f_{iV_i}$, where *i* is the TrCH number and $V_i = N_{ij} + \Delta N_{ij}$. The relations between y_{bik}, z_{bik}, and f_{ik} are given below.

For turbo encoded TrCHs with puncturing ($Y_i = X_i$):

$z_{i,3(k-1)+1+(\alpha_1+\beta_{n_i}) \bmod 3} = y_{1,i,k}$ $k = 1, 2, 3, \ldots, Y_I$

$z_{i,3\lfloor N_i/3 \rfloor + k} = y_{1,i,\lfloor N_i/3 \rfloor + k}$ $k = 1, \ldots, N_i \bmod 3$ Note: When (N_i mod 3) = 0 this row is not needed.

$z_{i,3(k-1)+1+(\alpha_2+\beta_{n_i}) \bmod 3} = y_{2,i,k}$ $k = 1, 2, 3, \ldots, Y_i$

$z_{i,3(k-1)+1+(\alpha_3+\beta_{n_i}) \bmod 3} = y_{3,i,k}$ $k = 1, 2, 3, \ldots, Y_i$

After the bit collection, bits $z_{i,k}$ with value δ, where $\delta \notin \{0, 1\}$, are removed from the bit sequence. Bit $f_{i,1}$ corresponds to the bit $z_{i,k}$ with smallest index *k* after puncturing, bit $f_{i,2}$ corresponds to the bit $z_{i,k}$ with second smallest index *k* after puncturing, and so on.

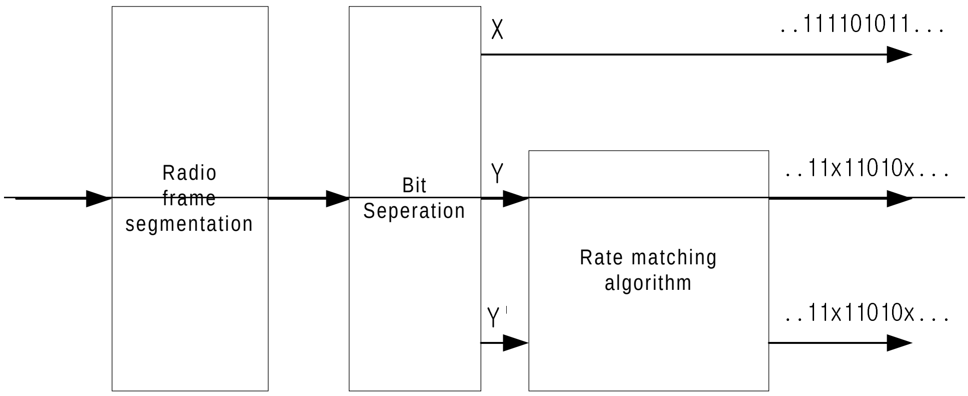
For uncoded TrCHs, convolutionally encoded TrCHs, and turbo encoded TrCHs with repetition:

$z_{i,k} = y_{1,i,k}$ $k = 1, 2, 3, \ldots, Y_i$

When repetition is used, $f_{i,k} = z_{i,k}$ and $Y_i = V_i$.

When puncturing is used, $Y_i = X_i$ and bits $z_{i,k}$ with value δ, where $\delta \notin \{0, 1\}$, are removed from the bit sequence. Bit $f_{i,1}$ corresponds to the bit $z_{i,k}$ with smallest index *k* after puncturing, bit $f_{i,2}$ corresponds to the bit $z_{i,k}$ with second smallest index *k* after puncturing, and so on.

~~4.2.7.2 Bit separation for rate matching~~



~~Figure 4-5: Overall rate matching block diagram after first interleaving where x denotes punctured bit~~

~~Rate matching puncturing for Turbo codes is applied separately to *Y* and *Y'* sequences. No puncturing is applied to *X* sequence. Therefore, it is necessary to separate *X*, *Y*, and *Y'* sequences before rate matching is applied.~~

~~There are two different alternation patterns in bit stream from Radio frame segmentation according to the TTI of a TrCH as shown in table 4.2.7-1.~~

~~Table 4.2.7-1: Alternation patterns of bits from radio frame segmentation~~

~~TTI (msec)~~	~~Alternation patterns~~
~~10, 40~~	~~… X,Y,Y',…~~
~~20, 80~~	~~… X,Y',Y,…~~

~~In addition, each radio frame of a TrCH starts with different initial parity type. Table 4.2.7-2 shows the initial parity type of each radio frame of a TrCH with TTI = {10, 20, 40, 80} msec.~~

~~Table 4.2.7-2: Initial parity type of radio frames of TrCH~~

~~TTI (msec)~~	~~Radio frame indexes (n_i)~~							
	~~0~~	~~1~~	~~2~~	~~3~~	~~4~~	~~5~~	~~6~~	~~7~~
~~10~~	~~X~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~
~~20~~	~~X~~	~~Y~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~
~~40~~	~~X~~	~~Y'~~	~~Y~~	~~X~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~
~~80~~	~~X~~	~~Y~~	~~Y'~~	~~X~~	~~Y~~	~~Y'~~	~~X~~	~~Y~~

~~Tables 4.2.7-1 and 4.2.7-2 defines a complete output bit pattern from Radio frame segmentation.~~

~~Ex. 1. TTI = 40 msec, n_i = 2~~
~~Radio frame pattern: *Y, Y', X, Y, Y', X, Y, Y', X, …*~~

~~Ex. 2 TTI = 40 msec, n_i = 3~~
~~Radio frame pattern: *X, Y, Y', X, Y, Y', X, Y, Y', X, …*~~

~~Therefore, bit separation is achieved with the alternative selection of bits with the initial parity type and alternation pattern specified in tables 4.2.7-1 and 4.2.7-2 according to the TTI and n_i of a TrCH.~~

4.2.7.3 Rate matching pattern determination

The bits input to the rate matching are denoted by $x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$ ~~$e_{i1}, e_{i2}, e_{13}, \ldots, e_{iN_i}$~~, where i is the TrCH ~~with $X_i = N_{ij} = N_i$. Here N~~ and X_i is the parameter given in sections 4.2.7.1.1 and 4.2.7.1.2. The bits output from the rate matching are denoted by $f_{i1}, f_{i2}, f_{13}, \ldots, f_{iV_i}$, where i is the TrCH number and V_i=N+ΔN .

Note that the transport format combination number j for simplicity has been left out in the bit numbering.

The rate matching rule is as follows:

```
if puncturing is to be performed
    e = e_ini     -- initial error between current and desired puncturing ratio
    m = 1         -- index of current bit
    do while m <= X_i N
        e = e – e_minus          -- update error
        if e <= 0 then           -- check if bit number m should be punctured
            set bit x_i,m to δ where δ∉{0, 1} puncture bit e_i,m
            e = e + e_plus       -- update error
        end if
        m = m + 1                --  next bit
    end do
else
    e = e_ini     -- initial error between current and desired puncturing ratio
    m = 1              -- index of current bit
    do while m <= X_i N
        e = e – e_minus          -- update error
        do while e <= 0          -- check if bit number m should be repeated
            repeat bit x_i,m e_i,m
            e = e + e_plus   -- update error
        end do
        m = m + 1                --  next bit
    end do
end if
```

A repeated bit is placed directly after the original one.

TSG-RAN Working Group 1(Radio) meeting #9 ***TSGR1#9(99) j12***

30 November – 3 December 1999, Dresden, Germany

Source : LGIC

Title : Revised CR to 25.222 for initial offset value change for convolutional code rate matching

Document for : Approval

1 Introduction

In WG1 #8 in New York, the proposal of changing the current initial offset value of rate matching algorithm for convolutional code[Tdoc R1-99g86] was approved in the plenary. But it was pointed out that the format of CR was wrong and was requested to be revised according to the CR rule with CR number.

The purpose of this document is to provide the revised CR of original Tdoc R1-99g86.

2 Text Proposal

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

Document ???99???
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.

25.222 CR 003 Current Version:

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)
		for information		non-strategic	

list expected approval meeting # here ↑

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: LGIC **Date:** 1999-11-22

Subject: Changing the initial offset value for convolutional code rate matching

Work item:

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

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

Release:

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

Reason for change: Current initial offset value for convolutional code rate matching provides a poor performance.

Clauses affected: 4.2.7.1 Determination of rate matching parameters

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:

help.doc

<--------- double-click here for help and instructions on how to create a CR.

4.2.7.1 Determination of rate matching parameters

The following relations are used when calculating the rate matching pattern:

$$Z_{0,j} = 0$$

$$Z_{ij} = \left\lfloor \frac{\sum_{m=1}^{i} RM_m \cdot N_{mj}}{\sum_{m=1}^{I} RM_m \cdot N_{mj}} \cdot N_{data,j} \right\rfloor \quad \text{for all i = 1 .. I}$$

$$\Delta N_{ij} = Z_{ij} - Z_{i-1,j} - N_{ij} \quad \text{for all i = 1 .. I}$$

Puncturing can be used to minimise the required transmission capacity. The maximum amount of puncturing that can be applied is signalled from higher layers and denoted by PL. The possible values for N_{data} in depend on the number of dedicated physical channels and on their characteristics (spreading factor, length of midamble and TFCI, usage of TPC and multiframe structure), respectively. The supported set of N_{data} , denoted SET0, depends on the UE capabilities.

$N_{data, j}$ for the transport format combination j is determined by executing the following algorithm:

SET1 = { N_{data} in SET0 such that $N_{data} - PL \cdot \sum_{x=1}^{I} \frac{RM_x}{\min_{1 \le y \le I} \{RM_y\}} \cdot N_{x,j}$ is non negative }

$N_{data, j}$ = min SET1

The number of bits to be repeated or punctured, ΔN_{ij}, within one radio frame for each TrCH i is calculated with the relations given at the beginning of this section for all possible transport format combinations j and selected every radio frame.

If $\Delta N_{ij} = 0$ then the output data of the rate matching is the same as the input data and the rate matching algorithm of section 4.2.7.3 does not need to be executed.

Otherwise, the rate matching pattern is calculated with the algorithm described in section 4.2.7.3. For this algorithm the parameters e_{ini}, e_{plus}, e_{minus}, and N are needed, which are calculated according to the following equations:

For convolutional codes,

a = 2

$\Delta N = \Delta N_{i,j}$

$N = N_{i,j}$

$q = \lfloor N / (|\Delta N|) \rfloor$

If q is even

then q' = q – gcd(q, F_i)/F_i -- where gcd (q, F_i) means greatest common divisor of q and F_i

-- note that q' is not an integer, but a multiple of 1/8

else

q' = q

endif

for x = 0 to F_i-1

$S(I_F(\lceil x*q' \rceil \bmod F_i)) = (\lceil x*q' \rceil \text{ div } F_i)$–

End for

$e_{ini} = (a \cdot S(n_i) \cdot |\Delta N| + 1) \bmod a \cdot N.$

$e_{plus} = a \cdot N$

$e_{minus} = a \cdot |\Delta N|$

puncturing for $\Delta N<0$, repeating otherwise.

For turbo codes, if repetition is to be performed, such as $\Delta N_{i,j} >0$, parameters for turbo codes are the same as parameter for convolutional codes. If puncturing is to be performed, parameters are as follows.

a = 2 for Y sequence, and

a = 1 for Y' sequence.

$$\Delta N = \begin{cases} \lfloor \Delta N_{i,j} / 2 \rfloor \text{for Y sequence} \\ \lceil \Delta N_{i,j} / 2 \rceil \text{for Y' sequence} \end{cases}$$

$N = \lfloor N_{i,j} / 3 \rfloor$,

$q = \lfloor N / |\Delta N| \rfloor$

if($q \leq 2$)

for x=0 to F_i-1

if(Y sequence)

$S[I_F[(3x+1) \bmod F_i]] = x \bmod 2;$

if(Y' sequence)

$S[I_F[(3x+2) \bmod F_i]] = x \bmod 2;$

end for

else

if q is even

then $q' = q - gcd(q, F_i)/F_i$ -- where $gcd(q, F_i)$ means greatest common divisor of q and F_i

-- note that q' is not an integer, but a multiple of 1/8

else $q' = q$

endif

for x=0 to F_i –1

$r = \lceil x*q' \rceil \bmod F_i;$

if(Y sequence)

$S[I_F[(3r+1) \bmod F_i]] = \lceil x*q' \rceil \text{ div } F_i;$

if(Y' sequence)

$S[I_F[(3r+2) \bmod F_i]] = \lceil x*q' \rceil \text{ div } F_i;$

endfor

endif

For each radio frame, the rate-matching pattern is calculated with the algorithm in section 4.2.7.3, where:

N is as above,

$e_{ini} = (a \cdot S(n_i) \cdot |\Delta N| + N) \bmod a \cdot N$, if $e_{ini} = 0$ then $e_{ini} = a \cdot N$.

$e_{plus} = a \cdot N$

$e_{minus} = a \cdot |\Delta N|$

puncturing for $\Delta N<0$, repeating otherwise.

3GPP TSG-RAN WG1 (Radio) Meeting #9 ***Document*** ***R1-99i94***

Dresden, Germany, 30 Nov- 03 Dec 1999

3G CHANGE REQUEST

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

25.222 CR 007 Current Version: 3.0.0

3G specification number ↑ *↑ CR number as allocated by 3G support team*

For submision to TSG RAN #6 for approval [X] for information [ ] *(only one box should be marked with an X)*

list TSG meeting no. here ↑

Form: 3G CR cover sheet, version 1.0 *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/3GCRF-xx.rtf*

Proposed change affects: USIM [ ] ME [X] UTRAN [X] Core Network [ ]

(at least one should be marked with an X)

Source: Siemens AG **Date:** 24th November 99

Subject: Update of rate matching rule for TDD

3G Work item: TS 25.222

Category:

	F	Correction	X
	A	Corresponds to a correction in a 2G specification	
(only one category	B	Addition of feature	
shall be marked	C	Functional modification of feature	
with an X)	D	Editorial modification	

Reason for change: For TDD the puncturing limit is needed for both, uplink and downlink. Further, a more precise formulation regarding the determination of physical channels dependent on the respective TFC has been included.

Clauses affected: 4.2.7, 4.2.7.1

Other specs affected:

Other 3G core specifications	[ ]	→ List of CRs:
Other 2G 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:

help.doc

<--------- double-click here for help and instructions on how to create a CR.

4.2.7 Rate matching

Rate matching means that bits on a TrCH are repeated or punctured. Higher layers assign a rate-matching attribute for each TrCH. This attribute is semi-static and can only be changed through higher layer signalling. The rate-matching attribute is used when the number of bits to be repeated or punctured is calculated.

The number of bits on a TrCH can vary between different transmission time intervals. When the number of bits between different transmission time intervals is changed, bits are repeated to ensure that the total bit rate after second multiplexing is identical to the total channel bit rate of the allocated ~~deicated~~ physical channels.

Notation used in section 4.2.7 and subsections:

N_{ij}: Number of bits in a radio frame before rate matching on TrCH *i* with transport format combination *j* .

ΔN_{ij} : If positive – number of bits to be repeated in each radio frame on TrCH *i* with transport format combination *j*.

If negative – number of bits to be punctured in each radio frame on TrCH *i* with transport format combination *j*.

RM_i: Semi-static rate matching attribute for TrCH *i*. Signalled from higher layers.

PL: Puncturing limit ~~for uplink~~. This value limits the amount of puncturing that can be applied in order to minimise the number of ~~dedicated~~ physical channels. Signalled from higher layers.

$N_{data,j}$: Total number of bits that are available for a CCTrCH in a radio frame with transport format combination j.

P: maximum number of physical channels for a CCTrCH.

I: Number of TrCHs in a CCTrCH.

Z_{mj}: Intermediate calculation variable.

F_i: Number of radio frames in the transmission time interval of TrCH *i*.

n_i: Radio frame number in the transmission time interval of TrCH *i* ($0 \le n_i < F_i$).

Q: Average puncturing distance.

$I_F(n_i)$: The inverse interleaving function of the 1st interleaver (note that the inverse interleaving function is identical to the interleaving function itself for the 1st interleaver).

$S(n_i)$: The shift of the puncturing pattern for radio frame n_i.

$TF_i(j)$: Transport format of TrCH i for the transport format combination j.

TFS(i): The set of transport format indexes *l* for TrCH i.

e_{ini}: Initial value of variable e in the rate matching pattern determination algorithm of section 4.2.7.3.

e_{plus} Increment of variable *e* in the rate matching pattern determination algorithm of section 4.2.7.3.

e_{minus} Decrement of variable *e* in the rate matching pattern determination algorithm of section 4.2.7.3.

X: Systematic bit in 4.2.3.2.1.

Y: 1st parity bit (from the upper Turbo constituent encoder) in section 4.2.3.2.1.

Y': 2nd parity bit (from the lower Turbo constituent encoder) in section 4.2.3.2.1.

NOTE: Time index t in 4.2.3.2.1 is omitted for simplify the rate matching description

4.2.7.1 Determination of rate matching parameters

The following relations are used when calculating the rate matching pattern:

$$Z_{0,j} = 0$$

$$Z_{ij} = \left\lfloor \frac{\sum_{m=1}^{i} RM_m \cdot N_{mj}}{\sum_{m=1}^{I} RM_m \cdot N_{mj}} \cdot N_{data,j} \right\rfloor \quad \text{for all i = 1 .. I}$$

$$\Delta N_{ij} = Z_{ij} - Z_{i-1,j} - N_{ij} \quad \text{for all i = 1 .. I}$$

Puncturing can be used to minimise the required transmission capacity. The maximum amount of puncturing that can be applied is signalled from higher layers and denoted by PL. The possible values for N_{data} ~~in~~ depend on the number of ~~dedicated~~ physical channels P, allocated to the respective CCTrCH, and on their characteristics (spreading factor, length of midamble and TFCI, usage of TPC and multiframe structure), ~~respectively~~which is given in [7].

Denote the number of data bits in each physical channel by $N_{k,Sk}$, where *k* refers to the sequence number $1 \leq k \leq P$ of this physical channel in the allocation message, and the second index *Sk* indicates the spreading factor with the possible values {*16*, *8*, *4*, *2*, *1*}, respectively. For each physical channel an individual minimum spreading factor Sk_{min} is transmitted by means of the higher layer. Then, for N_{data} one of the following values in ascending order can be chosen: $\{N_{1,16}, \ldots, N_{1,S1min}, N_{1,S1min}+N_{2,16}, \ldots, N_{1,S1min}+N_{2,S2min}, \ldots, N_{1,S1min}+N_{2,S2min}+\ldots+N_{P,16}, \ldots, N_{1,S1min}+N_{2,S2min}+\ldots+N_{P,SPmin}\}$. ~~The supported set of N_{data}, denoted SET0, depends on the UE capabilities.~~

$N_{data,j}$ for the transport format combination j is determined by executing the following algorithm:

SET1 = { N_{data} ~~in SET0~~ such that $N_{data} - PL \cdot \sum_{x=1}^{I} \frac{RM_x}{\min_{1 \leq y \leq I} \{RM_y\}} \cdot N_{x,j}$ is non negative }

$N_{data,j}$ = min SET1

The number of bits to be repeated or punctured, ΔN_{ij}, within one radio frame for each TrCH i is calculated with the relations given at the beginning of this section for all possible transport format combinations j and selected every radio frame.

If $\Delta N_{ij} = 0$ then the output data of the rate matching is the same as the input data and the rate matching algorithm of section 4.2.7.3 does not need to be executed.

Otherwise, the rate matching pattern is calculated with the algorithm described in section 4.2.7.3. For this algorithm the parameters e_{ini}, e_{plus}, e_{minus}, and N are needed, which are calculated according to the following equations:

For convolutional codes,

a = 2

$\Delta N = \Delta N_{i,j}$

$N = N_{i,j}$

$q = \lfloor N / (|\Delta N|) \rfloor$

If q is even

then $q' = q - gcd(q, F_i)/F_i$ -- where gcd (q, F_i) means greatest common divisor of q and F_i

-- note that q' is not an integer, but a multiple of 1/8

else

q' = q

endif

for x = 0 to F_i-1

S(I_F ($\lceil x*q' \rceil$ mod F_i)) = ($\lceil x*q' \rceil$ div F_i)–

End for

e_{ini} = (a·S(n_i)·|ΔN| + N) mod a·N, if e_{ini} =0 then e_{ini} = a·N.

e_{plus} = a·N

$e_{minus} = a \cdot |\Delta N|$

puncturing for ΔN<0, repeating otherwise.

For turbo codes, if repetition is to be performed, such as $\Delta N_{i,j}$ >0, parameters for turbo codes are the same as parameter for convolutional codes. If puncturing is to be performed, parameters are as follows.

a = 2 for Y sequence, and

a = 1 for Y' sequence.

$$\Delta N = \begin{cases} \lfloor \Delta N_{i,j} / 2 \rfloor \text{for Y sequence} \\ \lceil \Delta N_{i,j} / 2 \rceil \text{for Y' sequence} \end{cases}$$

N = $\lfloor N_{i,j} /3 \rfloor$,

q = $\lfloor N / |\Delta N| \rfloor$

if(q$\leq$2)

for x=0 to F_i-1

if(Y sequence)

S[I_F[(3x+1) mod F_i]] = x mod 2;

if(Y' sequence)

S[I_F [(3x+2) mod F_i]] = x mod 2;

end for

else

if q is even

then $q' = q - gcd(q, F_i)/ F_i$ -- where $gcd (q, F_i)$ means greatest common divisor of q and F_i

-- note that q' is not an integer, but a multiple of 1/8

else $q' = q$

endif

for x=0 to F_i –1

r = $\lceil x*q' \rceil$ mod F_i;

if(Y sequence)

S[I_F[(3r+1) mod F_i]] = $\lceil x*q' \rceil$ div F_i;

if(Y' sequence)

$S[I_F[(3r+2) \bmod F_i]] = \lceil x*q' \rceil \text{ div } F_i$;dfor

endif

For each radio frame, the rate-matching pattern is calculated with the algorithm in section 4.2.7.3, where:

N is as above,

$e_{ini} = (a \cdot S(n_i) \cdot |\Delta N| + N) \bmod a \cdot N$, if $e_{ini} = 0$ then $e_{ini} = a \cdot N$.

$e_{plus} = a \cdot N$

$e_{minus} = a \cdot |\Delta N|$

puncturing for $\Delta N<0$, repeating otherwise.

3GPP TSG RAN WG1 Meeting #9
Dresden, Germany, 30 NOV 1999 - 03 DEC 1999

Document R1-99l37
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 009r1 Current Version: V3.0.0

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

For submission to: TSG RAN #6
list expected approval meeting # here ↑

for approval	X	strategic		*(for SMG use only)*
for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form :* 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: Nokia, Siemens **Date:** 2 Dec 1999

Subject: Modified physical channel mapping scheme

Work item: TS25.222

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

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

Release:

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

Reason for change: The current physical channel mapping scheme does not support the multi-code transmission optimally

Clauses affected: 6.2.11.1, 6.2.11.2

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:

help.doc

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---**starting section**--

6.2.11 Physical channel mapping

The PhCH for both uplink and downlink is defined in [6]. The bits after physical channel mapping are denoted by $w_{p1}, w_{p2}, \ldots, w_{pU_p}$, where p is the PhCH number and U_p is the number of bits in one radio frame for the respective PhCH. The bits w_{pk} are mapped to the PhCHs so that the bits for each PhCH are transmitted over the air in ascending order with respect to k. The mapping scheme depends on the applied 2[nd] interleaving scheme.

6.2.11.1 Mapping scheme after frame related 2[nd] interleaving

6.2.11.1.1 Mapping scheme after frame related 2nd interleaving in uplink

In uplink there are at most two codes allocated (P≤2). If there is only one code, the same mapping as for downlink is applied, see section 6.2.11.1.2. Denote SF1 and SF2 the spreading factors used for code 1 and 2, respectively. Then denote the inverse relation of the spreading factors s1: s2 = SF2: SF1, where the smallest possible integers are used for s1 and s2.

The following mapping rule is applied:

Bits are mapped on the first PhCH (in forward order) if *(k-1)mod(s1+s2) = 0, …,* s1-1~~after physical channel mapping~~:

~~$w_{1k} = v_k$ $k = 1, 2, \ldots, U_1$~~

$w_{1,(k\,div\,(s1+s2))\cdot s1 + k \bmod (s1+s2)} = v_k$

else ~~B~~bits are mapped on the second PhCH (in reverse order)~~ after physical channel mapping~~:

~~$w_{2k} = v_{(k+U_1)}$ $k = U_2, U_2-1, \ldots\ldots 1$ $1, 2, \ldots, U_2$~~

$w_{2,U_2-(k\,div\,(s1+s2))\cdot s2 + k \bmod (s1+s2) - s1} = v_k$

~~…~~This formula is applied starting with k=1 and increasing k until one of the PhCH is completely filled. From then on, the remaining bits are mapped on the PhCH which has not been filled in the same order (forward or reverse depending on the PhCH) as used previously on that PhCH.

~~Bits on the odd numbered P^{th} PhCH after physical channel mapping (P = 1, 3, 5, …..):~~

~~$w_{Pk} = v_{(k+U_1+\ldots+U_{P-1})}$ $k = 1, 2, \ldots, U_P$~~

~~Bits on the even numbered P^{th} PhCH after physical channel mapping (P = 2, 4, 6, …..):~~

~~$w_{Pk} = v_{(k+U_1+\ldots+U_{P-1})}$ $k = U_P-1, U_P-2, \ldots, 1$~~

6.2.11.1.2 Mapping scheme after frame related 2nd interleaving in downlink

The mapping is equivalent to block interleaving, writing in colomns, but a PhCH with an odd number is filled in forward order, were as a PhCH with an even number is filled in reverse order.

The following mapping rule is applied:

Bits are mapped on an odd numbered PhCH (in forward order) according to the following rule, if (k mod P)+1 is odd:

$w_{k \bmod P+1,\, k\,div\,P} = v_k$

Bits are mapped on an even numbered PhCH (in reverse order) according to the following rule, if (k mod P)+1 is even:

$w_{k \bmod P+1,\, U_P-1-k\,div\,P} = v_k$

This formula is applied starting with k=1 and increasing k until all the PhCHs which carry TFCI are completely filled. From then on, the remaining bits are mapped on the remaining PhCHs in the same order (forward or reverse depending on the PhCH) as previously on these PhCHs.

6.2.11.2 Mapping scheme after timeslot related 2[nd] interleaving

For each timeslot only those physical channels with $p = 1, 2, \ldots, P_t$ are considered respectively, which are transmitted in that timeslot, and the following mapping scheme is applied:

--**starting section**---

6.2.11.2.1 Mapping scheme after timeslot related 2nd interleaving in uplink

In uplink there are at most two codes allocated (P≤2). If there is only one code, the same mapping as for downlink is applied, see section 6.2.11.1.2. Denote SF1 and SF2 the spreading factors used for code 1 and 2, respectively. Then denote the inverse relation of the spreading factors s1: s2 = SF2: SF1, where the smallest possible integers are used for s1 and s2.

The following mapping rule is applied:

Bits are mapped on the first PhCH (in forward order) if *(k-1)mod(s1+s2) = 0*, …, s1-1:

$$w_{1,(k\,div\,(s1+s2))\cdot s1+k\bmod(s1+s2)} = v_{tk}$$

else bits are mapped on the second PhCH (in reverse order):

$$w_{2,U_2-(k\,div\,(s1+s2))\cdot s2+k\bmod(s1+s2)-s1} = v_{tk}$$

This formula is applied starting with k=1 and increasing k until one of the PhCH is completely filled. From then on, the remaining bits are mapped on the PhCH which has not been filled in the same order (forward or reverse depending on the PhCH) as used previously on that PhCH.

6.2.11.2.2 Mapping scheme after timeslot related 2nd interleaving in downlink

The mapping is equivalent to block interleaving, writing in colomns, but a PhCH with an odd number is filled in forward order, were as a PhCH with an even number is filled in reverse order.

The following mapping rule is applied:

Bits are mapped on an odd numbered PhCH (in forward order) according to the following rule, if (k mod P_t)+1 is odd:

$$w_{k\bmod P_t+1,\,k\,div\,P_t} = v_{tk}$$

Bits are mapped on an even numbered PhCH (in reverse order) according to the following rule, if (k mod P_t)+1 is even:

$$w_{k\bmod P_t+1,\,U_{P_t}-1-k\,div\,P_t} = v_{tk}$$

This formula is applied starting with k=1 and increasing k until all the PhCHs which carry TFCI are completely filled. From then on, the remaining bits are mapped on the remaining PhCHs in the same order (forward or reverse depending on the PhCH) as previously on these PhCHs.

~~Bits on first PhCH in timeslot *t* after physical channel mapping:~~

~~$w_{1k} = v_{tk}$ $k = 1, 2, \ldots, U_1$~~

~~Bits on second PhCH in timeslot *t* after physical channel mapping:~~

~~$w_{2k} = v_{t(k+U_1)}$ $k = U_2, U_2-1, \ldots\ldots 1$ 1, 2, …, U_2~~

…

~~Bits on the odd numbered PhCH P_t in timeslot *t* after physical channel mapping (P = 1, 3, 5, …..)::~~

~~$w_{P_t k} = v_{t(k+U_1+\ldots+U_{P_t-1})}$ $k = 1, 2, \ldots, U_{P_t}$~~

~~Bits on the even numbered P^{th} PhCH P_t in timeslot *t* after physical channel mapping (P = 2, 4, 6, …..):~~

~~$w_{Pk} = v_{t(k+U_1+\ldots+U_{P-1})}$ $k = U_P-1, U_P-2, \ldots, 1$~~

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Dresden, Germany, 30 Nov- 03 Dec 1999

***Document* R1-99k57**

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.

25.222 CR 013 Current Version: V3.0.0

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

For submission to:	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 AG	**Date:**	01 Dec 1999
Subject:	Introduction of TFCI for S-CCPCH in TDD mode		
Work item:	Usage of TFCI		

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: See Subject, additional information given in TDoc TSG RAN WG1 (99) i93

Clauses affected: 4.2.12

Other specs affected:	Other 3G core specifications	X	→ List of CRs:	25.221-CR001r2
	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:

help.doc

<--------- double-click here for help and instructions on how to create a CR.

4.2.12 Multiplexing of different transport channels onto one CCTrCH, and mapping of one CCTrCH onto physical channels

Different transport channels can be encoded and multiplexed together into one Coded Composite Transport Channel (CCTrCH). The following rules shall apply to the different transport channels which are part of the same CCTrCH:

1) Transport channels multiplexed into one CCTrCh should have co-ordinated timings in the sense that transport blocks arriving from higher layers on different transport channels of potentially different transmission time intervals shall have aligned transmission time instants as shown in figure 4-6.

2) Different CCTrCHs cannot be mapped onto the same physical channel.

3) One CCTrCH shall be mapped onto one or several physical channels.

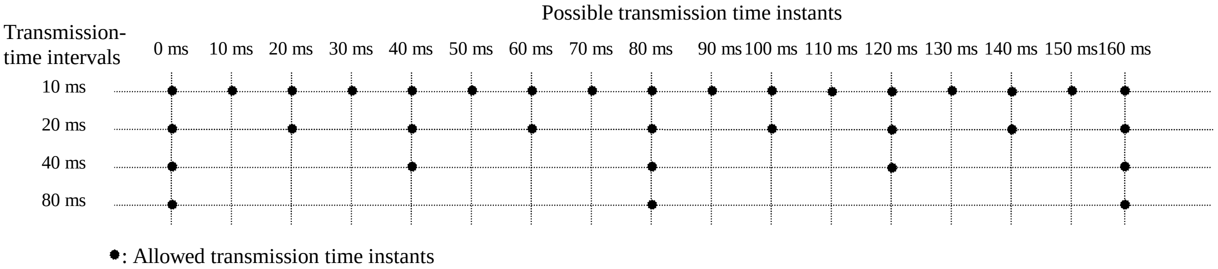

Figure 4-6: Possible transmission time instants regarding CCTrCH

4) Dedicated Transport channels and common transport channels cannot be multiplexed into the same CCTrCH.

5) For the common transport channels, only the FACH and PCH may belong to the same CCTrCH.

6) Each CCTrCH carrying a BCH shall carry only one BCH and shall not carry any other Transport Channel.

7) Each CCTrCH carrying a RACH shall carry only one RACH and shall not carry any other Transport Channel.

Hence, there are two types of CCTrCH

CCTrCH of dedicated type, corresponding to the result of coding and multiplexing of one or several DCH.

CCTrCH of common type, corresponding to the result of the coding and multiplexing of a common channel, i.e. RACH and USCH in the uplink and DSCH, BCH, FACH or PCH in the downlink, respectively.

Transmission of TFCI is possible for CCTrCH containing Transport Channels of:

- Dedicated type
- USCH type
- DSCH type
- FACH and/or PCH type.

4.2.12.1 Allowed CCTrCH combinations for one UE

4.2.12.1.1 Allowed CCTrCH combinations on the uplink

The following CCTrCH combinations for one UE are allowed, also simultaneously:

1) several CCTrCH of dedicated type

2) several CCTrCH of common type

4.2.12.1.2 Allowed CCTrCH combinations on the downlink

The following CCTrCH combinations for one UE are allowed, also simultaneously:

3) several CCTrCH of dedicated type

4) several CCTrCH of common type

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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	X	UTRAN / Radio	X	Core Network

Source:	Siemens, LGIC	**Date:**	1999-12-02
Subject:	TFCI coding and mapping in TDD		
Work item:			

Category:	F	Correction	X	**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			Release 98	
with an X)	D	Editorial modification			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.

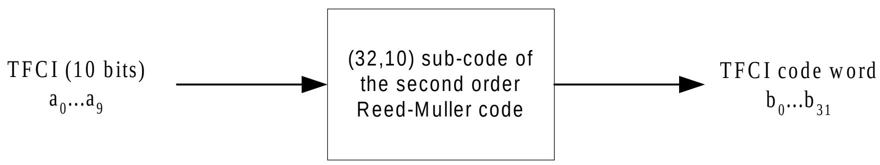


Figure 4.3.3.1-1: Channel coding of TFCI bits

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

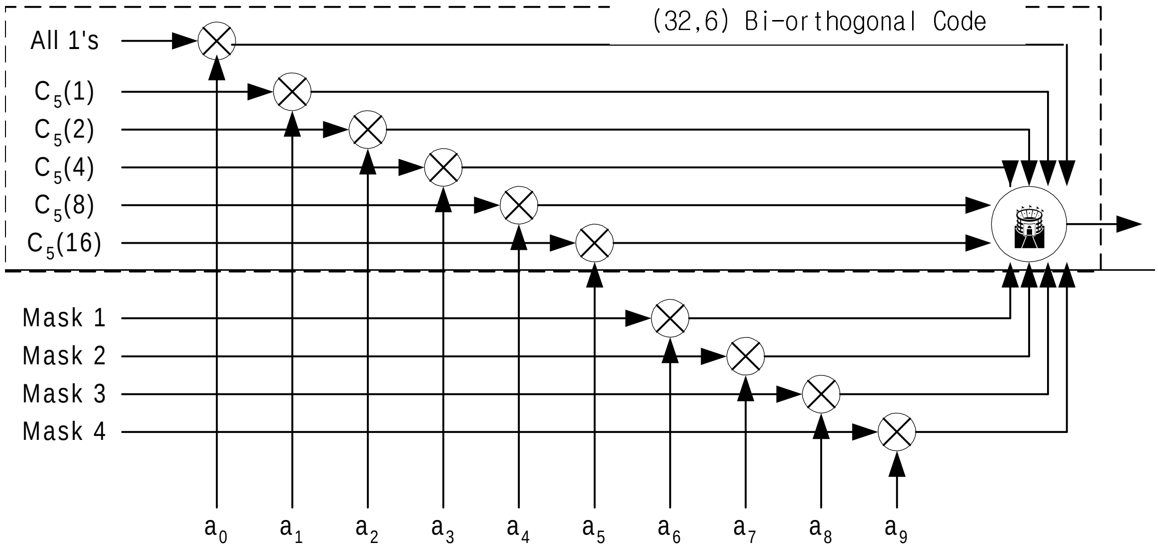
I	$M_{i,0}$	$M_{i,1}$	$M_{i,2}$	$M_{i,3}$	$M_{i,4}$	$M_{i,5}$	$M_{i,6}$	$M_{i,7}$	$M_{i,8}$	$M_{i,9}$
0	1	1	0	0	0	0	0	0	0	0
1	1	0	1	0	0	0	1	0	0	0
2	1	1	1	0	0	0	0	0	0	1
3	1	0	0	1	0	0	1	0	1	1
4	1	1	0	1	0	0	0	0	0	1
5	1	0	1	1	0	0	0	0	1	0
6	1	1	1	1	0	0	0	1	0	0
7	1	0	0	0	1	0	0	1	1	0
8	1	1	0	0	1	0	1	1	1	0
9	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 4~~3~~ 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, $S_{C_4} = \{C_4(0), C_4(1), \ldots, C_4(15)\}$ and its binary complement, $\bar{S}_{C_4} = \{\bar{C}_4(0), \bar{C}_4(1), \ldots, \bar{C}_4(15)\}$. 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.

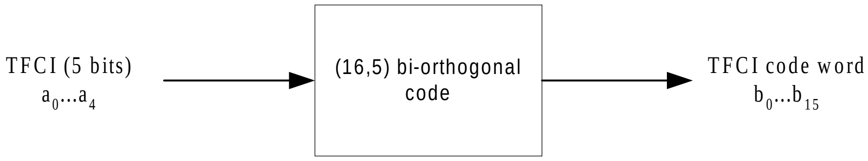


Figure 4-8: Channel coding of short length TFCI bits

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.

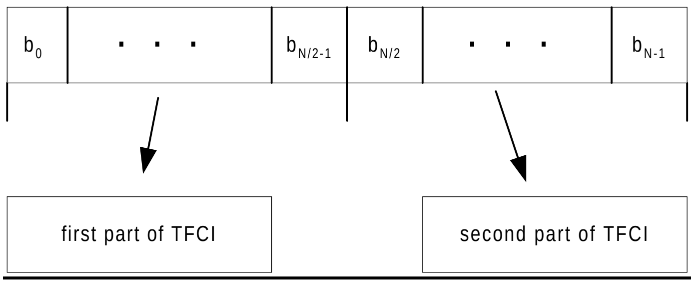


Figure 4-9: Mapping of TFCI word bits to timeslot

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.