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Contents

Foreword

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1 Scope

The present document describes multiplexing, channel coding and interleaving for UTRA Physical Layer TDD mode.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] 3G TS 25.202: "UE capabilities".

[2] 3G TS 25.211: "Transport channels and physical channels (FDD)".

[3] 3G TS 25.212: "Multiplexing and channel coding (FDD)".

[4] 3G TS 25.213: "Spreading and modulation (FDD)".

[5] 3G TS 25.214: "Physical layer procedures (FDD)".

[6] 3G TS 25.215: "Physical layer – Measurements (FDD)".

[7] 3G TS 25.221: "Transport channels and physical channels (TDD)".

[9] 3G TS 25.223: "Spreading and modulation (TDD)".

[10] 3G TS 25.224: "Physical layer procedures (TDD)".

[11] 3G TS 25.225: "Measurements".

[12] 3G TS S2.01: "Radio Interface Protocol Architecture".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

TrCH number: transport channel number represents a TrCH ID assigned to L1 by L2. Transport channels are multiplexed to the CCTrCH in the ascending order of these IDs.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

$\lceil x \rceil$	round towards ∞, i.e. integer such that $x \le \lceil x \rceil < x+1$
$\lfloor x \rfloor$	round towards -∞, i.e. integer such that $x-1 < \lfloor x \rfloor \le x$
$\lvert x \rvert$	absolute value of x

Unless otherwise is explicitly stated when the symbol is used, the meaning of the following symbols are:

i	TrCH number
j	TFC number
k	Bit number
l	TF number
m	Transport block number
n	Radio frame number
p	PhCH number
r	Code block number
I	Number of TrCHs in a CCTrCH.
C_i	Number of code blocks in one TTI of TrCH i.
F_i	Number of radio frames in one TTI of TrCH i.
M_i	Number of transport blocks in one TTI of TrCH i.
P	Number of PhCHs used for one CCTrCH.
PL	Puncturing Limit. Signalled from higher layers
RM_i	Rate Matching attribute for TrCH i. Signalled from higher layers.

Temporary variables, i.e. variables used in several (sub)clauses with different meaning.

x, X
y, Y
z, Z

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

<ACRONYM>	<Explanation>
ARQ	Automatic Repeat on Request
BCH	Broadcast Channel
BER	Bit Error Rate
BS	Base Station
BSS	Base Station Subsystem
CBR	Constant Bit Rate
CCCH	Common Control Channel
CCTrCH	Coded Composite Transport Channel
CDMA	Code Division Multiple Access
CFN	Connection Frame Number
CRC	Cyclic Redundancy Check
DCA	Dynamic Channel Allocation
DCCH	Dedicated Control Channel
DCH	Dedicated Channel
DL	Downlink
DRX	Discontinuous Reception
DSCH	Downlink Shared Channel
DTX	Discontinuous Transmission
FACH	Forward Access Channel
FDD	Frequency Division Duplex
FDMA	Frequency Division Multiple Access
FEC	Forward Error Control
FER	Frame Error Rate
GF	Galois Field
JD	Joint Detection
L1	Layer 1
L2	Layer 2
LLC	Logical Link Control
MA	Multiple Access
MAC	Medium Access Control
MS	Mobile Station
MT	Mobile Terminated
NRT	Non-Real Time

OVSF	Orthogonal Variable Spreading Factor
PC	Power Control
PCCC	Parallel Concatenated Convolutional Code
PCH	Paging Channel
PhCH	Physical Channel
PI	Paging Indicator
QoS	Quality of Service
QPSK	Quaternary Phase Shift Keying
RACH	Random Access Channel
RF	Radio Frequency
RLC	Radio Link Control
RRC	Radio Resource Control
RRM	Radio Resource Management
RSC	Recursive Systematic Convolutional Coder
RT	Real Time
RU	Resource Unit
SCCC	Serial Concatenated Convolutional Code
SCH	Synchronization Channel
SNR	Signal to Noise Ratio
TCH	Traffic channel
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
TFC	Transport Format Combination
TFCI	Transport Format Combination Indicator
TPC	Transmit Power Control
TrBk	Transport Block
TrCH	Transport Channel
TTI	Transmission Time Interval
UE	User Equipment
UL	Uplink
UMTS	Universal Mobile Telecommunications System
USCH	Uplink Shared Channel
UTRA	UMTS Terrestrial Radio Access
VBR	Variable Bit Rate

4 Multiplexing, channel coding and interleaving

4.1 General

Data stream from/to MAC and higher layers (Transport block / Transport block set) is encoded/decoded to offer transport services over the radio transmission link. Channel coding scheme is a combination of error detection, error correcting (including rate matching), and interleaving and transport channels mapping onto/splitting from physical channels.

In the UTRA-TDD mode, the total number of basic physical channels (a certain time slot one spreading code on a certain carrier frequency) per frame is given by the maximum number of time slots which is 15 and the maximum number of CDMA codes per time slot.

4.2 Transport channel coding/multiplexing

Figure 1 illustrates the overall concept of transport-channel coding and multiplexing. Data arrives to the coding/multiplexing unit in form of transport block sets, once every transmission time interval. The transmission time interval is transport-channel specific from the set {10 ms, 20 ms, 40 ms, 80 ms}.

The following coding/multiplexing steps can be identified:

- add CRC to each transport block (see subclause 4.2.1);

- TrBk concatenation / Code block segmentation (see subclause 4.2.2);

- channel coding (see subclause 4.2.3) ;
- radio frame size equalization (see subclause 4.2.4);
- interleaving (two steps, see subclauses 4.2.5 and 4.2.10);
- radio frame segmentation (see subclause 4.2.6);
- rate matching (see subclause 4.2.7);
- multiplexing of transport channels (see subclause 4.2.8);
- physical channel segmentation (see subclause 4.2.9);
- mapping to physical channels (see subclause 4.2.11).

The coding/multiplexing steps for uplink and downlink are shown in figure 1.

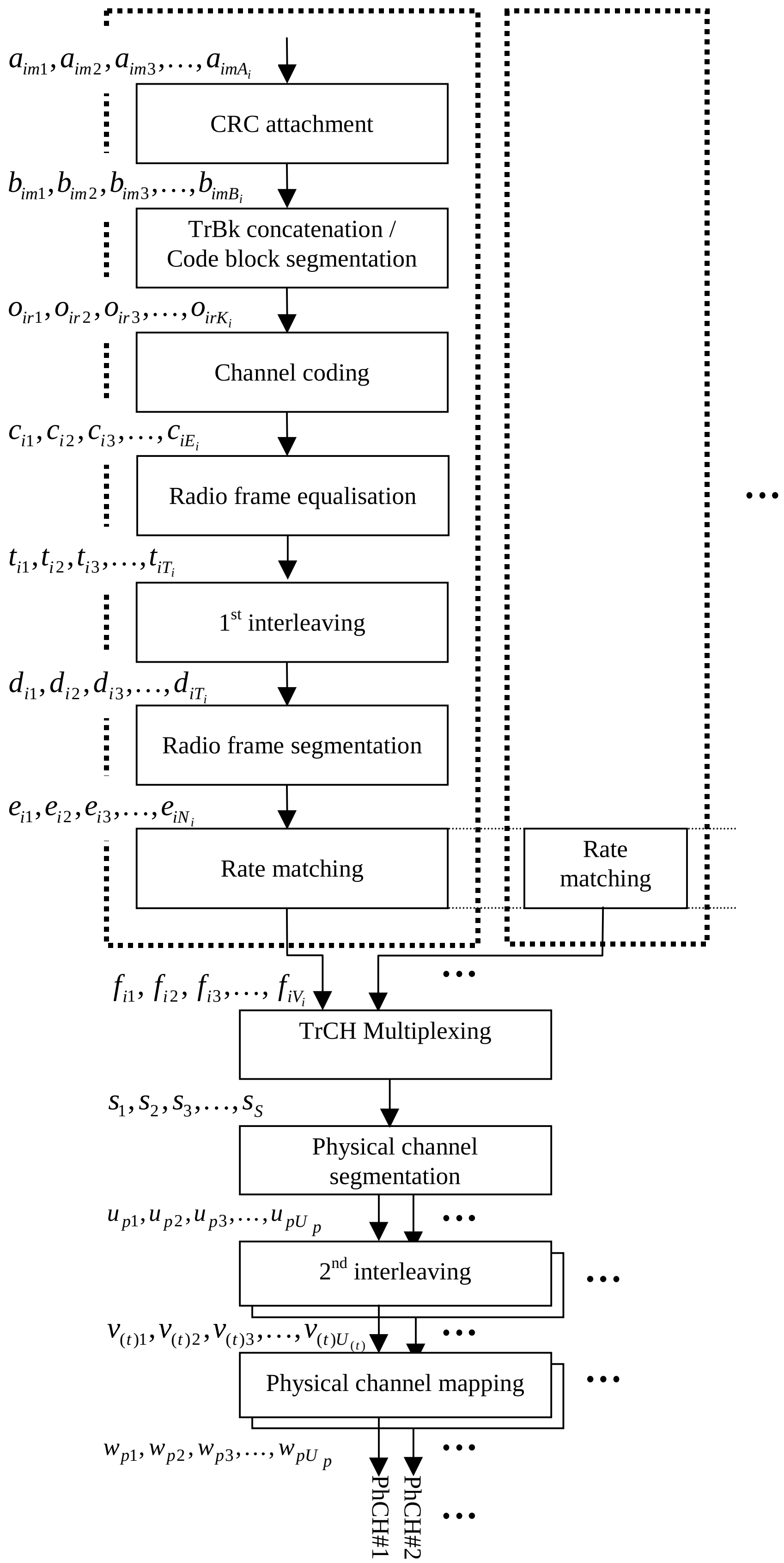


Figure 1: Transport channel multiplexing structure for uplink and downlink

Primarily, transport channels are multiplexed as described above, i.e. into one data stream mapped on one or several physical channels. However, an alternative way of multiplexing services is to use multiple CCTrCHs (Coded Composite Transport Channels), which corresponds to having several parallel multiplexing chains as in figure 1, resulting in several data streams, each mapped to one or several physical channels.

4.2.1 Error detection

Error detection is provided on transport blocks through a Cyclic Redundancy Check. The CRC is 24, 16, 12, 8 or 0 bits and it is signalled from higher layers what CRC length that should be used for each transport channel.

4.2.1.1 CRC calculation

The entire transport block is used to calculate the CRC parity bits for each transport block. The parity bits are generated by one of the following cyclic generator polynomials:

$g_{CRC24}(D) = D^{24} + D^{23} + D^6 + D^5 + D + 1$

$g_{CRC16}(D) = D^{16} + D^{12} + D^5 + 1$

$g_{CRC12}(D) = D^{12} + D^{11} + D^3 + D^2 + D + 1$

$g_{CRC8}(D) = D^8 + D^7 + D^4 + D^3 + D + 1$

Denote the bits in a transport block delivered to layer 1 by $a_{im1}, a_{im2}, a_{im3}, \ldots, a_{imA_i}$, and the parity bits by $p_{im1}, p_{im2}, p_{im3}, \ldots, p_{imL_i}$. A_i is the length of a transport block of TrCH i, m is the transport block number, and L_i is 24, 16, 12, 8, or 0 depending on what is signalled from higher layers.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_{im1}D^{A_i+23} + a_{im2}D^{A_i+22} + \ldots + a_{imA_i}D^{24} + p_{im1}D^{23} + p_{im2}D^{22} + \ldots + p_{im23}D^1 + p_{im24}$$

yields a remainder equal to 0 when divided by $g_{CRC24}(D)$, polynomial:

$$a_{im1}D^{A_i+15} + a_{im2}D^{A_i+14} + \ldots + a_{imA_i}D^{16} + p_{im1}D^{15} + p_{im2}D^{14} + \ldots + p_{im15}D^1 + p_{im16}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, polynomial:

$$a_{im1}D^{A_i+11} + a_{im2}D^{A_i+10} + \ldots + a_{imA_i}D^{12} + p_{im1}D^{11} + p_{im2}D^{10} + \ldots + p_{im11}D^1 + p_{im12}$$

yields a remainder equal to 0 when divided by $g_{CRC12}(D)$ and the polynomial:

$$a_{im1}D^{A_i+7} + a_{im2}D^{A_i+6} + \ldots + a_{imA_i}D^{8} + p_{im1}D^{7} + p_{im2}D^{6} + \ldots + p_{im7}D^1 + p_{im8}$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

If no transport blocks are input to the CRC calculation ($M_i = 0$), no CRC attachment shall be done. If transport blocks are input to the CRC calculation ($M_i \neq 0$) and the size of a transport block is zero ($A_i = 0$), CRC shall be attached, i.e. all parity bits equal to zero.

4.2.1.2 Relation between input and output of the Cyclic Redundancy Check

The bits after CRC attachment are denoted by $b_{im1}, b_{im2}, b_{im3}, \ldots, b_{imB_i}$, where $B_i = A_i + L_i$. The relation between a_{imk} and b_{imk} is:

$b_{imk} = a_{imk}$ $\quad k = 1, 2, 3, \ldots, A_i$

$b_{imk} = p_{im(L_i+1-(k-A_i))}$ $\quad k = A_i + 1, A_i + 2, A_i + 3, \ldots, A_i + L_i$

4.2.2 Transport block concatenation and code block segmentation

All transport blocks in a TTI are serially concatenated. If the number of bits in a TTI is larger than the maximum size of a code block , then code block segmentation is performed after the concatenation of the transport blocks. The maximum size of the code blocks depends on whether convolutional, turbo coding or no coding is used for the TrCH.

4.2.2.1 Concatenation of transport blocks

The bits input to the transport block concatenation are denoted by $b_{im1}, b_{im2}, b_{im3}, \dots, b_{imB_i}$ where i is the TrCH number, m is the transport block number, and B_i is the number of bits in each block (including CRC). The number of transport blocks on TrCH i is denoted by M_i. The bits after concatenation are denoted by $x_{i1}, x_{i2}, x_{i3}, \dots, x_{iX_i}$, where i is the TrCH number and $X_i=M_iB_i$. They are defined by the following relations:

$x_{ik} = b_{i1k}$ $\quad k = 1, 2, \dots, B_i$

$x_{ik} = b_{i,2,(k-B_i)}$ $\quad k = B_i + 1, B_i + 2, \dots, 2B_i$

$x_{ik} = b_{i,3,(k-2B_i)}$ $\quad k = 2B_i + 1, 2B_i + 2, \dots, 3B_i$

…

$x_{ik} = b_{i,M_i,(k-(M_i-1)B_i)}$ $\quad k = (M_i - 1)B_i + 1, (M_i - 1)B_i + 2, \dots, M_iB_i$

4.2.2.2 Code block segmentation

Segmentation of the bit sequence from transport block concatenation is performed if $X_i>Z$. The code blocks after segmentation are of the same size. The number of code blocks on TrCH i is denoted by C_i. If the number of bits input to the segmentation, X_i, is not a multiple of C_i, filler bits are added to the beginning of the first block. If turbo coding is selected and $X_i < 40$, filler bits are added to the beginning of the code block. The filler bits are transmitted and they are always set to 0. The maximum code block sizes are:

- convolutional coding: $Z = 504$;
- turbo coding: $Z = 5114$;
- no channel coding: $Z =$ *unlimited*.

The bits output from code block segmentation are denoted by $o_{ir1}, o_{ir2}, o_{ir3}, \dots, o_{irK_i}$, where i is the TrCH number, r is the code block number, and K_i is the number of bits.

Number of code blocks: $C_i = \lceil X_i / Z \rceil$

Number of bits in each code block:

if $X_i < 40$ and Turbo coding is used, then

$K_i = 40$

else

$K_i = \lceil X_i / C_i \rceil$

end if

Number of filler bits: $Y_i = C_iK_i - X_i$

for $k = 1$ to Y_I -- Insertion of filler bits

$o_{i1k} = 0$

end for

for $k = Y_i+1$ to K_i

$$o_{i1k} = x_{i,(k-Y_i)}$$

end for

$r = 2$ -- Segmentation

while $r \le C_i$

for $k = 1$ to K_i

$$o_{irk} = x_{i,(k+(r-1)\cdot K_i - Y_i)}$$

end for

r = r+1

end while

4.2.3 Channel coding

Code blocks are delivered to the channel coding block. They are denoted by $o_{ir1}, o_{ir2}, o_{ir3}, \ldots, o_{irK_i}$, where i is the TrCH number, r is the code block number, and K_i is the number of bits in each code block. The number of code blocks on TrCH i is denoted by C_i. After encoding the bits are denoted by $y_{ir1}, y_{ir2}, y_{ir3}, \ldots, y_{irY_i}$, where Y_i is the number of encoded bits. The relation between o_{irk} and y_{irk} and between K_i and Y_i is dependent on the channel coding scheme.

The following channel coding schemes can be applied to transport channels:

- convolutional coding;
- turbo coding;
- no coding.

Usage of coding scheme and coding rate for the different types of TrCH is shown in table 1. The values of Y_i in connection with each coding scheme:

- convolutional coding with rate 1/2: $Y_i = 2*K_i + 16$; rate 1/3: $Y_i = 3*K_i + 24$;
- turbo coding with rate 1/3: $Y_i = 3*K_i + 12$;
- no coding: $Y_i = K_i$.

Table 1: Usage of channel coding scheme and coding rate

Type of TrCH	Coding scheme	Coding rate
BCH	Convolutional coding	1/2
PCH		
RACH		
DCH, DSCH, FACH, USCH		1/3, 1/2
	Turbo coding	1/3
	No coding	

4.2.3.1 Convolutional coding

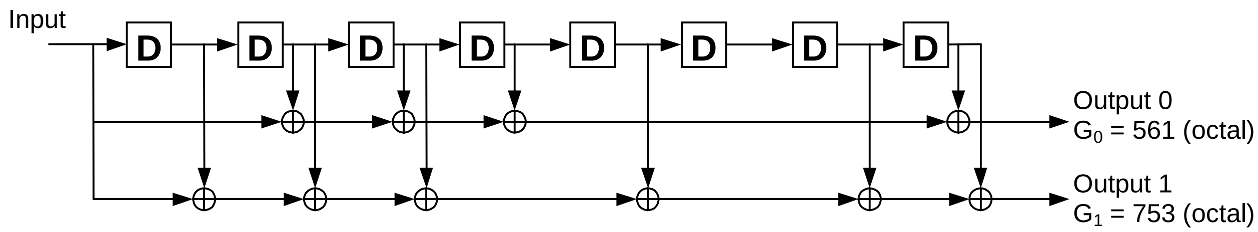
Convolutional codes with constraint length 9 and coding rates 1/3 and 1/2 are defined.

The configuration of the convolutional coder is presented in figure 2.

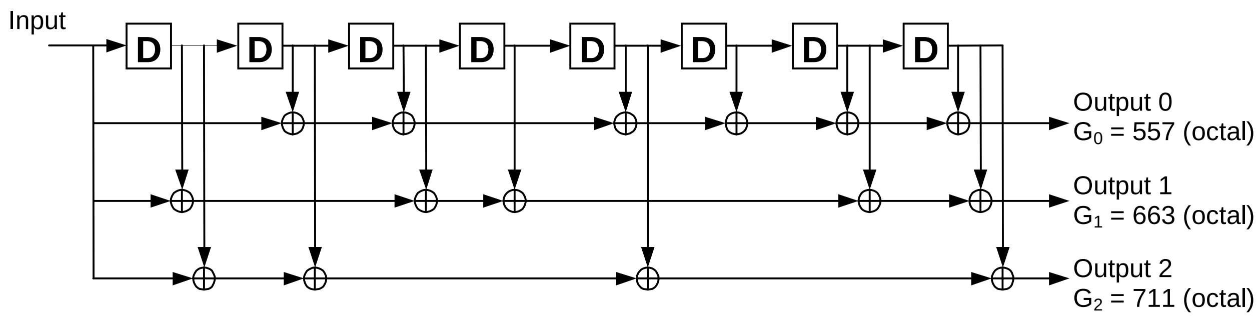
Output from the rate 1/3 convolutional coder shall be done in the order output0, output1, output2, output0, output1, output 2, output 0,…,output2. Output from the rate 1/2 convolutional coder shall be done in the order output 0, output 1, output 0, output 1, output 0, …, output 1.

8 tail bits with binary value 0 shall be added to the end of the code block before encoding.

The initial value of the shift register of the coder shall be "all 0" when starting to encode the input bits.



(a) Rate 1/2 convolutional coder



(b) Rate 1/3 convolutional coder

Figure 2: Rate 1/2 and rate 1/3 convolutional coders

4.2.3.2 Turbo coding

4.2.3.2.1 Turbo coder

The scheme of Turbo coder is a Parallel Concatenated Convolutional Code (PCCC) with two 8-state constituent encoders and one Turbo code internal interleaver. The coding rate of Turbo coder is 1/3. The structure of Turbo coder is illustrated in figure 3.

The transfer function of the 8-state constituent code for PCCC is:

$$\text{G(D)}=\left[1,\frac{g_1(D)}{g_0(D)}\right],$$

where

$$g_0(D) = 1 + D^2 + D^3,$$

$$g_1(D) = 1 + D + D^3.$$

The initial value of the shift registers of the 8-state constituent encoders shall be all zeros when starting to encode the input bits.

Output from the Turbo coder is , Y'(0), X(1), Y(1), Y'(1), etc:

$$x_1, z_1, z'_1, x_2, z_2, z'_2, \ldots, x_K, z_K, z'_K,$$

where $x_1, x_2, \ldots, x_K$ are the bits input to the Turbo coder i.e. both first 8-state constituent encoder and Turbo code internal interleaver, and K is the number of bits, and $z_1, z_2, \ldots, z_K$ and $z'_1, z'_2, \ldots, z'_K$ are the bits output from first and second 8-state constituent encoders, respectively.

The bits output from Turbo code internal interleaver are denoted by $x'_1, x'_2, \ldots, x'_K$, and these bits are to be input to the second 8-state constituent encoder.

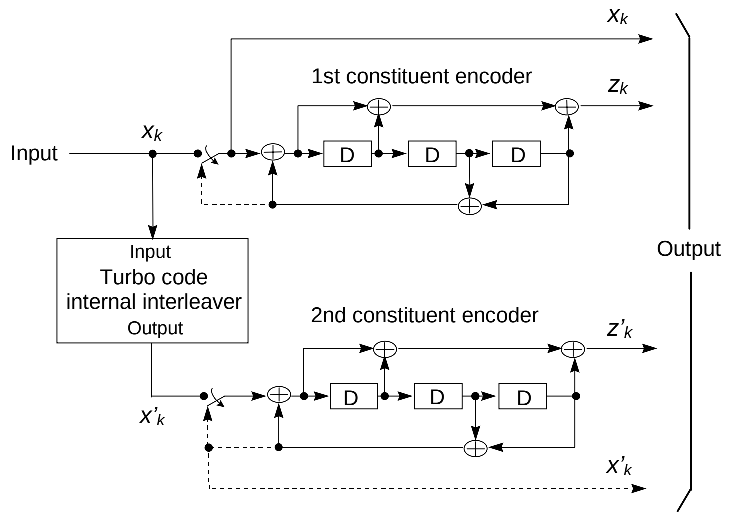


Figure 3: Structure of rate 1/3 Turbo coder (dotted lines apply for trellis termination only)

4.2.3.2.2 Trellis termination for Turbo coder

Trellis termination is performed by taking the tail bits from the shift register feedback after all information bits are encoded. Tail bits are padded after the encoding of information bits.

The first three tail bits shall be used to terminate the first constituent encoder (upper switch of figure 3 in lower position) while the second constituent encoder is disabled. The last three tail bits shall be used to terminate the second constituent encoder (lower switch of figure 3 in lower position) while the first constituent encoder is disabled.

The transmitted bits for trellis termination shall then be:

$$x_{K+1}, z_{K+1}, x_{K+2}, z_{K+2}, x_{K+3}, z_{K+3}, x'_{K+1}, z'_{K+1}, x'_{K+2}, z'_{K+2}, x'_{K+3}, z'_{K+3}).$$

4.2.3.2.3 Turbo code internal interleaver

The Turbo code internal interleaver consists of bits-input to a rectangular matrix, intra-row and inter-row permutations of the rectangular matrix, and bits-output from the rectangular matrix with pruning. The bits input to the Turbo code internal interleaver are denoted by $x_1, x_2, x_3, \ldots, x_K$, where K is the integer number of the bits and takes one value of $40 \le K \le 5114$. The relation between the bits input to the Turbo code internal interleaver and the bits input to the channel coding is defined by $x_k = o_{irk}$ and $K = K_i$.

The following subclause specific symbols are used in subclauses 4.2.3.2.3.1 to 4.2.3.4.3.3:

K	Number of bits input to Turbo code internal interleaver
R	Number of rows of rectangular matrix
C	Number of columns of rectangular matrix
p	Prime number
v	Primitive root
s(i)	Base sequence for intra-row permutation

qj Minimum prime integers

rj Permuted prime integers

T(j) Inter-row permutation pattern

Uj(i) Intra-row permutation pattern

i Index of matrix

j Index of matrix

k Index of bit sequence

4.2.3.2.3.1 Bits-input to rectangular matrix

The bit sequence input to the Turbo code internal interleaver x_k is written into the rectangular matrix as follows.

(1) Determine the number of rows R of the rectangular matrix such that:

$$R = \begin{cases} 5, \text{if } (40 \le K \le 159) \\ 10, \text{if } ((160 \le K \le 200) \text{ or } (481 \le K \le 530)) \\ 20, \text{if } (K = \text{any other value}) \end{cases}$$

where the rows of rectangular matrix are numbered 0, 1, 2, …, R - 1 from top to bottom.

(2) Determine the number of columns C of rectangular matrix such that:

if (481 $\le K \le$ 530) then

$p = 53$ and $C = p$.

else

Find minimum prime p such that,

$(p+1)-K/R \ge 0$,

and determine C such that

if $p-K/R \ge 0$) then

if (p - 1 - $K/R \ge 0$) then

$C = p - 1$.

else

$C = p$.

end if

else

C = p+1.

end if

end if

where the columns of rectangular matrix are numbered 0, 1, 2, …, C - 1 from left to right.

(3) Write the input bit sequence x_k into the $R \times C$ rectangular matrix row by row starting with bit x_1 in column 0 of:

row 0:

$$\begin{bmatrix} x_1 & x_2 & x_3 & \cdots x_C \\ x_{(C+1)} & x_{(C+2)} & x_{(C+3)} & \cdots x_{2C} \\ \vdots & \vdots & \vdots & \ldots \vdots \\ x_{((R-1)C+1)} & x_{((R-1)C+2)} & x_{((R-1)C+3)} & \cdots x_{RC} \end{bmatrix}.$$

4.2.3.2.3.2 Intra-row and inter-row permutations

After the bits-input to the $R\times C$ rectangular matrix, the intra-row and inter-row permutations for the $R\times C$ rectangular matrix are performed by using the following algorithm:

(1) Select a primitive root v from table 2.

(2) Construct the base sequence $s(i)$ for intra-row permutation as:

$s(i) = [v \times s(i - 1)] \bmod p$, i =1,2,…($p$-2)., and $s(0) = 1$.

(3) Let $q_0 = 1$ be the first prime integer in $\{q_j\}$, and select the consecutive minimum prime integers $\{q_j\}$ (j=1,2,…R-1):

such that

g.c.d$\{q_j, p - 1\} = 1$,

$q_j > 6$, and

$q_j > q_{(j-1)}$,

where g.c.d. is greatest common divisor.

(4) Permute $\{q_j\}$ to make $\{r_j\}$ such that:

$r_{T(j)} = q_j$, $j = 0, 1, \ldots$ R-1,

where $T(j)$ ($j = 0, 1, 2, \ldots, R - 1$) is the inter-row permutation pattern defined as the one of the following four kind of patterns: Pat_1, Pat_2, Pat_3 and Pat_4 depending on the number of input bits K.

$$\{T(0),T(1),T(2),...,T(R-1)\} = \begin{cases} Pat_4 & \text{if } (40 \le K \le 159) \\ Pat_3 & \text{if } (160 \le K \le 200) \\ Pat_1 & \text{if } (201 \le K \le 480) \\ Pat_3 & \text{if } (481 \le K \le 530) \\ Pat_1 & \text{if } (531 \le K \le 2280) \\ Pat_2 & \text{if } (2281 \le K \le 2480) \\ Pat_1 & \text{if } (2481 \le K \le 3160) \\ Pat_2 & \text{if } (3161 \le K \le 3210) \\ Pat_1 & \text{if } (3211 \le K \le 5114) \end{cases},$$

where Pat_1, Pat_2, Pat_3 and Pat_4 have the following patterns respectively.

Pat_1: {19, 9, 14, 4, 0, 2, 5, 7, 12, 18, 10, 8, 13, 17, 3, 1, 16, 6, 15, 11}

Pat_2: {19, 9, 14, 4, 0, 2, 5, 7, 12, 18, 16, 13, 17, 15, 3, 1, 6, 11, 8, 10}

Pat_3: {9, 8, 7, 6, 5, 4, 3, 2, 1, 0}

Pat_4: {4, 3, 2, 1, 0}

(5) Perform the j-th (j = 0,1, 2, …, R - 1) intra-row permutation as:

if ($C = p$) then

$U_j(i) = s([i\times r_j] \bmod (p - 1))$, i =0,1,2,…, ($p$-2)., and $U_j(p-1) = 0$,

where $U_j(i)$ is the input bit position of i-th output after the permutation of j-th row.

end if

if (C = p+1) then

$U_j(i) = s([i\times r_j]\mathrm{mod}(p - 1))$, i =0,1,2,…, (p-2)., $U_j(p\text{-}1) = 0$, and $U_j(p) = p$,

where $U_j(i)$ is the input bit position of i-th output after the permutation of j-th row, and

if ($K = C\times R$) then

Exhange $U_{R-1}(p)$ with $U_{R-1}(0)$.

end if

end if

if $(C = p\text{-}1)$ then

$U_j(i) = s([i\times r_j]\mathrm{mod}(p - 1)) -1$, i =0,1,2,…, (p-2),

where $U_j(i)$ is the input bit position of i-th output after the permutation of j-th row.

end if

(6) Perform the inter-row permutation based on the pattern $T(j)$ (j = 0, 1, 2, …, R - 1),

where $T(j)$ is the original row position of the j-th permuted row.

Table 2: Table of prime *p* and associated primitive root *v*

p	v	p	v	p	v	p	v	p	v
7	3	47	5	101	2	157	5	223	3
11	2	53	2	103	5	163	2	227	2
13	2	59	2	107	2	167	5	229	6
17	3	61	2	109	6	173	2	233	3
19	2	67	2	113	3	179	2	239	7
23	5	71	7	127	3	181	2	241	7
29	2	73	5	131	2	191	19	251	6
31	3	79	3	137	3	193	5	257	3
37	2	83	2	139	2	197	2		
41	6	89	3	149	2	199	3		
43	3	97	5	151	6	211	2		

4.2.3.2.3.3 Bits-output from rectangular matrix with pruning

After intra-row and inter-row permutations, the bits of the permuted rectangular matrix are denoted by y'_k:

$$\begin{bmatrix} y'_1 & y'_{(R+1)} & y'_{(2R+1)} & \cdots y'_{((C-1)R+1)} \\ y'_2 & y'_{(R+2)} & y'_{(2R+2)} & \cdots y'_{((C-1)R+2)} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ y'_R & y'_{2R} & y'_{3R} & \cdots & y'_{CR} \end{bmatrix}.$$

The output of the Turbo code internal interleaver is the bit sequence read out column by column from the intra-row and inter-row permuted $R \times C$ matrix starting with bit y'_1 in row 0 of column 0 and ending with bit y'_{CR} in row R - 1 of column C - 1. The output is pruned by deleting bits that were not present in the input bit sequence, i.e. bits y'_k that corresponds to bits x_k with $k > K$ are removed from the output. The bits output from Turbo code internal interleaver are denoted by $x'_1, x'_2, \ldots, x'_K$, where x'_1 corresponds to the bit y'_k with smallest index k after pruning, x'_2 to the bit y'_k with second smallest index k after pruning, and so on. The number of bits output from Turbo code internal interleaver is K and the total number of pruned bits is:

$R\times C - K$.

4.2.3.3 Concatenation of encoded blocks

After the channel coding for each code block, if C_i is greater than 1, the encoded blocks are serially concatenated so that the block with lowest index r is output first from the channel coding block, otherwise the encoded block is output from channel coding block as it is. The bits output are denoted by $c_{i1}, c_{i2}, c_{i3}, \ldots, c_{iE_i}$, where i is the TrCH number and $E_i = C_i Y_i$. The output bits are defined by the following relations:

$$c_{ik} = y_{i1k} \quad k = 1, 2, \ldots, Y_i$$

$$c_{ik} = y_{i,2,(k-Y_i)} \quad k = Y_i + 1, Y_i + 2, \ldots, 2Y_i$$

$$c_{ik} = y_{i,3,(k-2Y_i)} \quad k = 2Y_i + 1, 2Y_i + 2, \ldots, 3Y_i$$

…

$$c_{ik} = y_{i,C_i,(k-(C_i-1)Y_i)} \quad k = (C_i - 1)Y_i + 1, (C_i - 1)Y_i + 2, \ldots, C_iY_i$$

If no code blocks are input to the channel coding ($C_i = 0$), no bits shall be output from the channel coding, i.e. $E_i = 0$.

4.2.4 Radio frame size equalisation

Radio frame size equalisation is padding the input bit sequence in order to ensure that the output can be segmented in F_i data segments of same size as described in the subclause 4.2.6.

The input bit sequence to the radio frame size equalisation is denoted by $c_{i1}, c_{i2}, c_{i3}, \ldots, c_{iE_i}$, where i is TrCH number and E_i the number of bits. The output bit sequence is denoted by $t_{i1}, t_{i2}, t_{i3}, \ldots, t_{iT_i}$, where T_i is the number of bits. The output bit sequence is derived as follows:

$t_{ik} = c_{ik}$, for k = 1… E_i and

$t_{ik} = \{0 , 1\}$ for k= E_i +1… T_i, if $E_i < T_i$

where

$T_i = F_i * N_i$ and

$N_i = \lceil E_i / F_i \rceil$ is the number of bits per segment after size equalisation.

4.2.5 1st interleaving

The 1st interleaving is a block interleaver with inter-column permutations. The input bit sequence to the 1st interleaver is denoted by $x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$, where i is TrCH number and X_i the number of bits (at this stage X_i is assumed and guaranteed to be an integer multiple of TTI). The output bit sequence is derived as follows:

1) select the number of columns C_I from table 3;
2) determine the number of rows R_I defined as $R_I = X_i/C_I$;
3) write the input bit sequence into the $R_I \times C_I$ rectangular matrix row by row starting with bit $x_{i,1}$ in the first column of the first row and ending with bit $x_{i,(R_IC_I)}$ in column C_I of row R_I;

$$\begin{bmatrix} x_{i1} & x_{i2} & x_{i3} & \ldots & x_{iC_I} \\ x_{i,(C_I+1)} & x_{i,(C_I+2)} & x_{i,(C_I+3)} & \ldots & x_{i,(2C_I)} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ x_{i,((R_I-1)C_I+1)} & x_{i,((R_I-1)C_I+2)} & x_{i,((R_I-1)C_I+3)} & \ldots & x_{i,(R_IC_I)} \end{bmatrix}$$

4) perform the inter-column permutation based on the pattern $\{P_1(j)\}$ (j=0,1, …, C-1) shown in table 3, where $P_1(j)$ is the original column position of the j-th permuted column. After permutation of the columns, the bits are denoted by y_{ik}:

$$\begin{bmatrix} y_{i1} & y_{i,(R_I+1)} & y_{i,(2R_I+1)} & \cdots y_{i,((C_I-1)R_I+1)} \\ y_{i2} & y_{i,(R_I+2)} & y_{i,(2R_I+2)} & \cdots y_{i,((C_I-1)R_I+2)} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ y_{iR_I} & y_{i,(2R_I)} & y_{i,(3R_I)} & \cdots & y_{i,(C_I R_I)} \end{bmatrix}$$

5) read the output bit sequence $y_{i1}, y_{i2}, y_{i3}, \ldots, y_{i,(C_I R_I)}$ of the 1st interleaving column by column from the inter-column permuted $R_I \times C_I$ matrix. Bit $y_{i,1}$ corresponds to the first row of the first column and bit $y_{i,(R_I C_I)}$ corresponds to row R_I of column C_I.

The bits input to the 1st interleaving are denoted by $t_{i1}, t_{i2}, t_{i3}, \ldots, t_{iT_i}$, where i is the TrCH number and T_i the number of bits. Hence, $x_{ik} = t_{ik}$ and $X_i = T_i$.

The bits output from the 1st interleaving are denoted by $d_{i1}, d_{i2}, d_{i3}, \ldots, d_{iT_i}$, and $d_{ik} = y_{ik}$.

Table 3

TTI	Number of columns C_1	Inter-column permutation patterns
10 ms	1	{0}
20 ms	2	{0,1}
40 ms	4	{0,2,1,3}
80 ms	8	{0,4,2,6,1,5,3,7}

4.2.6 Radio frame segmentation

When the transmission time interval is longer than 10 ms, the input bit sequence is segmented and mapped onto consecutive F_i radio frames. Following radio frame size equalisation the input bit sequence length is guaranteed to be an integer multiple of F_i.

The input bit sequence is denoted by $x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$ where i is the TrCH number and X_i is the number bits. The F_i output bit sequences per TTI are denoted by $y_{i,n_i1}, y_{i,n_i2}, y_{i,n_i3}, \ldots, y_{i,n_iY_i}$ where n_i is the radio frame number in current TTI and Y_i is the number of bits per radio frame for TrCH i. The output sequences are defined as follows:

$y_{i,n_ik} = x_{i,((n_i-1)Y_i)+k}$, $n_i = 1 \ldots F_i$, $k = 1 \ldots Y_i$

where

$Y_i = (X_i / F_i)$ is the number of bits per segment.

The n_i –th segment is mapped to the n_i –th radio frame of the transmission time interval.

The input bit sequence to the radio frame segmentation is denoted by $d_{i1}, d_{i2}, d_{i3}, \ldots, d_{iT_i}$, where i is the TrCH number and T_i the number of bits. Hence, $x_{ik} = d_{ik}$ and $X_i = T_i$.

The output bit sequence corresponding to radio frame n_i is 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. Hence, $e_{i,k} = y_{i,n_ik}$ and $N_i = Y_i$.

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 TrCH multiplexing is identical to the total channel bit rate of the allocated physical channels.

If no bits are input to the rate matching for all TrCHs within a CCTrCH, the rate matching shall output no bits for all TrCHs within the CCTrCH.

Notation used in subclause 4.2.7 and subclauses:

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

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. This value limits the amount of puncturing that can be applied in order to minimise the number of 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: number of physical channels used in the current frame.

P_{max}: maximum number of physical channels allocated for a CCTrCH.

U_p: Number of data bits in the physical channel p with p = 1...P.

I: Number of TrCHs in a 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).

$I_F(n_i)$: 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 or repetition 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 subclause 4.2.7.3.

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

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

b: Indicates systematic and parity bits.

b=1: Systematic bit. *X(t)* in subclause 4.2.3.2.1.

b=2: 1st parity bit (from the upper Turbo constituent encoder). *Y(t)* in subclause 4.2.3.2.1.

b=3: 2nd parity bit (from the lower Turbo constituent encoder). *Y'(t)* in subclause 4.2.3.2.1.

4.2.7.1 Determination of rate matching parameters

The following relations, defined for all TFC *j*, are used when calculating the rate matching pattern:

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

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

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

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} depend on the number of physical channels P_{max}, allocated to the respective CCTrCH, and on their characteristics (spreading factor, length of midamble and TFCI, usage of TPC and multiframe structure), which is given in [7].

Denote the number of data bits in each physical channel by $U_{p,Sp}$, where p refers to the sequence number $1 \le p \le P_{max}$ of this physical channel in the allocation message, and the second index Sp indicates the spreading factor with the possible values {*16, 8, 4, 2, 1*}, respectively. For each physical channel an individual minimum spreading factor Sp_{min} is transmitted by means of the higher layer. Then, for N_{data} one of the following values in ascending order can be chosen:

$$\left\{U_{1,16},...,U_{1,S1_{min}}, U_{1,S1_{min}} + U_{2,16},...,U_{1,S1_{min}} + U_{2,S2_{min}},...,U_{1,S1_{min}} + U_{2,S2_{min}} + ... + U_{P_{max},16},...,U_{1,S1_{min}} + U_{2,S2_{min}} + ... + U_{P_{max},(SP_{max})_{min}}\right\}$$

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

SET1 = { N_{data} such that $\min_{1 \le y \le I}\{RM_y\} \cdot N_{data} - PL \cdot \sum_{x=1}^{I} RM_x \cdot N_{x,j}$ 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 subclause 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 subclause 4.2.7.3 does not need to be executed.

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

4.2.7.1.1 Uncoded and convolutionally encoded TrCHs

a = 2

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

$X_i = N_{i,j}$

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

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

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

else

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

endif

NOTE 1: q is a signed quantity.

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 2: q' is not an integer, but a multiple of 1/8.

else

$q' = q$

endif

for x = 0 to F_i-1

$S(I_F(|\lfloor x*q' \rfloor| \bmod F_i)) = (|\lfloor x*q' \rfloor| \operatorname{div} F_i)$

end for

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

$e_{plus} = a \cdot X_i$

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

puncturing for ΔN_i<0, repetition otherwise.

4.2.7.1.2 Turbo encoded TrCHs

If repetition is to be performed on turbo encoded TrCHs, i.e. $\Delta N_{i,j}$ >0, the parameters in subclause 4.2.7.1.1 are used.

If puncturing is to be performed, the parameters below 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*=2

a = 1 when *b*=3

$$\Delta N_i = \begin{cases} \lfloor \Delta N_{i,j}/2 \rfloor, & b = 2 \\ \lceil \Delta N_{i,j}/2 \rceil, & b = 3 \end{cases}$$

If ΔN_i is calculated as 0 for *b*=2 or *b*=3, then the following procedure and the rate matching algorithm of subclause 4.2.7.3 don't need to be performed for the corresponding parity bit stream.

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

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

if($q \leq 2$)

for *x*=0 to F_i-1

$S[I_F[(3x+b-1) \bmod F_i]] = x \bmod 2$; 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: q' is not an integer, but a multiple of 1/8.

else $q' = q$

endif

for x=0 to F_i –1

r = ⌈ x*q'⌉ mod F_i;

$S[I_F[(3r+b-1) \bmod F_i]]$ = ⌈ x*q'⌉ div F_i;

endfor

endif

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

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 $e_{ini} = a \cdot X_i$.

$e_{plus} = a \cdot X_i$

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

4.2.7.2 Bit separation and collection for rate matching

The systematic bits of turbo encoded TrCHs shall not be punctured, however systematic bits for trellis termination may be punctured. The systematic bits, first parity bits, and second parity bits in the bit sequence input to the rate matching block are therefore separated into three sequences, one sequence containing all of the systematic bits and some systematic, first and second parity trellis termination bits; the second sequence containing all of the first parity bits and some systematic, first and second parity trellis termination bits and the third sequence containing all of the second parity bits and some systematic, first and second parity trellis termination bits. Puncturing is only applied to the second and third sequences.

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 and 5.

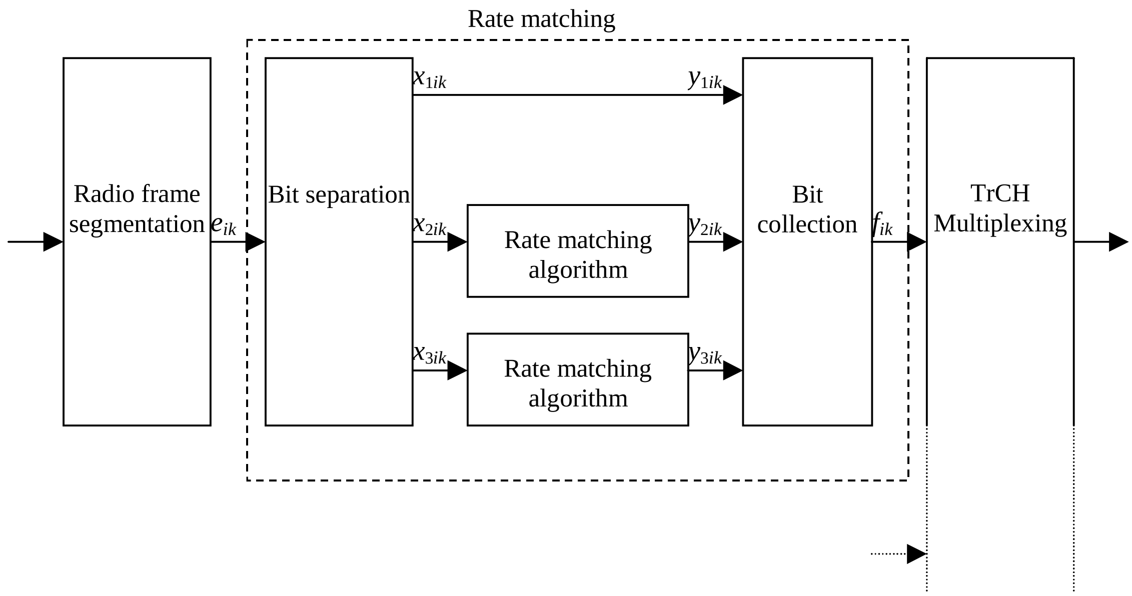


Figure 4: Puncturing of turbo encoded TrCHs

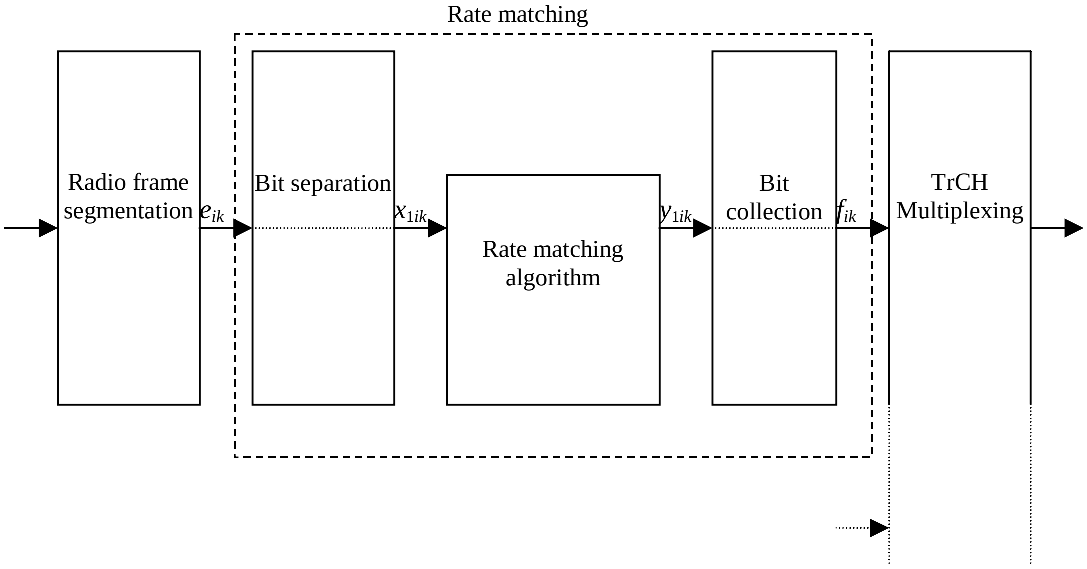


Figure 5: Rate matching for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition

The bit separation is dependent on the 1st interleaving and offsets are used to define the separation for different TTIs. The sequence denoted as b=1 contains all of the systematic bits and some systematic, first and second parity trellis termination bits; the sequence denoted as b=2 contains all of the first parity bits and some systematic, first and second parity trellis termination bits; the sequence denoted as b=3 contains all of the second parity bits and some systematic, first and second parity trellis termination bits. The offsets α_b for these sequences are listed in table 4.

Table 4: 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 5: 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 the three sequences defined in section 4.2.7.2. The sequence denoted as b=1 contains all of the systematic bits and some systematic, first and second parity trellis termination bits; the sequence denoted as b=2 contains all of the first parity bits and some systematic, first and second parity trellis termination bits; the sequence denoted as b=3 contains all of the second parity bits and some systematic, first and second parity trellis termination bits. 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:

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

$x_{1,i,\lfloor N_i/3 \rfloor + k} = e_{i,3\lfloor N_i/3 \rfloor + k}$ k = 1, …, N_i mod 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, …, 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, …, 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, …, 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 subclause 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, …, Y_I

$z_{i,3\lfloor N_i/3 \rfloor + k} = y_{1,i,\lfloor N_i/3 \rfloor + k}$ k = 1, …, N_i mod 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, …, Y_i

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

After the bit collection, bits $z_{i,k}$ with value δ, where $\delta \not\in \{0, 1\}$, 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, …, 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 $\delta \not\in \{0, 1\}$, 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.

4.2.7.3 Rate matching pattern determination

The bits input to the rate matching are denoted by $x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$, where i is the TrCH and X_i is the parameter given in subclauses 4.2.7.1.1 and 4.2.7.1.2.

NOTE: 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
        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}
            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
        e = e – e_minus       -- update error
        do while e <= 0       -- check if bit number m should be repeated
            repeat bit x_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.

4.2.8 TrCH multiplexing

Every 10 ms, one radio frame from each TrCH is delivered to the TrCH multiplexing. These radio frames are serially multiplexed into a coded composite transport channel (CCTrCH).

The bits input to the TrCH multiplexing are denoted by $f_{i1}, f_{i2}, f_{i3}, \ldots, f_{iV_i}$, where *i* is the TrCH number and V_i is the number of bits in the radio frame of TrCH *i*. The number of TrCHs is denoted by *I*. The bits output from TrCH multiplexing are denoted by $s_1, s_2, s_3, \ldots, s_S$, where *S* is the number of bits, i.e. $S = \sum_i V_i$. The TrCH multiplexing is defined by the following relations:

$$s_k = f_{1k} \quad k = 1, 2, \ldots, V_1$$

$$s_k = f_{2,(k-V_1)} \quad k = V_1+1, V_1+2, \ldots, V_1+V_2$$

$s_k = f_{3,(k-(V_1+V_2))}$ $k = (V_1+V_2)+1, (V_1+V_2)+2, \ldots, (V_1+V_2)+V_3$

…

$s_k = f_{I,(k-(V_1+V_2+\ldots+V_{I-1}))}$ $k = (V_1+V_2+\ldots+V_{I-1})+1, (V_1+V_2+\ldots+V_{I-1})+2, \ldots, (V_1+V_2+\ldots+V_{I-1})+V_I$

4.2.9 Physical channel segmentation

When more than one PhCH is used, physical channel segmentation divides the bits among the different PhCHs. The bits input to the physical channel segmentation are denoted by $s_1, s_2, s_3, \ldots, s_S$, where S is the number of bits input to the physical channel segmentation block. The number of PhCHs is denoted by *P*.

The bits after physical channel segmentation are denoted $u_{p1}, u_{p2}, u_{p3}, \ldots, u_{pU_p}$, where *p* is PhCH number and U_p is the in general variable number of bits in the respective radio frame for each PhCH. The relation between s_k and u_{pk} is given below.

Bits on first PhCH after physical channel segmentation:

$u_{1k} = s_k$ $k = 1, 2, \ldots, U_1$

Bits on second PhCH after physical channel segmentation:

$u_{2k} = s_{(k+U_1)}$ $k = 1, 2, \ldots, U_2$

…

Bits on the P^{th} PhCH after physical channel segmentation:

$u_{Pk} = s_{(k+U_1+\ldots+U_{P-1})}$ $k = 1, 2, \ldots, U_P$

4.2.10 2nd interleaving

The 2nd interleaving can be applied jointly to all data bits transmitted during one frame, or separately within each timeslot, on which the CCTrCH is mapped. The selection of the 2nd interleaving scheme is controlled by higher layer.

4.2.10.1 Frame related 2nd interleaving

In case of frame related interleaving, the bits input to the 2^{nd} interleaver are denoted $x_1, x_2, x_3, \ldots, x_U$, where *U* is the total number of bits after TrCH multiplexing transmitted during the respective radio frame with $S = U = \sum_p U_p$.

The relation between x_k and the bits u_{pk} in the respective physical channels is given below:

$x_k = u_{1k}$ $k = 1, 2, \ldots, U_1$

$x_{(k+U_1)} = u_{2k}$ k = 1, 2 , …, U_2

…

$x_{(k+U_1+\ldots+U_{P-1})} = u_{Pk}$ k = 1, 2 , …, U_P

The following steps have to be performed once for each CCTrCH:

(1) Set the number of columns $C_2 = 30$. The columns are numbered 0, 1, 2, …, C_2-1 from left to right.

(2) Determine the number of rows R_2 by finding minimum integer R_2 such that:

$U \le R_2C_2$.

(3) The bits input to the 2nd interleaving are written into the $R_2 \times C_2$ rectangular matrix row by row.

$$\begin{bmatrix} x_1 & x_2 & x_3 & \ldots & x_{30} \\ x_{31} & x_{32} & x_{33} & \ldots & x_{60} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ x_{(R_2-1)30+1} & x_{(R_2-1)30+2} & x_{(R_2-1)30+3} & \ldots & x_{R_2 \cdot 30} \end{bmatrix}$$

(4) Perform the inter-column permutation based on the pattern $\{P_2(j)\}$ (j = 0, 1, …, C_2-1) that is shown in table 6, where $P_2(j)$ is the original column position of the j-th permuted column. After permutation of the columns, the bits are denoted by y_k.

$$\begin{bmatrix} y_1 & y_{R_2+1} & y_{2R_2+1} & \ldots y_{29R_2+1} \\ y_2 & y_{R_2+2} & y_{2R_2+2} & \ldots y_{29R_2+2} \\ \vdots & \vdots & \vdots & \ldots \quad \vdots \\ y_{R_2} & y_{2R_2} & y_{3R_2} & \ldots \; y_{30R_2} \end{bmatrix}$$

(5) The output of the 2nd interleaving is the bit sequence read out column by column from the inter-column permuted $R_2 \times C_2$ matrix. The output is pruned by deleting bits that were not present in the input bit sequence, i.e. bits y_k that corresponds to bits x_k with k>U are removed from the output. The bits after 2nd interleaving are denoted by $v_1, v_2, \ldots, v_U$, where v_1 corresponds to the bit y_k with smallest index k after pruning, v_2 to the bit y_k with second smallest index k after pruning, and so on.

4.2.10.2 Timeslot related 2nd interleaving

In case of timeslot related 2nd interleaving, the bits input to the 2nd interleaver are denoted $x_{t1}, x_{t2}, x_{t3}, \ldots, x_{tU_t}$, where *t* refers to a certain timeslot, and U_t is the number of bits transmitted in this timeslot during the respective radio frame.

In each timeslot *t* the relation between x_{tk} and u_{tpk} is given below with P_t refering to the number of physical channels within the respective timeslot:

$x_{tk} = u_{t1k}$ $k = 1, 2, \ldots, U_{t1}$

$x_{t(k+U_{t1})} = u_{t2k}$ $k = 1, 2, \ldots, U_{t2}$

…

$x_{t(k+U_{t1}+\ldots+U_{t(P_t-1)})} = u_{tP_tk}$ $k = 1, 2, \ldots, U_{tP_t}$

The following steps have to be performed for each timeslot *t*, on which the respective CCTrCH is mapped:

(1) Set the number of columns $C_2 = 30$. The columns are numbered 0, 1, 2, …, C_2-1 from left to right.

(2) Determine the number of rows R_2 by finding minimum integer R_2 such that:

$U_t \le R_2C_2$.

(3) The bits input to the 2nd interleaving are written into the $R_2 \times C_2$ rectangular matrix row by row.

$$\begin{bmatrix} x_{t1} & x_{t2} & x_{t3} & \ldots & x_{t30} \\ x_{t31} & x_{t32} & x_{t33} & \ldots & x_{t60} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ x_{t,((R_2-1)30+1)} & x_{t,((R_2-1)30+2)} & x_{t,((R_2-1)30+3)} & \ldots & x_{t,(R_2 30)} \end{bmatrix}$$

(4) Perform the inter-column permutation based on the pattern $\{P_2(j)\}$ $(j = 0, 1, \ldots, C_2-1)$ that is shown in table 6, where $P_2(j)$ is the original column position of the j-th permuted column. After permutation of the columns, the bits are denoted by y_{tk}.

$$\begin{bmatrix} y_{t1} & y_{t,(R_2+1)} & y_{t,(2R_2+1)} & \cdots y_{t,(29R_2+1)} \\ y_{t2} & y_{t,(R_2+2)} & y_{t,(2R_2+2)} & \cdots y_{t,(29R_2+2)} \\ \vdots & \vdots & \vdots & \ldots \quad \vdots \\ y_{tR_2} & y_{t,(2R_2)} & y_{t,(3R_2)} & \cdots \; y_{t,(30R_2)} \end{bmatrix}$$

(5) The output of the 2nd interleaving is the bit sequence read out column by column from the inter-column permuted $R_2 \times C_2$ matrix. The output is pruned by deleting bits that were not present in the input bit sequence, i.e. bits y_{tk} that corresponds to bits x_{tk} with $k>U_t$ are removed from the output. The bits after 2nd interleaving are denoted by $v_{t1}, v_{t2}, \ldots, v_{tU_t}$, where v_{t1} corresponds to the bit y_{tk} with smallest index k after pruning, v_{t2} to the bit y_{tk} with second smallest index k after pruning, and so on.

Table 6

Column number C_2	Inter-column permutation pattern
30	{0, 20, 10, 5, 15, 25, 3, 13, 23, 8, 18, 28, 1, 11, 21, 6, 16, 26, 4, 14, 24, 19, 9, 29, 12, 2, 7, 22, 27, 17}

4.2.11 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 of the bits $v_{(t)1}, v_{(t)2}, \ldots, v_{(t)U_{(t)}}$ is performed like block interleaving, writing the bits into columns, 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 mapping scheme, as described in the following subclause, shall be applied individually for each timeslot t used in the current frame. Therefore, the bits $v_{t1}, v_{t2}, \ldots, v_{tU_t}$ are assigned to the bits of the physical channels $w_{t1,1\ldots U_{t1}}, w_{t2,1\ldots U_{t2}}, \ldots, w_{tP_t,1\ldots U_{tP_t}}$ in each timeslot.

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. Denote SF1 and SF2 the spreading factors used for code 1 and 2, respectively. For the number of consecutive bits to assign per code bs_k the following rule is applied:

if

SF1 >= SF2 then $bs_1 = 1$; $bs_2 =$ SF1/SF2 ;

else

SF2 > SF1 then bs_1 = SF2/SF1; $bs_2 = 1$;

end if

In the downlink case bs_p is 1 for all physical channels.

4.2.11.1 Mapping scheme

Notation used in this subclause:

P_t: number of physical channels for timeslot t , P_t = 1..2 for uplink ; P_t = 1...16 for downlink

U_{tp}: capacity in bits for the physical channel p in timeslot t

$U_{t.}$: total number of bits to be assigned for timeslot t

bs_p: number of consecutive bits to assign per code

for downlink all $bs_p = 1$

for uplink if SF1 >= SF2 then $bs_1 = 1$; $bs_2 =$ SF1/SF2 ;

if SF2 > SF1 then $bs_1 =$ SF2/SF1; $bs_2 = 1$;

fb_p: number of already written bits for each code

pos: intermediate calculation variable

```
for p=1 to P_t                  -- reset number of already written bits for every physical channel
    fb_p = 0
end for
p = 1                           -- start with PhCH #1
for k=1 to U_t.
    do while (fb_p == U_tp)     -- physical channel filled up already ?
        p = (p mod P_t) + 1;
    end do
    if (p mod 2) == 0
        pos = U_tp - fb_p       -- reverse order
    else
        pos = fb_p + 1          -- forward order
    endif
    w_tp,pos = v_t,k            -- assignment
    fb_p = fb_p + 1             -- Increment number of already written bits
    if (fb_p mod bs_p) == 0     -- Conditional change to the next physical channel
        p = (p mod P_t) + 1;
    end if
end for
```

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 shall have co-ordinated timings. When the TFCS of a CCTrCH is changed because one or more transport channels are added to the CCTrCH or reconfigured within the CCTrCH, or removed from the CCTrCH, the change may only be made at the start of a radio frame with CFN fulfilling the relation

CFN mod $F_{max} = 0$,

where F_{max} denotes the maximum number of radio frames within the transmission time intervals of all transport channels which are multiplexed into the same CCTrCH, including any transport channels *i* which are added reconfigured or have been removed, and CFN denotes the connection frame number of the first radio frame of the changed CCTrCH.

After addition or reconfiguration of a transport channel *i* within a CCTrCH, the TTI of transport channel *i* may only start in radio frames with CFN fulfilling the relation

$CFN_i \bmod F_i = 0$.

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

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

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.

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 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 is optional both in the UE and the UTRAN. Therefore, for all CCTrCH a TFCI shall be transmitted, including the possibilty of a TFCI length zero, if only one TFC is defined.

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)

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 subclause 4.3.1.1. Also specific coding of less than 6 bits is possible as explained in subclause 4.3.1.2.

4.3.1.1 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 6.

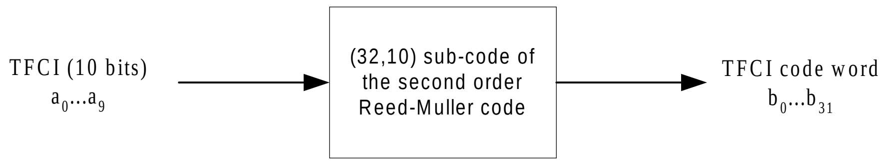


Figure 6: Channel coding of TFCI bits

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. The basis sequences are as follows in table 7.

Table 7: Basis 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	0	0	0	0	1	0	0	0	0
1	0	1	0	0	0	1	1	0	0	0
2	1	1	0	0	0	1	0	0	0	1
3	0	0	1	0	0	1	1	0	1	1
4	1	0	1	0	0	1	0	0	0	1
5	0	1	1	0	0	1	0	0	1	0
6	1	1	1	0	0	1	0	1	0	0
7	0	0	0	1	0	1	0	1	1	0
8	1	0	0	1	0	1	1	1	1	0
9	0	1	0	1	0	1	1	0	1	1
10	1	1	0	1	0	1	0	0	1	1
11	0	0	1	1	0	1	0	1	1	0
12	1	0	1	1	0	1	0	1	0	1
13	0	1	1	1	0	1	1	0	0	1
14	1	1	1	1	0	1	1	1	1	1
15	1	0	0	0	1	1	1	1	0	0
16	0	1	0	0	1	1	1	1	0	1
17	1	1	0	0	1	1	1	0	1	0
18	0	0	1	0	1	1	0	1	1	1
19	1	0	1	0	1	1	0	1	0	1
20	0	1	1	0	1	1	0	0	1	1
21	1	1	1	0	1	1	0	1	1	1
22	0	0	0	1	1	1	0	1	0	0
23	1	0	0	1	1	1	1	1	0	1
24	0	1	0	1	1	1	1	0	1	0
25	1	1	0	1	1	1	1	0	0	1
26	0	0	1	1	1	1	0	0	1	0
27	1	0	1	1	1	1	1	1	0	0
28	0	1	1	1	1	1	1	1	1	0
29	1	1	1	1	1	1	1	1	1	1
30	0	0	0	0	0	1	0	0	0	0
31	0	0	0	0	1	1	1	0	0	0

Let's define the TFCI information bits as 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 TFCI information bits shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the CCTrCH in the associated DPCH radio frame.

The 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.

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 times giving 4-bit transmission (N_{TFCI}=4) for a single TFCI bit and 8-bit transmission (N_{TFCI}=8) for 2 TFCI bits. Let's define the TFCI information bit(s) as b_0 (or b_0 and b_1). The TFCI information bit(s) shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the CCTrCH in the associated DPCH radio frame. 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 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 7.

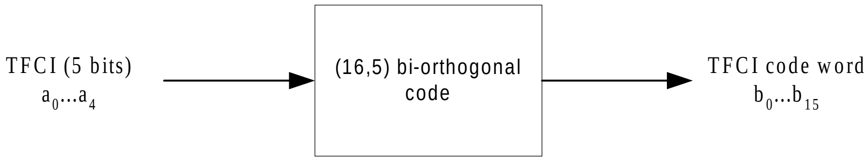


Figure 7: Channel coding of short length TFCI bits

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

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	0	0	0	1
1	0	1	0	0	1
2	1	1	0	0	1
3	0	0	1	0	1
4	1	0	1	0	1
5	0	1	1	0	1
6	1	1	1	0	1
7	0	0	0	1	1
8	1	0	0	1	1
9	0	1	0	1	1
10	1	1	0	1	1
11	0	0	1	1	1
12	1	0	1	1	1
13	0	1	1	1	1
14	1	1	1	1	1
15	0	0	0	0	1

Let's define the TFCI information bits as a_0 , a_1 , a_2 , a_3 , a_4 (a_0 is LSB and a_4 is MSB). The TFCI information bits shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the CCTrCH in the associated DPCH radio frame.

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.

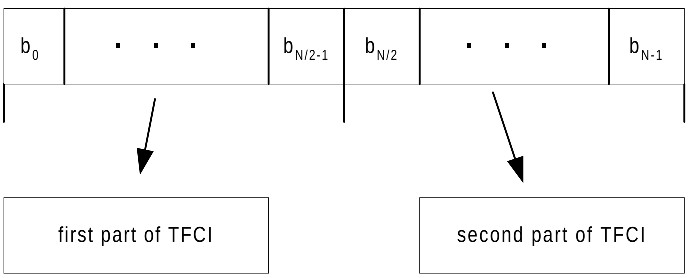


Figure 8: Mapping of TFCI word bits to timeslot

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.

4.3.2 Coding of Paging Indicator (PI)

The PI is an identifier to instruct the UE whether there is a paging message for the groups of mobiles that are associated to the PI. The length L_{PI} of the PI is L_{PI}=2, L_{PI}=4 or L_{PI}=8 symbols. The coding of the PI is shown in table 9.

Table 9: Coding of the PI

Bits	PI	Content
All '0'	Not set	There is no necessity to receive PCH
All '1'	Set	There is necessity to receive PCH-

4.3.3 Coding of Transmit Power Control (TPC)

The TPC command is an identifier sent in uplink transmission only, to instruct the NodeB whether Tx power has to be increased or decreased. The length of the TPC command is one symbol. The coding of the TPC command is shown in table 10.

Table 10: Coding of the TPC

TPC	TPC Bits	Meaning
'Down'	00	Decrease Tx Power
'Up'	11	Increase Tx Power

Annex A (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
14/01/00	RAN_05	RAN_05	-		Approved at TSG RAN #5 and placed under Change Control	-	3.0.0
14/01/00	RAN_06	RP-99694	001	3	Correction of rate matching parameters for repetition after 1st Interleaving in 25.222	3.0.0	3.1.0
14/01/00	RAN_06	RP-99694	002	1	Clarification of bit separation and collection	3.0.0	3.1.0
14/01/00	RAN_06	RP-99694	003	-	Changing the initial offset value for convolutional code rate matching	3.0.0	3.1.0
14/01/00	RAN_06	RP-99693	004	1	Editorial corrections to TS 25.222	3.0.0	3.1.0
14/01/00	RAN_06	RP-99694	007	-	Update of rate matching rule for TDD	3.0.0	3.1.0
14/01/00	RAN_06	RP-99694	009	1	Modified physical channel mapping scheme	3.0.0	3.1.0
14/01/00	RAN_06	RP-99694	013	-	Introduction of TFCI for S-CCPCH in TDD mode	3.0.0	3.1.0
14/01/00	RAN_06	RP-99694	015	-	TFCI coding and mapping in TDD	3.0.0	3.1.0
14/01/00	-	-	-		Change history was added by the editor	3.1.0	3.1.1
31/03/00	RAN_07	RP-000068	017	-	Corrections to TS 25.222	3.1.1	3.2.0
31/03/00	RAN_07	RP-000068	018	-	Refinements of Physical Channel Mapping	3.1.1	3.2.0
31/03/00	RAN_07	RP-000068	019	1	TFCI coding specification in TDD	3.1.1	3.2.0
31/03/00	RAN_07	RP-000068	021	-	Modification of Turbo code internal interleaver	3.1.1	3.2.0
31/03/00	RAN_07	RP-000068	023	-	Update of TS 25.222 - clarification of BTFD for TDD	3.1.1	3.2.0
31/03/00	RAN_07	RP-000068	025	-	Change of TFCI basis for TDD	3.1.1	3.2.0
31/03/00	RAN_07	RP-000068	026	-	Padding Function for Turbo coding of small blocks	3.1.1	3.2.0
31/03/00	RAN_07	RP-000068	027	-	Editorial modification of shifting parameter calculation for turbo code puncturing	3.1.1	3.2.0
31/03/00	RAN_07	RP-000068	029	1	Editorial changes of channel coding section	3.1.1	3.2.0
26/06/00	RAN_08	RP-000272	030	-	Parity bit attachment to 0 size transport block	3.2.0	3.3.0
26/06/00	RAN_08	RP-000272	031	-	Correction of the mapping formula	3.2.0	3.3.0
26/06/00	RAN_08	RP-000272	034	-	Alignment of Multiplexing for TDD	3.2.0	3.3.0
26/06/00	RAN_08	RP-000272	036	2	Bit separation of the Turbo encoded data	3.2.0	3.3.0
26/06/00	RAN_08	RP-000272	038	2	Revision of code block segmentation description	3.2.0	3.3.0
26/06/00	RAN_08	RP-000272	039	-	Editorial corrections in channel coding section	3.2.0	3.3.0

History

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