TSG-RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

RP-000266

Title: **Agreed CRs to TS 25.212**

Source: **TSG-RAN WG1**

Agenda item: **5.1.3**

No.	Doc #	Spec	CR	Rev	Subject	Cat	Current_v	New_v
1	R1-000585	25.212	066	1	Section 4.4.5 and table 9 is moved to informative	F	3.2.0	3.3.0
2	R1-000539	25.212	068	-	Editorial modifications of 25.212	D	3.2.0	3.3.0
3	R1-000541	25.212	069	-	Removal of BTFD for flexible positions in Release	F	3.2.0	3.3.0
4	R1-000560	25.212	070	1	Editorial modifications	D	3.2.0	3.3.0
5	R1-000572	25.212	071	1	Corrections and editorial modifications of 25.212	F	3.2.0	3.3.0
6	R1-000735	25.212	072	4	Corrections to 25.212 (Rate Matching, p-bit	F	3.2.0	3.3.0
7	R1-000634	25.212	073	-	Editorial correction in 25.212 coding/multiplexing	F	3.2.0	3.3.0
8	R1-000716	25.212	074	2	Bit separation of the Turbo encoded data	D	3.2.0	3.3.0
9	R1-000723	25.212	076	1	Revision of code block segmentation description	D	3.2.0	3.3.0
10	R1-000657	25.212	077	-	Clarifications for TFCI coding	F	3.2.0	3.3.0
11	R1-000775	25.212	078	2	Clarifying the rate matching parameter setting for	F	3.2.0	3.3.0
12	R1-000706	25.212	080	-	Clarification on BTFD utilisation (single CCTrCH)	F	3.2.0	3.3.0
13	R1-000741	25.212	081	-	Correction of order of checking TFC during	F	3.2.0	3.3.0
14	R1-000743	25.212	082	-	Editorial corrections in channel coding section	F	3.2.0	3.3.0
15	R1-000744	25.212	083	-	Correction for bit separation and bit collection	F	3.2.0	3.3.0
16	R1-000776	25.212	084	1	Correction on the spreading factor selection for	F	3.2.0	3.3.0

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00-0585*
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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

25.212 CR 066r1 Current Version: 3.2.0

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

For submission to: TSG RAN #8
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 is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

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

Source: TSG RAN WG1 **Date:** 12-Apr-00

Subject: Section 4.4.5 and table 9 is moved to informative annex.

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: Table 9 contains some ambiguities which are corrected. Most of the table is informative, thus it is moved to an annex.

Clauses affected: 4.4.5 and Annex B

Other specs affected:

Other 3G core specifications	X	→ List of CRs:	25.215-057
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:

4.4.5 Parameters for downlink compressed mode

Table 9 shows the detailed parameters for each transmission gap length for the different transmission time reduction methods.

Table 9: Parameters for compressed mode

TGL	Frame Type	Spreading Factor	Idle length [ms]	Transmission time Reduction method	Idle frame Combining
3	A	512 – 4	1.73-1.99	Puncturing, Spreading factor division by 2 or Higher layer scheduling	(S) (D) =(1,2) or (2,1)
	B	256 - 4	1.60-1.86		
4	A	512 - 4	2.40-2.66		(S) (D) =(1,3), (2,2) or (3,1)
	B	256 - 4	2.27-2.53		
5	A	512 - 4	3.07-3.33		(S) (D) = (1,4), (2,3), (3, 2) or (4,1)
	B	256 – 4	2.94-3.20		
7	A	512 -4	4.40-4.66		(S) (D)=(1,6), (2,5), (3,4), (4,3), (5,2) or (6,1)
	B	256 - 4	4.27-4.53		
10	A	512 - 4	6.40-6.66		(D)=(3,7), (4,6), (5,5), (6,4) or (7,3)
	B	256 - 4	6.27-6.53		
14	A	512 - 4	9.07-9.33		(D) =(7,7)
	B	256 - 4	8.93-9.19		

(S): Single-frame method as shown in figure 14 (1).

(D): Double-frame method as shown in figure 14 (2). (x,y) indicates x: the number of idle slots in the first frame, y: the number of idle slots in the second frame.

NOTE: Compressed mode by spreading factor reduction is not supported when SF=4 is used in normal mode.

Annex B (informative): Compressed mode idle lengths

The tables 9-11 show the resulting idle lengths for different transmission gap lengths, UL/DL modes and DL frame types. The idle lengths given are calculated purely from the slot and frame structures and the UL/DL offset. They do not contain margins for e.g. synthesizer switching.

B.1 Idle lengths for DL, UL and DL+UL compressed mode

Table 9: Parameters for DL compressed mode

TGL	DL Frame Type	Spreading Factor	Idle length [ms]	Transmission time Reduction method	Idle frame Combining
3	A	512 – 4	1.73 – 1.99	Puncturing, Spreading factor division by 2 or Higher layer scheduling	(S) (D) =(1,2) or (2,1)
	B		1.60 – 1.86		
4	A		2.40 – 2.66		(S) (D) =(1,3), (2,2) or (3,1)
	B		2.27 – 2.53		
5	A		3.07 – 3.33		(S) (D) = (1,4), (2,3), (3, 2) or (4,1)
	B		2.93 – 3.19		
7	A		4.40 – 4.66		(S) (D)=(1,6), (2,5), (3,4), (4,3), (5,2) or (6,1)
	B		4.27 – 4.53		
10	A		6.40 – 6.66		(D)=(3,7), (4,6), (5,5), (6,4) or (7,3)
	B		6.27 – 6.53		
14	A		9.07 – 9.33		(D) =(7,7)
	B		8.93 – 9.19		

Table 10: Parameters for UL compressed mode

TGL	Spreading Factor	Idle length [ms]	Transmission time Reduction method	Idle frame Combining
3	256 – 4	2.00	Spreading factor division by 2 or Higher layer scheduling	(S) (D) =(1,2) or (2,1)
4		2.67		(S) (D) =(1,3), (2,2) or (3,1)
5		3.33		(S) (D) = (1,4), (2,3), (3, 2) or (4,1)
7		4.67		(S) (D)=(1,6), (2,5), (3,4), (4,3), (5,2) or (6,1)
10		6.67		(D)=(3,7), (4,6), (5,5), (6,4) or (7,3)
14		9.33		(D) =(7,7)

Table 11: Parameters for combined UL/DL compressed mode

TGL	DL Frame Type	Spreading Factor	Idle length [ms]	Transmission time Reduction method	Idle frame Combining
3	A or B	DL: 512 – 4 UL: 256 – 4	1.47 – 1.73	DL: Puncturing, Spreading factor division by 2 or Higher layer scheduling UL: Spreading factor division by 2 or Higher layer scheduling	(S) (D) =(1,2) or (2,1)
4			2.13 – 2.39		(S) (D) =(1,3), (2,2) or (3,1)
5			2.80 – 3.06		(S) (D) = (1,4), (2,3), (3, 2) or (4,1)
7			4.13 – 4.39		(S) (D)=(1,6), (2,5), (3,4), (4,3), (5,2) or (6,1)
10			6.13 – 6.39		(D)=(3,7), (4,6), (5,5), (6,4) or (7,3)
14			8.80 – 9.06		(D) =(7,7)

(S): Single-frame method as shown in figure 14 (1).

(D): Double-frame method as shown in figure 14 (2). (x,y) indicates x: the number of idle slots in the first frame, y: the number of idle slots in the second frame.

NOTE: Compressed mode by spreading factor reduction is not supported when SF=4 is used in normal mode

Annex ~~B~~ C (informative): Change history

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00539*

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

CHANGE REQUEST

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

25.212 CR 068 Current Version: 3.2.0

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

For submission to: TSG RAN#8	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: TSG RAN WG1 **Date:**

Subject: Editorial modifications of 25.212

Work item: TS 25.212

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

Reason for change: Editorial modifications correcting small mistakes left in change request 25.212-042-r5 (Downlink compressed mode by puncturing)

Clauses affected: 4.2, 4.2.5.3, 4.2.5.4, 4.2.7.2, 4.2.9.1, 4.2.10

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 Transport-channel coding/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);
- transport block concatenation and code block segmentation (see subclause 4.2.2);
- channel coding (see subclause 4.2.3);
- rate matching (see subclause 4.2.7);
- insertion of discontinuous transmission (DTX) indication bits (see subclause 4.2.9);
- interleaving (two steps, see subclauses 4.2.4 and 4.2.11);
- radio frame segmentation (see subclause 4.2.6);
- multiplexing of transport channels (see subclause 4.2.8);
- physical channel segmentation (see subclause 4.2.10);
- mapping to physical channels (see subclause 4.2.12).

The coding/multiplexing steps for uplink and downlink are shown in figure 1 and figure 2 respectively.

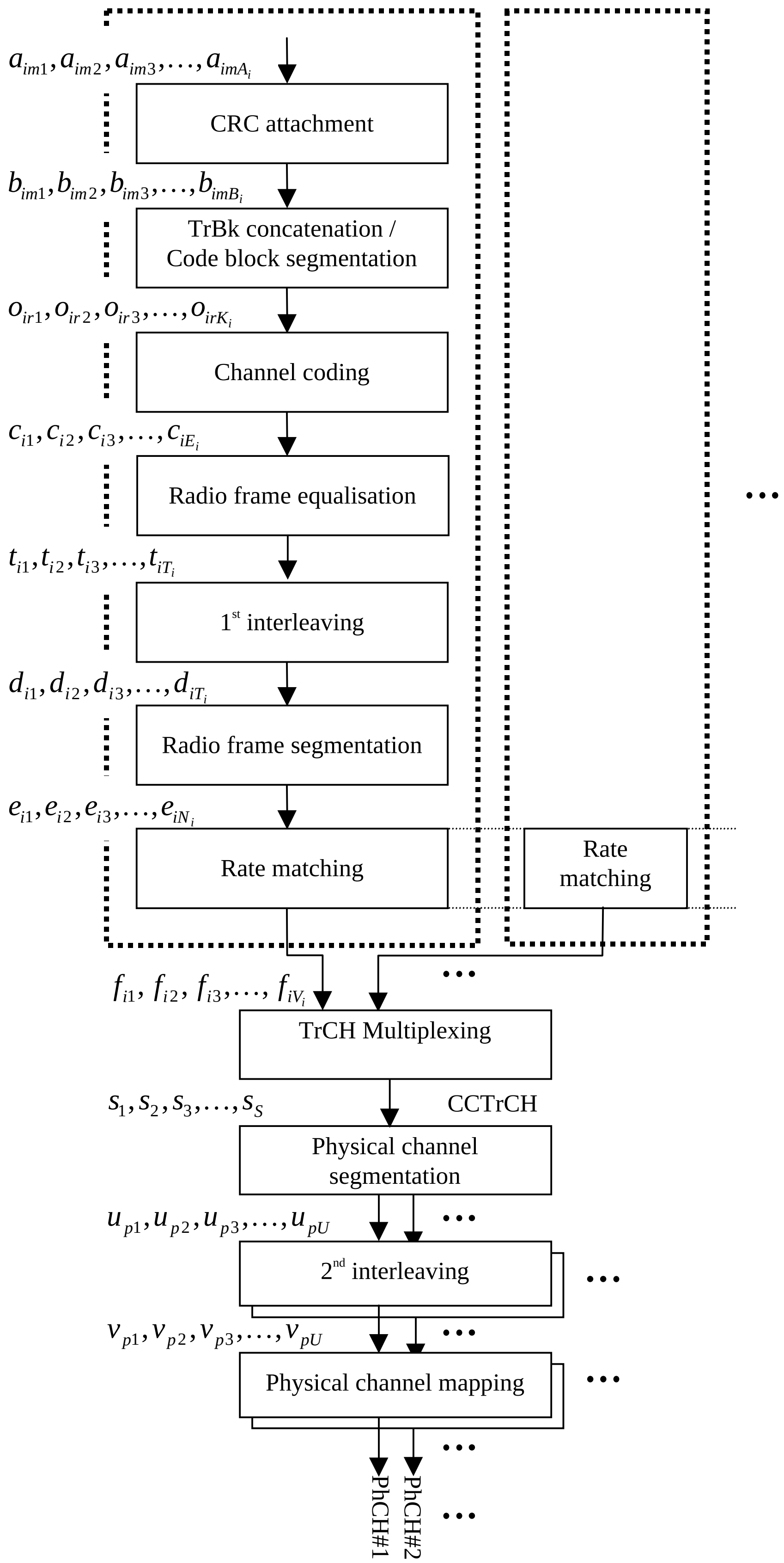
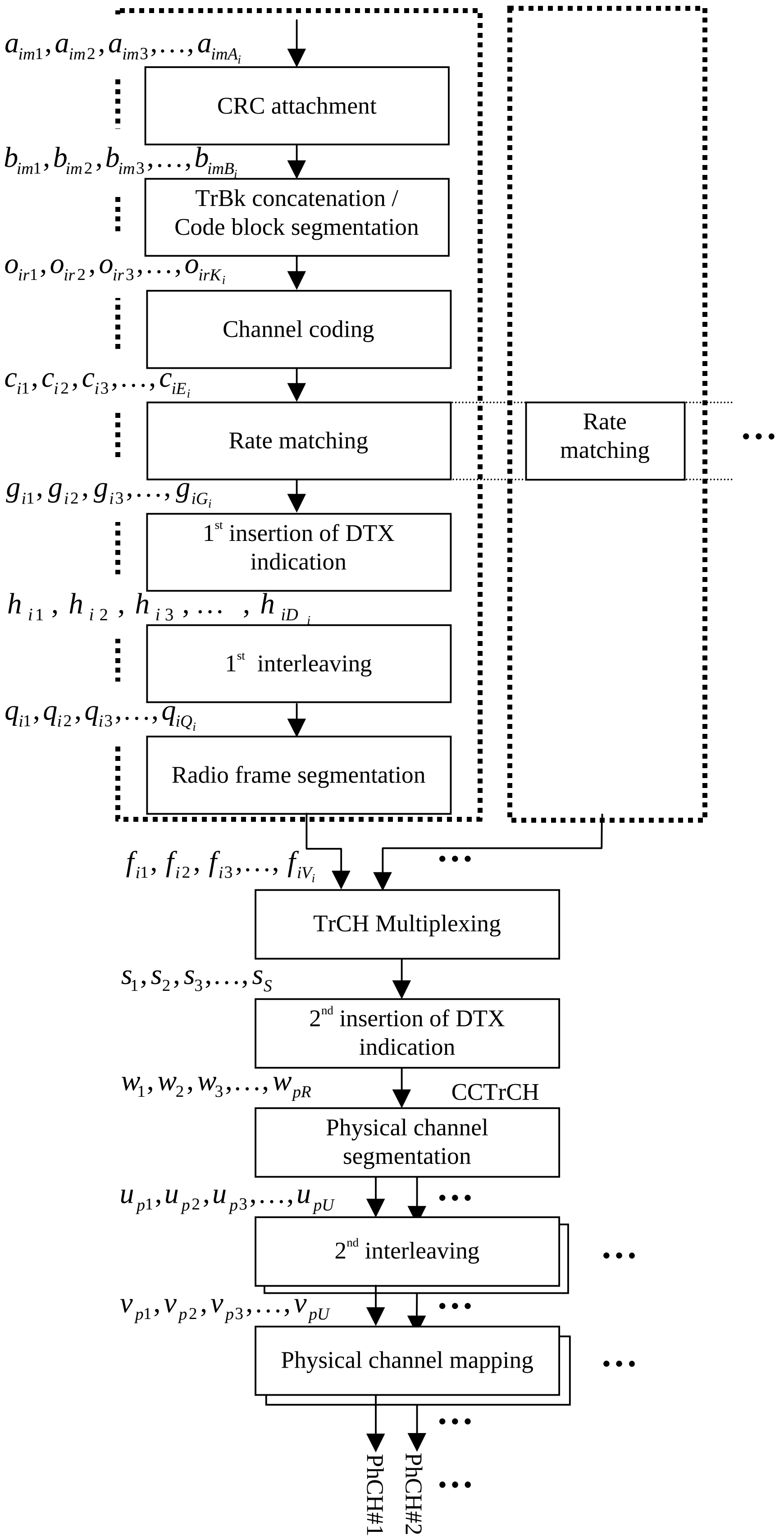


Figure 1: Transport channel multiplexing structure for uplink



CRC attachment
TrBk concatenation / Code block segmentation
Channel coding
Rate matching
Rate matching
1st insertion of DTX indication
1st interleaving
Radio frame segmentation
TrCH Multiplexing
2nd insertion of DTX indication
CCTrCH
Physical channel segmentation
2nd interleaving
Physical channel mapping
PhCH#1
PhCH#2

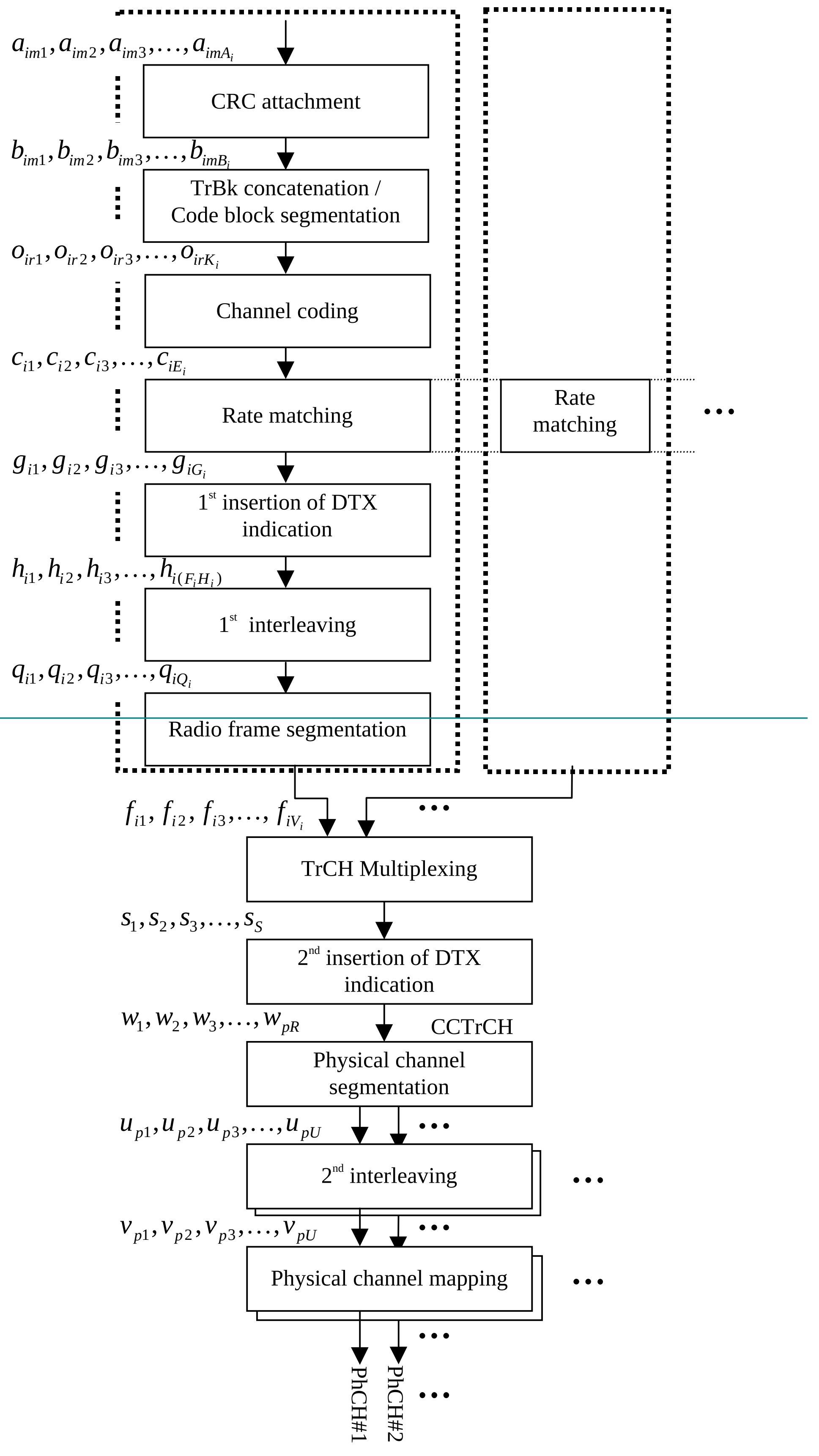


Figure 2: Transport channel multiplexing structure for downlink

The single output data stream from the TrCH multiplexing, including DTX indication bits in downlink, is denoted *Coded Composite Transport Channel (CCTrCH)*. A CCTrCH can be mapped to one or several physical channels.

4.2.5 1st interleaving

In Compressed Mode by puncturing, bits marked with a fourth value on top of {0, 1, δ} and noted p, are introduced in the radio frames to be compressed, in positions corresponding to the first bits of the radio frames. They will be removed in a later stage of the multiplexing chain to create the actual gap. Additional puncturing has been performed in the rate matching step, over the TTI containing the compressed radio frame, to create room for these p-bits. The following subclause describes this feature.

4.2.5.1 Insertion of marked bits in the sequence to be input in first interleaver

In normal mode, compressed mode by higher layer scheduling, and compressed mode by spreading factor reduction:

$x_{ik} = z_{ik}$ and $X_i = Z_{i.}$

In case of compressed mode by puncturing and fixed positions, sequence $x_{i,k}$ which will be input to first interleaver for TrCh *i* and TTI *m* within largest TTI, is built from bits $z_{i,k}$, $k=1, ..Z_i$, plus $Np^{TTI,m}_{i,max}$ bits marked p and $X_i = Z_i + Np^{TTI,m}_{i,max}$, as is described thereafter.

$Np^{TTI,m}_{i,max}$ is defined in the Rate Matching subclause 4.2.7.

$P_{Fi}[x]$ defines the inter column permutation function for a TTI of length Fi *10ms, as defined in Table 3 above. $P_{Fi}[x]$ is the Bit Reversal function of x on $\log_2(Fi)$ bits.

NOTE 1: C[x], x= 0 to Fi – 1, the number of bits p which have to be inserted in each of the Fi segments of the TTI, i.e. in each column of the first interleaver. C[x] is equal to $Np^{x}_{i,max}$ for x equal 0 to Fi –1 for fixed positions . It is noted Np^{x}_{i} in the following initialisation step.

NOTE 2: cbi[x], x=0 to Fi – 1, the counter of the number of bits p inserted in each of the Fi segments of the TTI, i.e. in each column of the first interleaver.

col = 0

while col < F_i **do**

C[col] = Np^{col}_{i} -- initialisation of number of bits p to be inserted in each of the Fi segments of the TTI

cbi[col] = 0 -- initialisation of counter of number of bits p inserted in each of the Fi segments of the TTI

end do

n = 0, m = 0

while n < X_i **do**

col = *n* mod F_i

if cbi[col] < C[P_{Fi}(col)] **do**

$x_{i,n}$ = p -- insert one p bit

cbi[col] = cbi[col]+1 -- update counter of number of bits p inserted

else -- no more p bit to insert in this segment

$x_{i,n} = z_{i,m}$

m = m+1

endif

n = n +1

end do

4.2.5.2 1st interleaver operation

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 $x_{i,(R_I C_I)}$ in column C_I of row R_I:

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

(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}:

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

(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.

Table 3

TTI	Number of columns C_I	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}

4.2.5.3 Relation between input and output of 1st interleaving in uplink

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, $z_{ik} = t_{ik}$ and Z~~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 $d_{ik} = y_{ik}$.

4.2.5.4 Relation between input and output of 1st interleaving in downlink

If fixed positions of the TrCHs in a radio frame is used then the bits input to the 1st interleaving are denoted by $h_{i1}, h_{i2}, h_{i3}, \ldots, h_{i(F_i H_i)}$, where i is the TrCH number. Hence, $z_{ik} = h_{ik}$ and Z_i = D_i ~~$F_i * H_i - Np^{TTI,m}_{i,max}$ in compressed mode by puncturing, and $Z_i = F_i H_i$ otherwise~~.

If flexible positions of the TrCHs in a radio frame is used then the bits input to the 1st interleaving are denoted by $g_{i1}, g_{i2}, g_{i3}, \ldots, g_{iG_i}$, where i is the TrCH number. Hence, $z_{ik} = g_{ik}$ and $Z_i = G_i$.

The bits output from the 1st interleaving are denoted by $q_{i1}, q_{i2}, q_{i3}, \ldots, q_{iQ_i}$, where i is the TrCH number and Q_i is the number of bits. Hence, $q_{ik} = y_{ik}$, $Q_i = F_i H_i$ if fixed positions are used, and $Q_i = G_i$ if flexible positions are used.

4.2.7.2 Determination of rate matching parameters in downlink

For downlink $N_{data,j}$ does not depend on the transport format combination j. $N_{data,*}$ is given by the channelization code(s) assigned by higher layers. Denote the number of physical channels used for the CCTrCH by P. $N_{data,*}$ is the number of bits available to the CCTrCH in one radio frame and defined as $N_{data,*}=P(15N_{data1}+15N_{data2})$, where N_{data1} and N_{data2} are defined in [2]. Note that contrary to the uplink, the same rate matching patterns are used in normal and compressed mode by spreading factor reduction or higher layer scheduling.

In the following, the total amount of puncturing or repetition for the TTI is calculated.

Additional calculations for compressed mode by puncturing in case of fixed positions are performed to determine this total amount of rate matching needed.

For compressed mode by puncturing, in TTIs where some compressed radio frames occur, the puncturing is increased or the repetition is decreased compared to what is calculated according to the rate matching parameters provided by higher layers. This allows to create room for later insertion of marked bits, noted p-bits, which will identify the positions of the gaps in the compressed radio frames.

The amount of additional puncturing corresponds to the number of bits to create the gap in the TTI for TrCh $_i$. In case of fixed positions, it is calculated in addition to the amount of rate matching indicated by higher layers. It is noted $Np^{TTI,\,m}{}_{i,max}$.

In fixed positions case, to obtain the total rate matching $\Delta N_{i,\max}^{TTI,cm,m}$ to be performed on the TTI m, $Np^{TTI,\,m}{}_{i,max}$ is sub-stracted from $\Delta N^{TTI,\,m}{}_{i,max}$ (calculated based on higher layers RM parameters as for normal rate matching). This allows to create room for the $Np^{TTI,\,m}{}_{i,max}$ bits p to be inserted later. If the result is null, i.e. the amount of repetition matches exactly the amount of additional puncturing needed, then no rate matching is necessary.

In case of compressed mode by puncturing and fixed positions, for some calculations, $N'_{data,*}$ is used for radio frames with gap instead of $N_{data,*}$, where $N'_{data,*}=P(15N'_{data1}+15N'_{data2})$. N'_{data1} and N'_{data2} are the number of bits in the data fields of the slot format used for the current compressed mode, i.e. slot format A or B as defined in [2] corresponding to the Spreading Factor and the number of transmitted slots in use.

The number of bits corresponding to the gap for TrCh i, in each radio frame of its TTI is calculated using the number of bits to remove on ~~each~~ all Physical Channels $N_{TGL}[k]$, where k is the radio frame number in the TTI.

For each radio frame k of the TTI, $N_{TGL}[k]$ is given by the relation:

$$N_{TGL}=\begin{cases}\frac{TGL}{15}N'_{data,*}\text{, if } N_{first}+TGL\le 15\\ \frac{15-N_{first}}{15}N'_{data,*}\text{, in first radio frame of the gap if } N_{first}+TGL>15\\ \frac{TGL-(15-N_{first})}{15}N'_{data,*}\text{, in second radio frame of the gap if } N_{first}+TGL>15\end{cases}$$

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

Note that $N_{TGL}[k] = 0$ if radio frame k is not compressed.

4.2.9.1 1[st] insertion of DTX indication bits

This step of inserting DTX indication bits is used only if the positions of the TrCHs in the radio frame are fixed. With fixed position scheme a fixed number of bits is reserved for each TrCH in the radio frame.

The bits from rate matching are denoted by $g_{i1}, g_{i2}, g_{i3}, \ldots, g_{iG_i}$, where G_i is the number of bits in one TTI of TrCH i. Denote the number of bits in one radio frame of TrCH i by H_i. Denote D_i the number of bits output of the first DTX insertion block.

In normal or compressed mode by spreading factor reduction, H_i is constant and corresponds to the maximum number of bits from TrCH i in one radio frame for any transport format of TrCH i. and $D_i = F_i * H_i$.

In compressed mode by puncturing, additional puncturing is performed in the rate matching block. The empty positions resulting from the additional puncturing are used to insert p-bits in the first interleaving block, the DTX insertion is therefore limited to allow for later insertion of p-bits. Thus DTX bits are inserted until the total number of bits is Di where $D_i = F_i * H_{i,*}$ $- Np^{TTI,\,m}_{i,max}$ ~~$+ \Delta N^{TTI}_{cm,\,i,\,max}$~~, and $H_i = N_{i,*} + \Delta N_{i,*}$.

The bits output from the DTX insertion are denoted by $h_{i1}, h_{i2}, h_{i3}, \ldots, h_{iD_i}$ Note that these bits are three valued. They are defined by the following relations:

$$h_{ik} = g_{ik} \quad k = 1, 2, 3, \ldots, G_i$$

$$h_{ik} = \delta \quad k = G_i+1, G_i+2, G_i+3, \ldots, D_i$$

where DTX indication bits are denoted by δ. Here $g_{ik} \in \{0, 1\}$ and $\delta \notin \{0, 1\}$.

4.2.10 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 $x_1, x_2, x_3, \ldots, x_Y$, where Y 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 $u_{p1}, u_{p2}, u_{p3}, \ldots, u_{pU}$, where p is PhCH number and U is the number of bits in one radio frame for each PhCH, i.e. $U = (Y - N_{TGL}) / P$ for compressed mode by puncturing, and $U = \frac{Y}{P}$ otherwise. The relation between x_k and u_{pk} is given below.

For all modes, some bits of the input flow are mapped to each code until the number of bits on the code is ~~Y~~U. For modes other than compressed mode by puncturing, all bits of the input flow are taken to be mapped to the codes. For compressed mode by puncturing, only the bits of the input flow not corresponding to bits p are taken to be mapped to the codes, each bit p is removed to ensure creation the gap required by the compressed mode, as described below.

Bits on first PhCH after physical channel segmentation:

$$u_{1,k} = x_{i,f(k)} \quad k = 1, 2, \ldots, U$$

Bits on second PhCH after physical channel segmentation:

$$u_{2,k} = x_{i,f(k+U)} \quad k = 1, 2, \ldots, U$$

…

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

$$u_{P,k} = x_{i,f(k+(P-1)U)} \quad k = 1, 2, \ldots, U$$

where f is such that :

- for modes other than compressed mode by puncturing, $x_{i,f(k)} = x_{i,k}$, i.e. $f(k) = k$, for all k.
- for compressed mode by puncturing, bit $u_{1,1}$ corresponds to the bit $x_{i,k}$ with smallest index k when the bits p are not counted, bit $u_{1,2}$ corresponds to the bit $x_{i,k}$ with second smallest index k when the bits p are not counted, and so on for bits $u_{1,3}, \ldots$ $u_{1,}$~~Y~~$_U$, $u_{2,1}, u_{2,2}, \ldots$ $u_{2,}$~~Y~~$_U$, $\ldots u_{P,1}, u_{P,2}, \ldots$ $u_{P,}$~~Y~~$_U$,

4.2.10.1 Relation between input and output of the physical segmentation block in uplink

The bits input to the physical segmentation are denoted by $s_1, s_2, s_3, \ldots, s_S$. Hence, $x_k = s_k$ and $Y = S$.

4.2.10.2 Relation between input and output of the physical segmentation block in downlink

The bits input to the physical segmentation are denoted by $w_1, w_2, w_3, \ldots, w_{(PU)}$. Hence, $x_k = w_k$ and $Y = PU$.

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00-0541*

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

CHANGE REQUEST

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

25.212	**CR**	**069**	Current Version:	3.2.0

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

For submission to:	TSG-RAN #8	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: TSG RAN WG1 **Date:** 2000-04-07

Subject: Removal of BTFD for flexible positions in Release 99

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: BTFD is only mandatory for fixed positions, hence it is proposed to remove remaining specification text on BTFD for flexible positions.

Clauses affected: 4.2.12.2, A.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

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

4.2.12 Physical channel mapping

The PhCH for both uplink and downlink is defined in [2]. The bits input to the physical channel mapping are denoted by $v_{p1}, v_{p2}, \ldots, v_{pU}$, where p is the PhCH number and U is the number of bits in one radio frame for one PhCH. The bits v_{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.

In compressed mode, no bits are mapped to certain slots of the PhCH(s). If $N_{first} + TGL \leq 15$, no bits are mapped to slots N_{first} to N_{last}. If $N_{first} + TGL > 15$, i.e. the transmission gap spans two consecutive radio frames, the mapping is as follows:

- In the first radio frame, no bits are mapped to slots N_{first}, $N_{first}+1$, $N_{first}+2$, …, 14.
- In the second radio frame, no bits are mapped to the slots 0, 1, 2, …, N_{last}.

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

4.2.12.1 Uplink

In uplink, the PhCHs used during a radio frame are either completely filled with bits that are transmitted over the air or not used at all. The only exception is when the UE is in compressed mode. The transmission can then be turned off during consecutive slots of the radio frame.

4.2.12.2 Downlink

In downlink, the PhCHs do not need to be completely filled with bits that are transmitted over the air. Bits $v_{pk} \notin \{0, 1\}$ are not transmitted.

During compressed mode by reducing the spreading factor by 2, no bits are mapped to the DPDCH field as follows:

If $N_{first} + TGL \leq 15$, i.e. the transmission gap spans one radio frame,

if $N_{first} + 7 \leq 14$

no bits are mapped to slots N_{first},$N_{first} + 1$, $N_{first} +2$,…, $N_{last} + (7 - TGL)$

no bits are mapped to the first $(N_{Data1}+ N_{Data2})/2$ bit positions of slot $N_{last} + (8 - TGL)$

else

no bits are mapped to slots N_{first}, $N_{first} + 1$, $N_{first} + 2$,…, 14

no bits are mapped to slots $N_{first} - 1$, $N_{first} - 2$, $N_{first} - 3$, …, $N_{first} - (7 - TGL - (14 - N_{last}))$

no bits are mapped to the last $(N_{Data1}+ N_{Data2})/2$ bit positions of slot $N_{first} - (8 - TGL - (14 - N_{last}))$

end if

If $N_{first} + TGL > 15$, i.e. the transmission gap spans two consecutive radio frames,

In the first radio frame, no bits are mapped to last $(N_{Data1}+ N_{Data2})/2$ bit positions in slot 7 as well as to slots 8, 9, 10, ..., 14.

In the second radio frame, no bits are mapped to slots 0, 1, 2, ..., 6 as well as to first $(N_{Data1}+ N_{Data2})/2$ bit positions in slot 7.

$N_{Data1}$and N_{Data2} are defined in [2].

~~The following rules should be used for the selection of fixed or flexible positions of the TrCHs in the radio frame:~~

- ~~For TrCHs not relying on TFCI for transport format detection (blind transport format detection), the positions of the transport channels within the radio frame should be fixed. In a limited number of cases, where there are a small number of transport format combinations, it is possible to allow flexible positions.~~

- For TrCHs relying on TFCI for transport format detection, higher layer signal whether the positions of the transport channels should be fixed or flexible.

A.2 Blind transport format detection with flexible positions

In certain cases where the CCTrCH consists of multiple transport channels and a small number of transport format combinations are allowed, it is possible to allow blind transport format detection with flexible positions.

Several examples for how the blind transport format detection with flexible positions might be performed are:

- The blind transport format detection starts at a fixed position and identifies the transport format of the first present transport channel and stops. The position of the other transport channels and their transport format being derived on the basis of the allowed transport format combinations, assuming that there is a one to one relationship between the transport format combination and the transport format of the first present transport channel.

- The blind rate detection evaluates all transport format combinations and picks the most reliable one.

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00-0560*
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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

25.212	**CR**	**070r1**	Current Version:	3.2.0

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

For submission to:	TSG RAN #8	for approval	X	strategic		(for SMG
list expected approval meeting # here ↑		for information		non-strategic		use only)

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:	TSG RAN WG1	**Date:**	11 April 2000
Subject:	Editorial modifications		
Work item:			

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			Release 98	
with an X)	D	Editorial modification	X		Release 99	X
					Release 00	

Reason for change:	Table titles are added to table 3 and table 6. A minor correction in section 4.2.3.3. The symbols in section 4.2.7 are changed to align with the changes in section 4.2.3.2.1.
Clauses affected:	4.2.3.3, 4.2.5.2, 4.2.7, 4.2.11

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:	

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 $E_i = C_iY_i$. The output bits are defined by the following relations:

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

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

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

$$\ldots$$

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

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

4.2.5.2 1st interleaver operation

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 $x_{i,(R_I C_I)}$ in column C_I of row R_I:

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

(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}:

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

(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.

Table 3 Inter-column permutation patterns for 1st interleaving

TTI	Number of columns C_I	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}

4.2.7 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 TrCH multiplexing is identical to the total channel bit rate of the allocated dedicated 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 and no uplink DPDCH will be selected in the case of uplink rate matching.

Notation used in subcaluse 4.2.7 and subclauses:

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 an 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 an 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.

$Np^{TTI,m}_{i,l}$, $m=0$ to $F_{max} / F_i - 1$:Positive or null: number of bits to be removed in TTI number *m* within the largest TTI, to create the required gaps in the compressed radio frames of this TTI, in case of compressed mode by puncturing, for TrCh *i* with transport format *l*. In case of fixed positions and compressed mode by puncturing, this value is noted $Np^{TTI,m}_{i,max}$ since it is calculated for all TrCh with their maximum number of bits; thus it is the same for all TFCs

Used in downlink only.

$Np^{n}_{i,l}$ $n=0$ to $F_{max} -1$:Positive or null: number of bits, in radio frame number *n* within the largest TTI, corresponding to the gap for compressed mode in this radio frame, for TrCH *i* with transport format *l*. The value will be null for the un-compressed radio frames. In case of fixed positions and compressed mode by puncturing, this value is noted $Np^{n}_{i,max}$ since it is calculated for all TrChs with their maximum number of bits; thus it is the same for all TFCs

Used in downlink only.

$N_{TGL}[k]$, $k=0$ to $F_i -1$: Positive or null: number of bits in each radio frame corresponding to the gap for compressed mode for the CCTrCh.

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.

$F_{\max}$ Maximum number of radio frames in a transmission time interval used in the CCTrCH :

$$F_{\max} = \max_{1 \le i \le I} F_i$$

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.

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

$TFCS$ The set of transport format combination indexes j.

e_{ini} Initial value of variable e in the rate matching pattern determination algorithm of subclause 4.2.7.5.

e_{plus} Increment of variable e in the rate matching pattern determination algorithm of subclause4.2.7.5.

e_{minus} Decrement of variable e in the rate matching pattern determination algorithm of subclause 4.2.7.5.

b: Indicates systematic and parity bits

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

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

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

The * (star) notation is used to replace an index x when the indexed variable X_x does not depend on the index x. In the left wing of an assignment the meaning is that "$X_* = Y$" is equivalent to "**for all** $\underline{x}$ **do** $X_x = Y$ ". In the right wing of an assignment, the meaning is that "$Y = X_*$ " is equivalent to "**take any** $\underline{x}$ **and do** $Y = X_x$".

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

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

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

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

4.2.11 2nd interleaving

The 2nd interleaving is a block interleaver with inter-column permutations. The bits input to the 2nd interleaver are denoted $u_{p1}, u_{p2}, u_{p3}, \ldots, u_{pU}$, where p is PhCH number and U is the number of bits in one radio frame for one PhCH.

(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:

$U \leq R_2 C_2$.

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

$$\begin{bmatrix} u_{p1} & u_{p2} & u_{p3} & \ldots & u_{p30} \\ u_{p31} & u_{p32} & u_{p33} & \ldots & u_{p60} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ u_{p,((R_2-1)30+1)} & u_{p,((R_2-1)30+2)} & u_{p,((R_2-1)30+3)} & \ldots & u_{p,(R_2 30)} \end{bmatrix}$$

(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_{pk}.

$$\begin{bmatrix} y_{p1} & y_{p,(R_2+1)} & y_{p,(2R_2+1)} & \ldots & y_{p,(29R_2+1)} \\ y_{p2} & y_{p,(R_2+2)} & y_{p,(2R_2+2)} & \ldots & y_{p,(29R_2+2)} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ y_{pR_2} & y_{p,(2R_2)} & y_{p,(3R_2)} & \ldots & y_{p,(30R_2)} \end{bmatrix}$$

(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_{pk} that corresponds to bits u_{pk} with $k>U$ are removed from the output. The bits after 2nd interleaving are denoted by $v_{p1}, v_{p2}, \ldots, v_{pU}$, where v_{p1} corresponds to the bit y_{pk} with smallest index k after pruning, v_{p2} to the bit y_{pk} with second smallest index k after pruning, and so on.

Table 6 Inter-column permutation pattern for 2nd interleaving

Number of column 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}

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00-0572*
e.g. for 3GPP use the format TP-99xxx or for SMG, use the format P-99-xxx

CHANGE REQUEST

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

25.212 CR 071r1 Current Version: 3.2.0

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

For submission to: TSG RAN#8 — for approval: X — for information: [ ] — strategic: [ ] — non-strategic: [ ] *(for SMG use only)*

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: TSG RAN WG1 **Date:**

Subject: Corrections and editorial modifications of 25.212 for 2nd insertion of DTX bits for CM

Work item: TS 25.212

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: Editorial corrections on section 4.2.9.2, reflecting the remarks made by Nortel Networks on the RAN1 reflector between RAN1#11 and RAN1#12.

Clauses affected: 4.2.9.2

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

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

4.2.9.2 2nd insertion of DTX indication bits

The DTX indication bits inserted in this step shall be placed at the end of the radio frame. Note that the DTX will be distributed over all slots after 2nd interleaving.

The bits input to the DTX insertion block are denoted by $s_1, s_2, s_3, \ldots, s_S$, where S is the number of bits from TrCH multiplexing. The number of PhCHs is denoted by P and the number of bits in one radio frame, including DTX indication bits, for each PhCH by R..

In normal mode $R = \frac{N_{data,*}}{P} = 15N_{data1} + 15N_{data2}$, where N_{data1} and N_{data2} are defined in [2].

For compressed mode, $N'_{data,*}$ is defined as $N'_{data,*} = P(15N'_{data1} + 15N'_{data2})$. N'_{data1} and N'_{data2} are the number of bits in the data fields of the slot format used for the current compressed mode, i.e. slot format A or B as defined in [2] corresponding to the Spreading Factor and the number of transmitted slots in use.

In case of compressed mode by puncturing and fixed positions, DTX shall be inserted until $N'_{data,*}$, bits, since the exact room for the gap is already reserved thanks to the earlier insertion of the p-bits. Therefore R is defined as $R = N'_{data,*} / P$~~.~~

In compressed mode ~~by SF reduction and~~ by higher layer scheduling, additional DTX with respect to normal mode shall be inserted if the ~~transmission time reduction method~~ transmission time reduction by higher layer scheduling does not exactly create a transmission gap of the desired TGL.

The number of bits available to the CCTrCH in one radio frame in compressed mode by SF reduction and by higher layer scheduling is denoted by $N^{cm}_{data,*}$ and $R = \frac{N^{cm}_{data,*}}{P}$.

~~The exact value of $N^{cm}_{data,*}$ is dependent on the *TGL* and the transmission time reduction method, which are signalled from higher layers.~~ For the transmission time reduction by SF/2 method in compressed mode $N^{cm}_{data,*} = \frac{N'_{data,*}}{2}$ ~~,~~

~~and f~~For ~~other methods~~ compressed mode by higher layer scheduling the exact value of $N^{cm}_{data,*}$ is dependent on the *TGL* which is signalled from higher layers. ~~i~~It can be calculated as $N^{cm}_{data,*} = N'_{data,*} - N_{TGL}$. ~~For every transmission time reduction method $N'_{data,*} = P(15N'_{data1} + 15N'_{data2})$, where N'_{data1} and N'_{data2} are the number of bits in the data fields of a slot for slot format A or B as defined in [2]~~.

N_{TGL} is the number of bits that are located within the transmission gap and defined as:

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

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

~~NOTE : In compressed mode by SF/2 method DTX is also added in physical channel mapping stage (subclause 4.2.12.2). During 2nd DTX insertion the number of CCTrCH bits is kept the same as in normal mode.~~

The bits output from the DTX insertion block are denoted by $w_1, w_2, w_3, \ldots, w_{(PR)}$. Note that these bits are four valued in case of compressed mode by puncturing, and three valued otherwise. They are defined by the following relations:

$w_k = s_k$ k = 1, 2, 3, …, S

$w_k = \delta$ k = S+1, S+2, S+3, …, P*R*

where DTX indication bits are denoted by δ. Here $s_k \in \{0,1, p\}$ and $\delta \notin \{0,1\}$.

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00-0735*
e.g. for 3GPP use the format TP-99xxx or for SMG, use the format P-99-xxx

CHANGE REQUEST

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

25.212 CR 72r4 Current Version: 3.2.0

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

For submission to: TSG RAN#8	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: TSG RAN WG1 **Date:** 25th May 2000

Subject: Corrections to 25.212 (Rate Matching, p-bit insertion, PhCH segmentation)

Work item: TS 25.212

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

F	Correction	X	**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature			Release 98	
D	Editorial modification	X		Release 99	X
				Release 00	

Reason for change:

- P1 1st IL column permutation is not named clearly
- formula $\Delta N^{TTI,m}_{i,max} = \Sigma_{n=0}^{n=Fi} \Delta N^{n}_{i,*}$ should sum up to F_i-1
- PhCH segmentation uses sometimes symbol *V* instead of *U*
- Indexing by frame number for CM by puncturing was not done with regards to largest TTI
- Specification was using the fact that P1 is self inverse
- Plenty of editorials, like putting symbols in italic and using equation editor instead of text editor for formulas, along with using unified mathematical notations.

Clauses affected: 4.2.5. ; 4.2.7. ; 4.2.9.2. ; 4.2.10, 4.2.11

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:

4.2.5 1st interleaving

In Compressed Mode by puncturing, bits marked with a fourth value on top of {0, 1, δ} and noted p, are introduced in the radio frames to be compressed, in positions corresponding to the first bits of the radio frames. They will be removed in a later stage of the multiplexing chain to create the actual gap. Additional puncturing has been performed in the rate matching step, over the TTI containing the compressed radio frame, to create room for these p-bits. The following subclause describes this feature.

4.2.5.1 Insertion of marked bits in the sequence to be input in first interleaver

In normal mode, compressed mode by higher layer scheduling, and compressed mode by spreading factor reduction:

~~$x_{ik} = z_{ik}$ and $X_i = Z_i$.~~ $x_{i,k} = z_{i,k}$ and $X_i = Z_i$.

In case of compressed mode by puncturing and fixed positions, sequence $x_{i,k}$ ~~$x_{i,k}$~~ which will be input to first interleaver for TrC~~h~~H i and TTI m within largest TTI, is built from bits $z_{i,k}$ ~~$z_{i,k}$~~, $k=1$, ~~...~~…, Z_i, plus $Np_{i,\max}^{TTI,m}$ ~~$Np^{TTI,m}_{i,max}$~~ bits marked p and $X_i = Z_i + Np_{i,\max}^{TTI,m}$ ~~$Np^{TTI,m}_{i,max}$~~, as is described thereafter.

$Np_{i,\max}^{TTI,m}$ ~~$Np^{TTI,m}_{i,max}$~~ is defined in the Rate Matching subclause 4.2.7.

P1~~$_{Fi}$[~~(x~~]~~) defines the inter column permutation function for a TTI of length F_i ~~Fi~~ *10ms, as defined in Table 3 ~~above~~in section 4.2.5.2. P1$_{Fi}$ ~~$_{Fi}$[~~(x~~]~~) is the Bit Reversal function of x on $\log_2$(F_i ~~Fi~~) bits.

NOTE 1: C[x], x= 0 to F_i ~~Fi~~ – 1, the number of bits p which have to be inserted in each of the F_i ~~Fi~~ segments of the TTI, where x is the column number before permutation, i.e. in each column of the first interleaver. C[P1$_{Fi}$(x)] is equal to $Np_{i,\max}^{m \cdot F_i + x}$ ~~$Np^{x}_{i,max}$~~ for x equal 0 to F_i ~~Fi~~ –1 for fixed positions . It is noted $Np_i^{m \times F_i + x}$ ~~Np^{x}_{i}~~ in the following initialisation step.

NOTE 2: cbi[x], x=0 to F_i ~~Fi~~ – 1, the counter of the number of bits p inserted in each of the F_i ~~Fi~~ segments of the TTI, i.e. in each column of the first interleaver. x is the column number before permutation.

col = 0

while col < F_i **do** -- here col is the column number after column permutation

C[P1$_{Fi}$(col)] = $Np_i^{m \times F_i + col}$ ~~Np^{col}_{i}~~ -- initialisation of number of bits p to be inserted in each of the F_i ~~Fi~~ segments of the TTI number m

cbi[P1$_{Fi}$(col)] = 0 -- initialisation of counter of number of bits p inserted in each of the F_i ~~Fi~~ segments of the TTI

col = col +1

end do

n = 0, m = 0

while n < ~~X_i~~ X_i **do** -- from here col is the column number before column permutation

col = n mod F_i

if cbi[col] < C[~~P$_{Fi}$ (~~col~~)~~] **do**

~~$x_{i,n}$~~ $x_{i,n}$ = p -- insert one p bit

cbi[col] = cbi[col]+1 -- update counter of number of bits p inserted

else -- no more p bit to insert in this segment

~~$x_{i,n} = z_{i,m}$~~ $x_{i,n} = z_{i,m}$

m = m+1

endif

n = n +1

end do

4.2.5.2 1st interleaver operation

The 1st interleaving is a block interleaver with inter-column permutations. The input bit sequence to the 1st interleaver is denoted by $x_{i,1}, x_{i,2}, x_{i,3}, \ldots, x_{i,X_i}$ ~~$x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$~~, 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 C1~~C_I~~ from table 3.

(2) Determine the number of rows R1~~R_I~~ defined as:

R1~~R_I~~ = X_i/ C1~~X_i/C_I~~

(3) Write the input bit sequence into the R1~~R_I~~ × C1~~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 $x_{i,(\mathrm{R1}\times\mathrm{C1})}$ ~~$x_{i,(R_I C_I)}$~~ in column C1~~C_I~~ of row R1~~R_I~~:

$$\begin{bmatrix} x_{i,1} & x_{i,2} & x_{i,3} & \ldots & x_{i,\mathrm{C1}} \\ x_{i,(\mathrm{C1}+1)} & x_{i,(\mathrm{C1}+2)} & x_{i,(\mathrm{C1}+3)} & \ldots & x_{i,(2\times\mathrm{C1})} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ x_{i,((\mathrm{R1}-1)\times\mathrm{C1}+1)} & x_{i,((\mathrm{R1}-1)\times\mathrm{C1}+2)} & x_{i,((\mathrm{R1}-1)\times\mathrm{C1}+3)} & \ldots & x_{i,(\mathrm{R1}\times\mathrm{C1})} \end{bmatrix}$$

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

(4) Perform the inter-column permutation based on the pattern $\langle \mathrm{P1}_{\mathrm{C1}}(j) \rangle_{j\in\{0,1,\ldots,\mathrm{C1}-1\}}$ ~~$\{P_I(j)\}$ (j=0,1, ..., C-1)~~ shown in table 3, where P1$_{\mathrm{C1}}$ ~~P_I~~(j) is the original column position of the j-th permuted column. After permutation of the columns, the bits are denoted by $y_{i,k}$:

$$\begin{bmatrix} y_{i,1} & y_{i,(\mathrm{R1}+1)} & y_{i,(2\times\mathrm{R1}+1)} & \ldots & y_{i,((\mathrm{C1}-1)\times\mathrm{R1}+1)} \\ y_{i,2} & y_{i,(\mathrm{R1}+2)} & y_{i,(2\times\mathrm{R1}+2)} & \ldots & y_{i,((\mathrm{C1}-1)\times\mathrm{R1}+2)} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ y_{i,\mathrm{R1}} & y_{i,(2\times\mathrm{R1})} & y_{i,(3\times\mathrm{R1})} & \ldots & y_{i,(\mathrm{C1}\times\mathrm{R1})} \end{bmatrix} \cancel{\begin{bmatrix} y_{i1} & y_{i,(R_I+1)} & y_{i,(2R_I+1)} & \ldots & y_{i,((C_I-1)R_I+1)} \\ y_{i2} & y_{i,(R_I+2)} & y_{i,(2R_I+2)} & \ldots & y_{i,((C_I-1)R_I+2)} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ y_{iR_I} & y_{i,(2R_I)} & y_{i,(3R_I)} & \ldots & y_{i,(C_I R_I)} \end{bmatrix}}$$

(5) Read the output bit sequence $y_{i1}, y_{i2}, y_{i3}, \ldots, y_{i,(\mathrm{C1}\times\mathrm{R1})}$ ~~$y_{i1}, y_{i2}, y_{i3}, \ldots, y_{i,(C_I R_I)}$~~ of the 1st interleaving column by column from the inter-column permuted R1~~R_I~~ × C1~~C_I~~ matrix. Bit $y_{i,1}$ corresponds to the first row of the first column and bit $y_{i,(\mathrm{R1}\times\mathrm{C1})}$ ~~$y_{i,(R_I C_I)}$~~ corresponds to row R1~~R_I~~ of column C1~~C_I~~.

Table 3

TTI	Number of columns C1 C_I	Inter-column permutation patterns <P1$_{C1}$(0), …, P1$_{C1}$(C1-1)>
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}>

4.2.5.3 Relation between input and output of 1st interleaving in uplink

The bits input to the 1st interleaving are denoted by $t_{i,1}, t_{i,2}, t_{i,3}, \ldots, t_{i,T_i}$ $t_{i1}, t_{i2}, t_{i3}, \ldots, t_{iT_i}$, where i is the TrCH number and T_i the number of bits. Hence, $z_{ik} = t_{ik}$ $z_{i,k} = t_{i,k}$ and $X_i = T_i$.

The bits output from the 1st interleaving are denoted by $d_{i,1}, d_{i,2}, d_{i,3}, \ldots, d_{i,T_i}$ $d_{i1}, d_{i2}, d_{i3}, \ldots, d_{iT_i}$, and $d_{ik} = y_{ik}$ $d_{i,k} = y_{i,k}$.

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 TrCH multiplexing is identical to the total channel bit rate of the allocated dedicated 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 and no uplink DPDCH will be selected in the case of uplink rate matching.

Notation used in subcaluse 4.2.7 and subclauses:

$N_{i,j}$: 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 an integer but a multiple of 1/8).

$N_{i,l}^{TTI}$ ~~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.

$\Delta N_{i,j}$ ~~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 an integer but a multiple of 1/8).

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

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

Used in downlink only.

$Np_{i,l}^{TTI,m}$ ~~$Np^{TTI,m}_{i,l}$~~, *m=0 to* (F_{max} / F_i) *- 1* :Positive or null: number of bits to be removed in TTI number *m* within the largest TTI, to create the required gaps in the compressed radio frames of this TTI, in case of compressed mode by puncturing, for TrC~~h~~H *i* with transport format *l*. In case of fixed positions and compressed mode by puncturing, this value is noted $Np_{i,\max}^{TTI,m}$ ~~$Np^{TTI,m}_{i,max}$~~ since it is calculated for all TrC~~h~~H with their maximum number of bits; thus it is the same for all TFCs

Used in downlink only.

$Np_{i,l}^{n}$ ~~$Np^{n}_{i,l}$~~ *n=0 to* F_{max} *-1:*Positive or null: number of bits, in radio frame number *n* within the largest TTI, corresponding to the gap for compressed mode in this radio frame, for TrCH *i* with transport format *l*. The value will be null for the ~~un-compressed~~ radio frames not overlapping with a transmission gap. In case of fixed positions and compressed mode by puncturing, this value is noted $Np_{i,\max}^{n}$ ~~$Np^{n}_{i,max}$~~ since it is calculated for all TrC~~h~~Hs with their maximum number of bits; thus it is the same for all TFCs

Used in downlink only.

~~$N_{TGL}[k]$~~ $N_{TGL}[k]$, *k=0 to* ~~F_i -1~~ F_{max}-1 : Positive or null: number of bits in each radio frame corresponding to the gap for compressed mode for the CCTrC~~h~~H.

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.

$Z_{i,j}$: Intermediate calculation variable.

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

$F_{\max}$ Maximum number of radio frames in a transmission time interval used in the CCTrCH :

$$F_{\max} = \max_{1 \le i \le I} F_i$$

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~~ $P1_F(n_i)$: The ~~inverse interleaving~~ column permutation function of the 1st interleaver, $P1_F(x)$ is the original position of column with number x after permutation. P1 is defined on table 3 of section 4.2.5.2 (note that the $P1_F$ ~~inverse interleaving function is identical to the interleaving function itself for the 1st interleaver).~~ is self-inverse). Used for rate matching in uplink only.

S[n] ~~$S(n_i)$~~: The shift of the puncturing or repetition pattern for radio frame n_i when $n = P1_{F_i}(n_i)$. Used in uplink only.

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

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

TFCS The set of transport format combination indexes *j*.

e_{ini} Initial value of variable *e* in the rate matching pattern determination algorithm of subclause 4.2.7.5.

e_{plus} Increment of variable *e* in the rate matching pattern determination algorithm of subclause4.2.7.5.

e_{minus} Decrement of variable *e* in the rate matching pattern determination algorithm of subclause 4.2.7.5.

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 subcaluse 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.

The * (star) notation is used to replace an index *x* when the indexed variable X_x does not depend on the index *x*. In the left wing of an assignment the meaning is that "$X_* = Y$" is equivalent to "**for all** *x* **do** $X_x = Y$ ". In the right wing of an assignment, the meaning is that "$Y = X_*$ " is equivalent to "**take any** *x* **and do** $Y = X_x$".

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

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

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

for all i = 1 –… I I (1) (1)

$$\Delta N_{i,j} = Z_{i,j} - Z_{i-1,j} - N_{i,j} \quad \Delta N_{ij} = Z_{ij} - Z_{i-1,j} - N_{ij}$$

for all i = 1 –… I I

4.2.7.1 Determination of rate matching parameters in uplink

4.2.7.1.1 Determination of SF and number of PhCHs needed

In uplink, puncturing can be applied to match the CCTrCH bit rate to the PhCH bit rate. The bit rate of the PhCH(s) is limited by the UE capability and restrictions imposed by UTRAN, through limitations on the PhCH spreading factor. The maximum amount of puncturing that can be applied is signalled from higher layers and denoted by PL. The number of available bits in the radio frames of one PhCH for all possible spreading factors is given in [2]. Denote these values by N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, and N_4, where the index refers to the spreading factor. The possible number of bits available to the CCTrCH on all PhCHs, N_{data}, then are { N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, N_4, $2N_4$, $3N_4$, $4N_4$, $5N_4$, $6N_4$}{ N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, N_4, $2\times N_4$, $3\times N_4$, $4\times N_4$, $5\times N_4$, $6\times N_4$}. Depending on the UE capability and the restrictions from UTRAN, the allowed set of N_{data} N_{data}, denoted SET0, can be a subset of { N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, N_4, $2\times N_4$, $3\times N_4$, $4\times N_4$, $5\times N_4$, $6\times N_4$}{ N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, N_4, $2N_4$, $3N_4$, $4N_4$, $5N_4$, $6N_4$}. $N_{data,j}$ for the transport format combination j is determined by executing the following algorithm:

SET1 = { N_{data} in SET0 such that

$$\left(\min_{1\le y\le I}\{RM_y\}\right) \times N_{data} - \sum_{x=1}^{I} RM_x \times N_{x,j} \quad \min_{1\le y\le I}\{RM_y\} \cdot N_{data} - \sum_{x=1}^{I} RMx \cdot N_{x,j}$$

is non negative }

If SET1 is not empty and the smallest element of SET1 requires just one PhCH then

$N_{data,j}$ = min SET1

else

SET2 = { N_{data} in SET0 such that

$$\left(\min_{1\le y\le I}\{RM_y\}\right) \times N_{data} - PL \times \sum_{x=1}^{I} RM_x \times N_{x,j} \quad \min_{1\le y\le I}\{RM_y\} \cdot N_{data} - PL \cdot \sum_{x=1}^{I} RMx \cdot N_{x,j}$$

is non negative }

Sort SET2 in ascending order

N_{data} = min SET2

While N_{data} is not the max of SET2 and the follower of N_{data} requires no additional PhCH do

N_{data} = follower of N_{data} in SET2

End while

$N_{data,j} = N_{data}$ $N_{data,j} = N_{data}$

End if

4.2.7.1.2 Determination of parameters needed for calculating the rate matching pattern

The number of bits to be repeated or punctured, $\Delta N_{i,j}$, 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 subclause 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 as follows:

In compressed mode by higher layer scheduling, $N^{cm}_{data,j}$ is obtained by executing the algorithm in subclause 4.2.7.1.1 but with the number of bits in one radio frame of one PhCH reduced to $\frac{N_{tr}}{15}$ of the value in normal mode.

N_{tr} is the number of transmitted slots in a compressed radio frame and is defined by the following relation:

$$N_{tr} = \begin{cases} 15 - TGL, \text{ if } N_{first} + TGL \le 15 \\ N_{first}, \text{ in first frame if } N_{first} + TGL > 15 \\ 30 - TGL - N_{first}, \text{ in second frame if } N_{first} + TGL > 15 \end{cases}$$

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

In compressed mode by spreading factor reduction, $N^{cm}_{data,j} = 2 \times (N_{data,j} - N_{TGL})$ ~~$N^{cm}_{data,j} = 2N_{data,j} - 2N_{TGL}$~~,

where $N_{TGL} = \frac{15 - N_{tr}}{15} \times N_{data,j}$ ~~$N_{TGL} = \frac{15 - N_{tr}}{15} N_{data,j}$~~

If $\Delta N_{i,j} = 0$ then the output data of the rate matching is the same as the input data and the rate matching algorithm of subclause 4.2.7.5 does not need to be executed.

If $\Delta N_{i,j} \neq 0$ the parameters listed in subclauses 4.2.7.1.2.1 and 4.2.7.1.2.2 shall be used for determining e_{ini}, e_{plus}, and e_{minus} (regardless if the radio frame is compressed or not).

4.2.7.1.2.1 Uncoded and convolutionally encoded TrCHs

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

if $R \neq 0$ and $2 \times R \le N_{i,j}$

then q = ⌈ N_{ij} ~~N_{ij}~~ / ~~R~~ R ⌉

else

q = ⌈ $N_{i,j}$ ~~N_{ij}~~ / (~~R~~ R - $N_{i,j}$ ~~N_{ij}~~) ⌉

endif

-- note: ~~q~~ q is a signed quantity.

if q is even

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

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

else

q' = q

endif

for x = 0 to F_i ~~F_i~~-1

S[~~(I_F~~ (| ⌊x×~~*~~q'⌋ | mod F_i ~~F_i~~)~~)~~] = (| ⌊x*q'⌋ | div F_i ~~F_i~~)

end for

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

a = 2

For each radio frame, the rate-matching pattern is calculated with the algorithm in subclause 4.2.7.5, where :

$X_i = N_{i,j}$., and

$e_{ini} = (a \times S[P1_{Fi}(n_i)] \times |\Delta N_i| + 1) \bmod (a \cdot N_{ij})$.

$e_{plus} = a \times N_{i,j}$

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

$X_i = N_{i,j}$., and

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

$e_{plus} = a \cdot N_{ij}$

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

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

4.2.7.1.2.2 Turbo encoded TrCHs

If repetition is to be performed on turbo encoded TrCHs, i.e. $\Delta\Delta N_{i,j}$ >0, the parameters in subclause 4.2.7.1.2.1 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 4.2.7.5 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 $x r$=0 to F_i-1

S[I_F[(3×r x+b-1) mod F_i F_i]] = x r mod 2;

end for

else

if q is even

then q' q' = q q – $gcd(q$ q, $F_i)/F_i$ -- where gcd (q q, F_i) means greatest common divisor of q q and F_i
-- note that q' q' is not an integer, but a multiple of 1/8

else q' = q

endif

for x=0 to F_i -1

r = ⌈ $x*$ x×q'⌉ mod F_i F_i;

S[IF[(3×r+b-1) mod F$_i$ F_i]] = ⌈ x* x×q'⌉ div F$_i$ F_i;

endfor

endif

For each radio frame, the rate-matching pattern is calculated with the algorithm in subclause 4.2.7.5, where:

X_i is as above:

e_{ini} = (a×·S[P1$_{Fi}$(n_i)](n_i)×·|ΔN$_i$| + X$_i$) mod (a·X$_i$×X_i), if e_{ini} =0 then e_{ini} = a×X_i e_{ini} = a·X$_i$.

e_{plus} = a×X_i a·X$_i$

e_{minus} = a× |ΔN_i | a· |ΔN$_i$ |

4.2.7.2 Determination of rate matching parameters in downlink

For downlink $N_{data,j}$ does not depend on the transport format combination j. $N_{data,*}$ is given by the channelization code(s) assigned by higher layers. Denote the number of physical channels used for the CCTrCH by P. $N_{data,*}$ is the number of bits available to the CCTrCH in one radio frame and defined as $N_{data,*}=P\times15\times(15N_{data1}+15N_{data2})$, where N_{data1} and N_{data2} are defined in [2]. Note that contrary to the uplink, the same rate matching patterns are used in normal and compressed mode by spreading factor reduction or higher layer scheduling.

In the following, the total amount of puncturing or repetition for the TTI is calculated.

Additional calculations for compressed mode by puncturing in case of fixed positions are performed to determine this total amount of rate matching needed.

For compressed mode by puncturing, in TTIs where some compressed radio frames occur, the puncturing is increased or the repetition is decreased compared to what is calculated according to the rate matching parameters provided by higher layers. This allows to create room for later insertion of marked bits, noted p-bits, which will identify the positions of the gaps in the compressed radio frames.

The amount of additional puncturing corresponds to the number of bits to create the gap in the TTI for TrChH i i. In case of fixed positions, it is calculated in addition to the amount of rate matching indicated by higher layers. It is noted $Np_{i,\max}^{TTI,m}$ $Np^{TTI,m}_{i,max}$.

In fixed positions case, to obtain the total rate matching $\Delta N_{i,\max}^{TTI,cm,m}$ to be performed on the TTI m, $Np_{i,\max}^{TTI,m}$ $Np^{TTI,m}_{i,max}$ is sub-stracted from $\Delta N_{i,\max}^{TTI,m}$ $\Delta N^{TTI,m}_{i,max}$ (calculated based on higher layers RM parameters as for normal rate matching). This allows to create room for the $Np_{i,\max}^{TTI,m}$ $Np^{TTI,m}_{i,max}$ bits p to be inserted later. If the result is null, i.e. the amount of repetition matches exactly the amount of additional puncturing needed, then no rate matching is necessary.

In case of compressed mode by puncturing and fixed positions, for some calculations, $N'_{data,*}$ is used for radio frames with gap instead of $N_{data,*}$, where $N'_{data,*} = P\times15\times(N'_{data1}+N'_{data2})$ $N'_{data,*} = P(15N'_{data1}+15N'_{data2})$.

N'_{data1} and N'_{data2} are the number of bits in the data fields of the slot format used for the current compressed mode, i.e. slot format A or B as defined in [2] corresponding to the Spreading Factor and the number of transmitted slots in use.

The number of bits corresponding to the gap for TrCh i TrCH i, in each radio frame of its TTI is calculated using the number of bits to remove on each Physical Channel N_{TGL}[k], where k is the radio frame number in the largest TTI.

For each radio frame k of the largest TTI that is overlapping with a transmission gap, N_{TGL}[k] is given by the relation:

$$N_{TGL} = \begin{cases} \frac{TGL}{15}\times N'_{data,*} \quad \frac{TGL}{15} N'_{data,*}, \text{ if } N_{first} + TGL \le 15 \\ \end{cases}$$

$$\frac{15 - N_{first}}{15} \times N'_{data,*}\ \frac{15 - N_{first}}{15} N'_{data,*}$$, in first radio frame of the gap if $N_{first} + TGL > 15$

$$\frac{TGL - (15 - N_{first})}{15} \times N'_{data,*}\ \frac{TGL - (15 - N_{first})}{15} N'_{data,*}$$, in second radio frame of the gap if $N_{first} + TGL > 15$

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

Note that N_{TGL} [k] = 0 if radio frame k is not compressedoverlapping with a transmission gap.

4.2.7.2.1 Determination of rate matching parameters for fixed positions of TrCHs

4.2.7.2.1.1 Calculation of $\Delta N_{i,\max}$ $\Delta N_{i,max}$ for normal mode and compressed mode by higher layer scheduling and spreading factor reduction

First an intermediate calculation variable $N_{i,*}$ is calculated for all transport channels *i* by the following formula:

$$N_{i,*} = \frac{1}{F_i} \times \left(\max_{l \in TFS(i)} N_{i,l}^{TTI} \right) N_{i,*} = \frac{1}{F_i} \cdot \max_{l \in TFS(i)} N_{i,l}^{TTI}$$

In order to compute The computation of the $\Delta N_{i,l}^{TTI}$ parameters is then performed in for all TrCH *i* and all TF *l*, we first compute an intermediate parameter $\Delta N_{i,\max}$ by the following formula, where $\Delta N_{i,*}$ is derived from $N_{i,*}$ by the formula given at subclause 4.2.7:

$$\Delta N_{i,max} = F_i \times \Delta N_{i,*}\ \Delta N_{max} = F_i \cdot \Delta N_{i,*}$$

If $\Delta N_{i,max} = 0$ $\Delta N_{max} = 0$ then, for TrCH *i*, the output data of the rate matching is the same as the input data and the rate matching algorithm of subclause 4.2.7.5 does not need to be executed. In this case we have :

$$\forall l \in TFS(i)\ \Delta N_{i,l}^{TTI} = 0$$

If $\Delta N_{i,max} \neq 0$ $\Delta N_{max} \neq 0$ the parameters listed in subclauses 4.2.7.2.1.3 and 4.2.7.2.1.4 shall be used for determining e_{ini}, e_{plus}, and e_{minus}, and $\Delta N_{i,l}^{TTI}$.

4.2.7.2.1.2 Calculations for compressed mode by puncturing

Calculations of $\Delta N_{i,\max}^{TTI,m}$ $\Delta N^{TTI,m}_{i,max}$, for all TTI *m* within largest TTI, for all TrChH *i*

First an intermediate calculation variable $N^{n}_{i,*}$ is calculated for all transport channels *i* and all frames *n* in TTI *m* within the largest TTI, using the same formula as for normal mode above by replacing $N^{TTI}_{i,l}$ by $N^{TTI,m}_{i,l}$, the number of bits in TTI *m*.

First an intermediate calculation variable $N_{i,*}$ is calculated for all transport channels *i* by the following formula:

$$N_{i,*} = \frac{1}{F_i} \times \left(\max_{l \in TFS(i)} N_{i,l}^{TTI} \right)$$

Then an intermediate calculation variable $\Delta N_{i,*}^{n}$ is derived from $N_{i,*}$ by the formula given at subclause 4.2.7, for all TrCH *i* and all frames *n* in the largest TTI, from the formula given at subclause 4.2.7 using $N_{data,*}$, when index *n* designates a radio frame of the largest TTI that is not overlapping with a transmission gap, and using $N'_{data,*}$ instead of $N_{data,*}$, when index *n* designate a frame that is overlapping with a transmission gap.

In order to compute the $\Delta N_{i,l}^{TTI,m}$ parameters for all TrCH *i*, all TF *l* and all TTI with number *m* in the largest TTI, we first compute an intermediate parameter $\Delta N_{i,\max}^{m}$ by the following formula ::

$$\Delta N_{i,\max}^{m} = \sum_{n=m\times F_i}^{n=(m+1)\times F_i - 1} \Delta N_{i,*}^{n}$$

~~The computation of the $\Delta N^{TTI,m}_{i,max}$ parameters is then performed for all TrCH *i* by the following formula,~~

~~$\Delta N^{TTI,m}_{i,max} = \Sigma_{n=0}^{n=Fi} \Delta N^{n}_{i,*}$~~

~~where all $\Delta N^{n}_{i,*}$ are derived from $N^{n}_{i,*}$ for all TrCh i and all frames *n* in TTI *m*, from the formula given at subclause 4.2.7 using $N_{data,*}$, for the non compressed frames of TTI *m* and using $N'_{data,*}$ instead of $N_{data,*}$, for the compressed frames of TTI *m*.~~

Calculations of $Np_{i,\max}^{n}$ ~~$Np^{n}_{i,max}$~~ and $Np_{i,\max}^{TTI,m}$ ~~$Np^{TTI,m}_{i,max}$~~

Let $Np_{i,\max}^{n}$ ~~$Np^{n}_{i,max}$~~ be the number of bits to eliminate on TrC~~h~~H *i* to create the gap for compressed mode, in each radio frame k of the TTI, calculated for the Transport Format Combination of TrC~~h~~H *i*, in which the number of bits of TrC~~h~~H *i* is at its maximum.

$Np_{i,\max}^{n}$ ~~$Np^{n}_{i,max}$~~ is calculated for each radio frame k of the TTI in the following way.

Intermediate variables Z_i *for i = 1 to I* are calculated using the formula (1) in 4.2.7, by replacing $N_{data,j}$ by $N_{TGL}[$~~k~~$n]$.

Then $Np_{i,\max}^{n}$ ~~$Np^{n}_{i,max}$~~ = $(Z_i - Z_{i-1})$ *for i = 1 to I*

The total number of bits $Np_{i,\max}^{TTI,m}$ ~~$Np^{TTI,m}_{i,max}$~~ corresponding to the gaps for compressed mode for TrC~~h~~H i in the TTI is calculated as:

$$Np_{i,\max}^{TTI,m} = \sum_{n=m\times F_i}^{n=(m+1)\times F_i - 1} Np_{i,\max}^{n}$$

~~$Np^{TTI,m}_{i,max} = \Sigma_{n=0}^{Fi-1} Np^{n}_{i,max}$~~

~~If $\Delta N_{max} = Np^{TTI,m}_{i,max}$, then, for TrCH *i*, the output data of the rate matching is the same as the input data and the rate matching algorithm of subclause 4.2.7.5 does not need to be executed. If $\Delta N_{max} \neq Np^{TTI,m}_{i,max}$, then, for TrCH *i*, the rate matching algorithm of subclause 4.2.7.5 needs to be executed.~~

The amount of rate matching $\Delta N_{i,\max}^{TTI,cm,m}$ for the highest TrCH bit rate is then computed by the following formula :

$\Delta N_{i,\max}^{TTI,cm,m}$ = $\Delta N_{i,\max}^{m}$ ~~$\Delta N^{TTI,m}_{i,max}$~~ - $Np_{i,\max}^{TTI,m}$ ~~$Np^{TTI,m}_{i,ma}$~~

If $\Delta N_{i,\max}^{TTI,cm,m}$ = 0, then, for TrCH *i*, the output data of the rate matching is the same as the input data and the rate matching algorithm of subclause 4.2.7.5 does not need to be executed.

If $\Delta N_{i,\max}^{TTI,cm,m} \neq 0$, then, for TrCH *i*, the rate matching algorithm of subclause 4.2.7.5 needs to be executed, and the parameters listed in subclauses 4.2.7.2.1.3 and 4.2.7.2.1.4 shall be used for determining e_{ini}, e_{plus}, and e_{minus}, and $\Delta N_{i,l}^{TTI,m}$.

*

4.2.7.2.1.3 Determination of rate matching parameters for uncoded and convolutionally encoded TrCHs

$$\Delta N_i = \Delta N_{i,max} \quad \Delta N_i = \Delta N_{max}$$

For compressed mode by puncturing, ΔN_i is defined as: $\Delta N_i = \Delta N_{i,\max}^{TTI,cm,m}$, instead of the previous relation.

a=2

$$N_{max} = \max_{l \in TFS(i)} N_{il}^{TTI}$$

For each transmission time interval of TrCH *i* with TF *l*, the rate-matching pattern is calculated with the algorithm in subclause 4.2.7.5. The following parameters are used as input:

$$X_i = N_{il}^{TTI}$$

$$e_{ini} = 1$$

$$e_{plus} = a \times N_{max} \quad e_{plus} = a \cdot N_{max}$$

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

Puncturing if $\Delta N_i < 0$, repetition otherwise. The values of $\Delta N_{i,l}^{TTI}$ may be computed by counting repetitions or puncturing when the algorithm of subclause 4.2.7.5 is run. The resulting values of $\Delta N_{i,l}^{TTI}$ can be represented with following expression.

$$\Delta N_{i,l}^{TTI} = \left\lceil \frac{|\Delta N_i| \times X_i}{N_{max}} \right\rceil \times \text{sgn}(\Delta N_i) \quad \Delta N_{i,l}^{TTI} = \left\lceil \frac{|\Delta N_{max}| \times X_i}{N_{max}} \right\rceil \times \text{sgn}(\Delta N_{max})$$

For compressed mode by puncturing, the above formula produces $\Delta N_{i,l}^{TTI,m}$ instead of $\Delta N_{i,l}^{TTI}$.

4.2.7.2.1.4 Determination of rate matching parameters for Turbo encoded TrCHs

If repetition is to be performed on turbo encoded TrCHs, i.e. $\Delta N_{i,max} > 0$ $\Delta N_{max} > 0$, the parameters in subclause 4.2.7.2.1.3 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

The bits indicated by *b*=1 shall not be punctured.

$$\Delta N_i^b = \begin{cases} \lfloor \Delta N_{i,max}/2 \rfloor, & \text{for } b=2 \\ \lceil \Delta N_{i,max}/2 \rceil, & \text{for } b=3 \end{cases} \quad \Delta N_i = \begin{cases} \lfloor \Delta N_{max}/2 \rfloor, & b=2 \\ \lceil \Delta N_{max}/2 \rceil, & b=3 \end{cases}$$

In Compressed Mode by puncturing, the following relations are used instead of the previous ones:

ΔN_i^b ΔN_i = $\lfloor \Delta N_{i,\max}^{TTI,cm,m}/2 \rfloor$ $\lfloor \Delta N_{i,\max}^{TTI,cm,m}/2 \rfloor$, for $b=2$

ΔN_i^b ΔN_i = $\lceil \Delta N_{i,\max}^{TTI,cm,m}/2 \rceil$ $\lceil \Delta N_{i,\max}^{TTI,cm,m}/2 \rceil$, for $b=3$

$$N_{max} = \max_{l \in TFS(i)} (N_{il}^{TTI}/3)$$

For each transmission time interval of TrCH *i* with TF *l*, the rate-matching pattern is calculated with the algorithm in subcaluse 4.2.7.5. The following parameters are used as input:

$$X_i = N_{il}^{TTI}/3$$

$$e_{ini} = N_{max}$$

$$e_{plus} = a \times N_{max} \quad e_{plus} = a \cdot N_{max}$$

$$e_{\min us} = a \times \left|\Delta N_i^b\right| \quad e_{\min us} = a \cdot \left|\Delta N_i\right|$$

The values of $\Delta N_{i,l}^{TTI}$ may be computed by counting puncturing when the algorithm of subclause 4.2.7.5 is run. The resulting values of $\Delta N_{i,l}^{TTI}$ can be represented with following expression.

$$\Delta N_{i,l}^{TTI} = -\left\lfloor \frac{\left|\Delta N_i^2\right| \times X_i}{N_{max}} + 0.5 \right\rfloor - \left\lfloor \frac{\left|\Delta N_i^3\right| \times X_i}{N_{max}} \right\rfloor$$

$$\Delta N_{i,l}^{TTI} = -\left\lfloor \frac{\left|\lfloor \Delta N_{max}/2 \rfloor\right| \times X_i}{N_{max}} + 0.5 \right\rfloor - \left\lfloor \frac{\left|\lceil \Delta N_{max}/2 \rceil\right| \times X_i}{N_{max}} \right\rfloor$$

In the above equation, the first term of the right hand side represents the amount of puncturing for *b*=2 and the second term represents the amount of puncturing for *b*=3.

For compressed mode by puncturing, the above formula produces $\Delta N_{i,l}^{TTI,m}$ instead of $\Delta N_{i,l}^{TTI}$.

4.2.9.2 2nd insertion of DTX indication bits

The DTX indication bits inserted in this step shall be placed at the end of the radio frame. Note that the DTX will be distributed over all slots after 2nd interleaving.

The bits input to the DTX insertion block are denoted by $s_1, s_2, s_3, \ldots, s_S$,where *S* is the number of bits from TrCH multiplexing. The number of PhCHs is denoted by *P* and the number of bits in one radio frame, including DTX indication bits, for each PhCH by *R*..

In normal mode $R = \frac{N_{data,*}}{P} = 15 \times \left(N_{data1} + N_{data2}\right)$ ~~$R = \frac{N_{data,*}}{P} = 15N_{data1} + 15N_{data2}$~~, where N_{data1} and N_{data2} are defined in [2].

For compressed mode, $N'_{data,*}$ is defined as $N'_{data,*} = P \times 15 \times (N'_{data1} + N'_{data2})$ ~~$N'_{data,*} = P(15N'_{data1} + 15N'_{data2})$~~.

N'_{data1} and N'_{data2} are the number of bits in the data fields of the slot format used for the current compressed mode, i.e. slot format A or B as defined in [2] corresponding to the Spreading Factor and the number of transmitted slots in use.

In case of compressed mode by puncturing and fixed positions, DTX shall be inserted until $N'_{data,*}$, bits, since the exact room for the gap is already reserved thanks to the earlier insertion of the p-bits. Therefore R is defined as $R = N'_{data,*} / P$.

In compressed mode by SF reduction and by higher layer scheduling, additional DTX shall be inserted if the transmission time reduction method does not exactly create a transmission gap of the desired ~~TGL~~ *TGL*. The number of bits available to the CCTrCH in one radio frame in compressed mode by SF reduction and by higher layer scheduling is denoted by $N^{cm}_{data,*}$ and $R = \frac{N^{cm}_{data,*}}{P}$. The exact value of $N^{cm}_{data,*}$ is dependent on the *TGL* and the transmission time reduction method, which are signalled from higher layers. For transmission time reduction by SF/2 method in compressed mode $N^{cm}_{data,*} = \frac{N'_{data,*}}{2}$, and for other methods it can be calculated as $N^{cm}_{data,*} = N'_{data,*} - N_{TGL}$. For every transmission time reduction method $N'_{data,*} = P \times 15 \times (N'_{data1} + N'_{data2})$ ~~$N'_{data,*} = P(15N'_{data1} + 15N'_{data2})$~~, where N'_{data1} and N'_{data2} are the number of bits in the data fields of a slot for slot format A or B as defined in [2]. N_{TGL} is the number of bits that are located within the transmission gap and defined as:

$$N_{TGL} = \begin{cases} \frac{TGL}{15} \times N'_{data,*} \quad \sout{\frac{TGL}{15} N'_{data,*}}, & \text{if } N_{first} + TGL \le 15 \\ \frac{15 - N_{first}}{15} \times N'_{data,*} \quad \sout{\frac{15 - N_{first}}{15} N'_{data,*}}, & \text{in first frame if } N_{first} + TGL > 15 \\ \frac{TGL - (15 - N_{first})}{15} \times N'_{data,*} \quad \sout{\frac{TGL - (15 - N_{first})}{15} N'_{data,*}}, & \text{in second frame if } N_{first} + TGL > 15 \end{cases}$$

N_{first} and *TGL* are defined in subclause 4.4.

NOTE : In compressed mode by SF/2 method DTX is also added in physical channel mapping stage (subclause 4.2.12.2). During 2nd DTX insertion the number of CCTrCH bits is kept the same as in normal mode.

The bits output from the DTX insertion block are denoted by $w_1, w_2, w_3, \ldots, w_{(PR)}$. Note that these bits are four valued in case of compressed mode by puncturing, and three valued otherwise. They are defined by the following relations:

$w_k = s_k$ k = 1, 2, 3, …, S

$w_k = \delta$ k = S+1, S+2, S+3, …, ~~P~~P *R*

where DTX indication bits are denoted by δ. Here $s_k \in \{0,1, \text{p}\}$ and $\delta \notin \{0,1\}$.

4.2.10 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 $x_1, x_2, x_3, \ldots, x_X$ ~~$x_1, x_2, x_3, \ldots, x_Y$~~, where ~~*Y*~~ *X* 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 $u_{p1}, u_{p2}, u_{p3}, \ldots, u_{pU}$, where *p* is PhCH number and *U* is the number of bits in one radio frame for each PhCH, i.e. $U = ($~~Y~~ $X - N_{TGL}) / P$ for compressed mode by puncturing, and $U = \frac{X}{P}$ ~~$U = \frac{Y}{P}$~~ otherwise. The relation between x_k and u_{pk} is given below.

For all modes, some bits of the input flow are mapped to each code until the number of bits on the code is ~~*V*~~*U*. For modes other than compressed mode by puncturing, all bits of the input flow are taken to be mapped to the codes. For compressed mode by puncturing, only the bits of the input flow not corresponding to bits p are taken to be mapped to the codes, each bit p is removed to ensure creation the gap required by the compressed mode, as described below.

Bits on first PhCH after physical channel segmentation:

$u_{1,k} = x_{i,f(k)}$ $k = 1, 2, \ldots, U$

Bits on second PhCH after physical channel segmentation:

$u_{2,k} = x_{i,f(k+U)}$ $k = 1, 2, \ldots, U$

…

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

$u_{P,k} = x_{i,f(k+(P-1)\times U)}$ $k = 1, 2, \ldots, U$

where *f* is such that :

- for modes other than compressed mode by puncturing, $x_{i,f(k)} = x_{i,k}$, i.e. $f(k) = k$, for all ~~k~~ *k*.
- for compressed mode by puncturing, bit $u_{1,1}$ corresponds to the bit $x_{i,k}$ with smallest index *k* when the bits p are not counted, bit $u_{1,2}$ corresponds to the bit $x_{i,k}$ with second smallest index *k* when the bits p are not counted, and so on for bits $u_{1,3}, \ldots u_{1,}$~~V~~$_{U}, u_{2,1}, u_{2,2}, \ldots u_{2,}$~~V~~$_{U}, \ldots u_{P,1}, u_{P,2}, \ldots u_{P,}$~~V~~$_{U}$,

4.2.11 2nd interleaving

The 2nd interleaving is a block interleaver with inter-column permutations. The bits input to the 2nd interleaver are denoted $u_{p,1}, u_{p,2}, u_{p,3}, \ldots, u_{p,U}$ ~~$u_{p1}, u_{p2}, u_{p3}, \ldots, u_{pU}$~~, where p is PhCH number and U is the number of bits in one radio frame for one PhCH.

(1) Set the number of columns C2~~C_2~~ = 30. The columns are numbered 0, 1, 2, …, C2~~C_2~~-1 from left to right.

(2) Determine the number of rows R2~~R_2~~ by finding minimum integer R2~~R_2~~ such that:

$U \leq$ R2×C2~~$R_2 C_2$~~.

(3) The bits input to the 2nd interleaving are written into the R2 × C2~~$R_2 \times C_2$~~ rectangular matrix row by row.

$$\begin{bmatrix} u_{p,1} & u_{p,2} & u_{p,3} & \ldots & u_{p,30} \\ u_{p,31} & u_{p,32} & u_{p,33} & \ldots & u_{p,60} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ u_{p,((R2-1)\times 30+1)} & u_{p,((R2-1)\times 30+2)} & u_{p,((R2-1)\times 30+3)} & \ldots & u_{p,(R2\times 30)} \end{bmatrix}$$

~~$$\begin{bmatrix} u_{p1} & u_{p2} & u_{p3} & \ldots & u_{p30} \\ u_{p31} & u_{p32} & u_{p33} & \ldots & u_{p60} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ u_{p,((R_2-1)30+1)} & u_{p,((R_2-1)30+2)} & u_{p,((R_2-1)30+3)} & \ldots & u_{p,(R_2 30)} \end{bmatrix}$$~~

(4) Perform the inter-column permutation based on the pattern ~~$\{P_2(j)\}$~~ P2(j) ~~(~~(j = 0, 1, ..., C2~~C_2~~-1~~)~~) that is shown in table 6, where P2~~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_{pk}.

$$\begin{bmatrix} y_{p,1} & y_{p,(R2+1)} & y_{p,(2\times R2+1)} & \ldots & y_{p,(29\times R2+1)} \\ y_{p,2} & y_{p,(R2+2)} & y_{p,(2\times R2+2)} & \ldots & y_{p,(29\times R2+2)} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ y_{p,R2} & y_{p,(2\times R2)} & y_{p,(3\times R2)} & \ldots & y_{p,(30\times R2)} \end{bmatrix}$$

~~$$\begin{bmatrix} y_{p1} & y_{p,(R_2+1)} & y_{p,(2R_2+1)} & \ldots & y_{p,(29R_2+1)} \\ y_{p2} & y_{p,(R_2+2)} & y_{p,(2R_2+2)} & \ldots & y_{p,(29R_2+2)} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ y_{pR_2} & y_{p,(2R_2)} & y_{p,(3R_2)} & \ldots & y_{p,(30R_2)} \end{bmatrix}$$~~

(5) The output of the 2nd interleaving is the bit sequence read out column by column from the inter-column permuted R2 × C2~~$R_2 \times C_2$~~ matrix. The output is pruned by deleting bits that were not present in the input bit sequence, i.e. bits y_{pk} that corresponds to bits u_{pk} with $k>U$ are removed from the output. The bits after 2nd interleaving are denoted by $v_{p,1}, v_{p,2}, \ldots, v_{p,U}$ ~~$v_{p1}, v_{p2}, \ldots, v_{pU}$~~, where $v_{p,1}$ corresponds to the bit $y_{p,k}$ with smallest index k after pruning, $v_{p,2}$ to the bit y_{pk} with second smallest index k after pruning, and so on.

Table 6

Number of column ~~C_2~~ C2	Inter-column permutation pattern < P2(0), P2(1), …,P2(29) >
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>~~}~~

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00-0634*

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

CHANGE REQUEST

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

25.212 **CR** **073** Current Version: 3.2.0

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

For submission to: TSG RAN#8	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: TSG RAN WG1 **Date:** 06 May 2000

Subject: Editorial correction in 25.212 coding/multiplexing

Work item:

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

F	Correction	X	**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature			Release 98	
D	Editorial modification			Release 99	X
				Release 00	

Reason for change: Text outline of transport channel coding/multiplexing is mis-numbered and missing mention of radio-frame equalisation.

Clauses affected: 4.2

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:

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

4.2 Transport-channel coding/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);
- transport block concatenation and code block segmentation (see subclause 4.2.2);
- channel coding (see subclause 4.2.3);
- radio frame equalisation (see subclause 4.2.4);
- rate matching (see subclause 4.2.7);
- insertion of discontinuous transmission (DTX) indication bits (see subclause 4.2.9);
- interleaving (two steps, see subclauses 4.2.54 and 4.2.11);
- radio frame segmentation (see subclause 4.2.6);
- multiplexing of transport channels (see subclause 4.2.8);
- physical channel segmentation (see subclause 4.2.10);
- mapping to physical channels (see subclause 4.2.12).

The coding/multiplexing steps for uplink and downlink are shown in figure 1 and figure 2 respectively.

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00-0716*
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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

25.212 CR 074r2 Current Version: 3.2.0

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

For submission to: TSG RAN #8 — for approval [X] — for information [ ]
list expected approval meeting # here ↑

strategic [ ] non-strategic [ ] *(for SMG use only)*

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 [ ] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: TSG RAN WG1 **Date:** 23, May 2000

Subject: Bit separation of the Turbo encoded data

Work item: TS 25.212

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

Reason for change: The introductory description of bit separation and subsequent puncturing of Turbo coded data, specifically trellis termination bits is unclear..

Clauses affected: 4.2.7.3, 4.2.7.3.1, 4.2.7.4, 4.2.7.4.1

Other specs affected:			
	Other 3G core specifications	[ ]	→ List of CRs: 25.222
	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.

4.2.7.3 Bit separation and collection in uplink

The systematic bits ~~(excluding bits for trellis termination)~~ 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 ~~from each other~~ 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 parity bits and systematic bits used for trellis termination.~~ 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 6 and 7.

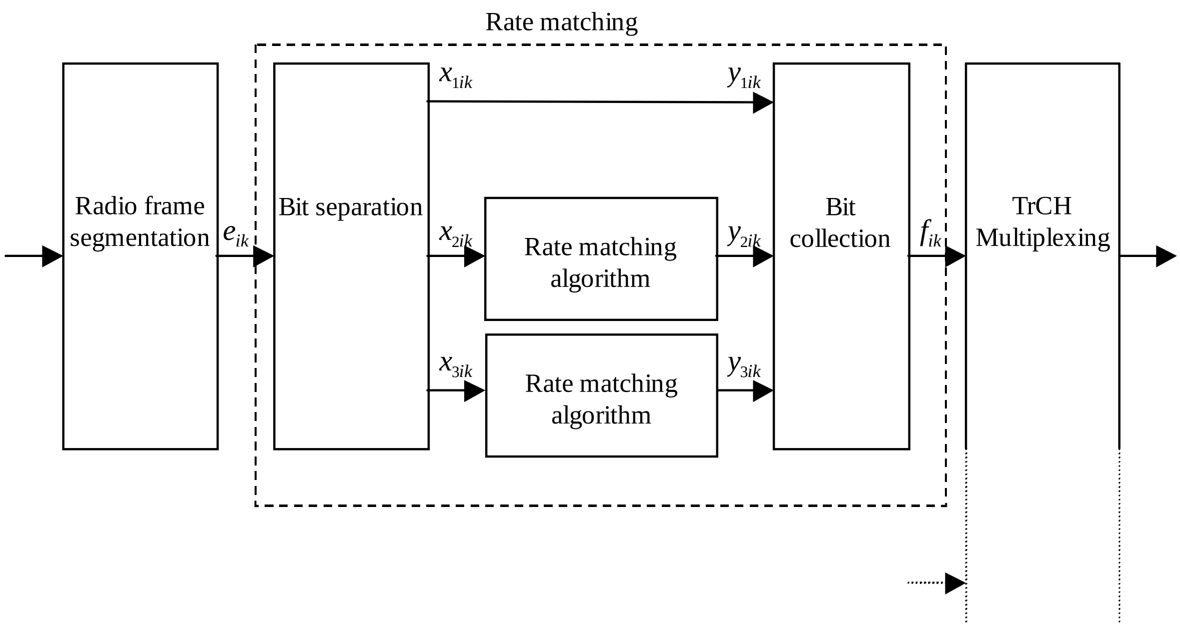


Figure 5: Puncturing of turbo encoded TrCHs in uplink

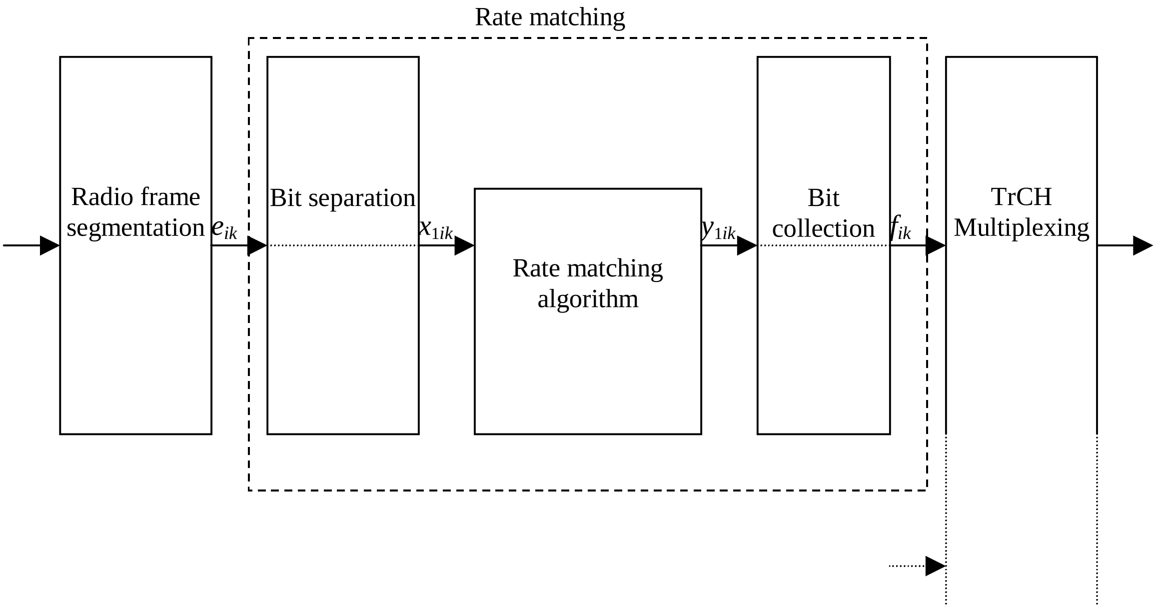


Figure 6: Rate matching for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition in uplink.

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 ~~the~~ these sequences ~~systematic (b=1) and parity bits ($b \in \{2, 3\}$)~~ 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

4.2.7.3.1 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.~~ the three sequences defined in section 4.2.7.3 .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:

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

$x_{1,i,\lfloor N_i/3 \rfloor+k} = e_{i,3\lfloor N_i/3 \rfloor+k}$ $k = 1, \ldots, N_i \bmod 3$ 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:

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

4.2.7.3.2 Bit collection

The bits x_{bik} are input to the rate matching algorithm described in section 4.2.7.5. 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}+ΔN_{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:

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

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.

4.2.7.4 Bit separation and collection in downlink

~~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 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 8 and 9.

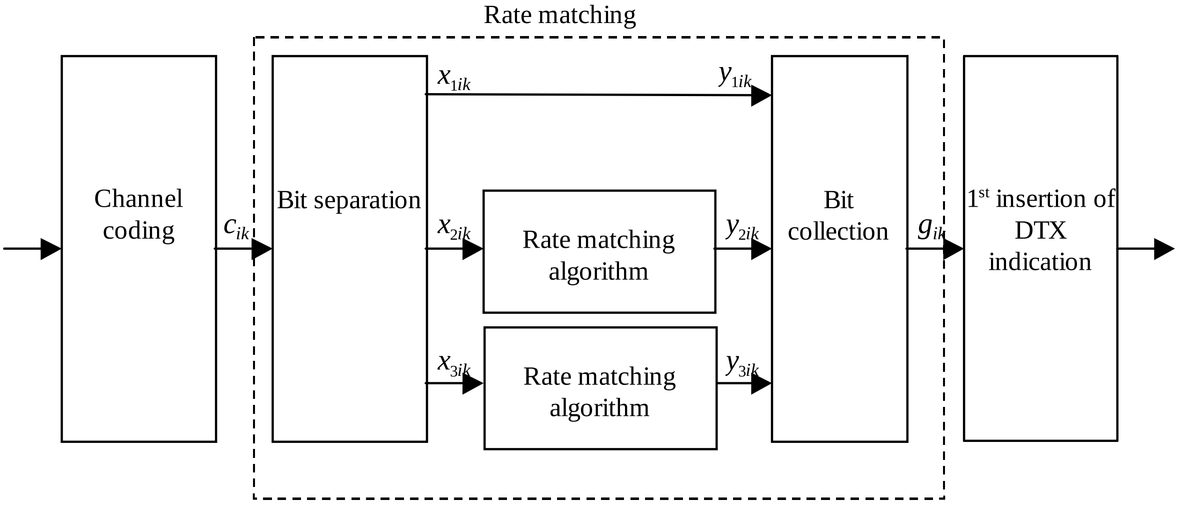


Figure 7: Puncturing of turbo encoded TrCHs in downlink.

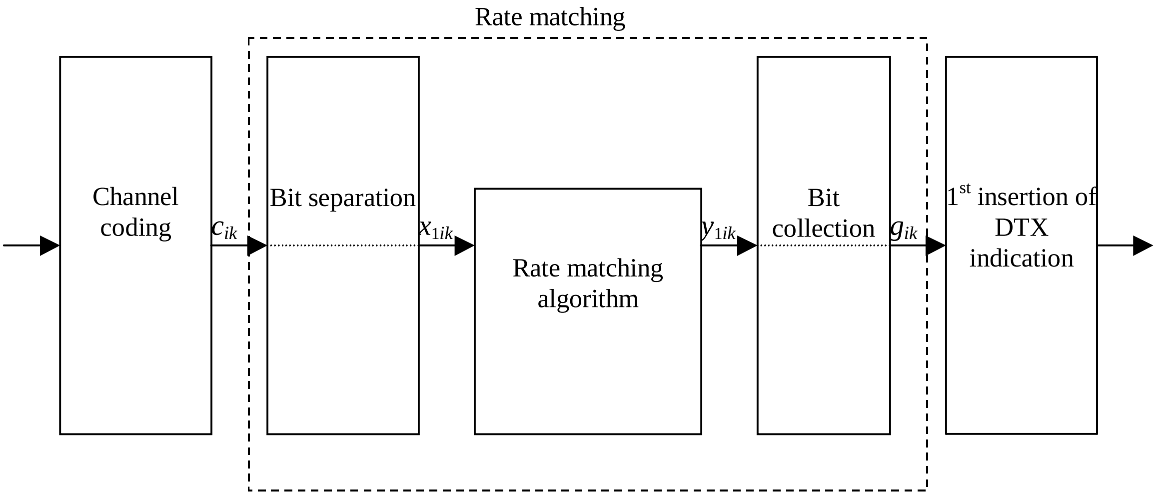


Figure 8: Rate matching for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition in downlink.

4.2.7.4.1 Bit separation

The bits input to the rate matching are denoted by $c_{i1}, c_{i2}, c_{i3}, \ldots, c_{iE_i}$, where *i* is the TrCH number and E_i is the number of bits input to the rate matching block. Note that E_i is a multiple of 3 for turbo encoded TrCHs and that the transport format combination number *j* for simplicity has been left out in the bit numbering, i.e. $E_i = N_{ij}$. 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~~ the three sequences defined in section 4.2.7.4.. 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 c_{ik} and x_{bik} is given below.

For turbo encoded TrCHs with puncturing:

$x_{1,i,k} = c_{i,3(k-1)+1}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = E_i / 3$

$x_{2,i,k} = c_{i,3(k-1)+2}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = E_i / 3$

$x_{3,i,k} = c_{i,3(k-1)+3}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = E_i / 3$

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

$x_{1,i,k} = c_{i,k}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = E_i$

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document R1-00-0723
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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

25.212 CR 076r1 Current Version: 3.2.0

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

For submission to: TSG RAN #8
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 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: TSG RAN WG1 **Date:** 8.5.2000

Subject: Revision of Code Block Segmentation Description

Work item:

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

F	Correction		**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature			Release 98	
D	Editorial modification	X		Release 99	X
				Release 00	

Reason for change: The insertion of filler bits within the first block of code block segmentation does not depend on the conditions $X_i \le Z$ or $X_i > Z$. In that way the current specification is redundant. This is changed in the proposed modification. Additionally by reformulating some formulas a more precise description is given.

Clauses affected: Chapter 4.2.2.2

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

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

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 $o_{ir1}, o_{ir2}, o_{ir3}, \ldots, o_{irK_i}$, 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: $Y_i = C_iK_i - X_i$

~~If $X_i \leq Z$, then~~

~~$o_{i1k} = 0$ $k = 1, 2, \ldots, Y_i$~~

for k = 1 to Y_i -- Insertion of filler bits

$o_{i1k} = 0$

end for

~~$o_{i1k} = x_{i,(k-Y_i)}$ $k = Y_i+1, Y_i+2, \ldots, K_i$~~

for k = Y_i+1 to K_i

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

end for

~~end if~~

~~If $X_i > Z$, then~~

~~$o_{i1k} = 0$ $k = 1, 2, \ldots, Y_i$~~

~~$o_{i1k} = x_{i,(k-Y_i)}$ $k = Y_i+1, Y_i+2, \ldots, K_i$~~

$r = 2$ -- Segmentation

while $r \leq C_i$

for k = 1 to K_i

$o_{i2k} = x_{i,(k+K_i-Y_i)}$ $o_{irk} = x_{i,(k+(r-1)\cdot K_i-Y_i)}$ k = 1, 2, …, K_i

end for

$r = r+1$

end while

$o_{i3k} = x_{i,(k+2K_i-Y_i)}$ k = 1, 2, …, K_i

…

$o_{iC_ik} = x_{i,(k+(C_i-1)K_i-Y_i)}$ k = 1, 2, …, K_i

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00-0657*
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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

25.212	**CR**	**077**	Current Version:	3.2.0

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

For submission to:	TSG-RAN #8	for approval	X	strategic		*(for SMG use only)*
list expected approval meeting # here ↑		for information		non-strategic		

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

Source: TSG RAN WG1 **Date:** 2000-05-19

Subject: Clarifications for TFCI coding

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: Some clarifications are necessary in addition to the ones introduced in CR25.212-067r1 at WG1#12.
In 4.3.5.2.2, the mapping modes should be distinguished by slot formats instead of spreading factors, because the slot formats 9B and 11B can not be classified correctly by spreading factors.

Clauses affected: 4.3.3, 4.3.4, 4.3.5.1, 4.3.5.2.1, 4.3.5.2.2

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: This CR is superseding CR25.212-067r1 (TdocR1-00-0553) from Siemens that was approved at WG1#12.

4.3.3 Coding of Transport-Format-Combination Indicator (TFCI)

The TFCI ~~bits are~~is encoded using a (32, 10) sub-code of the second order Reed-Muller code. The coding procedure is as shown in figure 9.

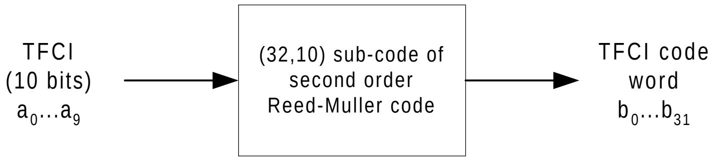


Figure 9: Channel coding of TFCI information bits

If the TFCI consist of less than 10 bits, it is padded with zeros to 10 bits, by setting the most significant bits to zero. The length of the TFCI code word is 32 bits.

The code words of the (32,10) sub-code of second order Reed-Muller code are linear combination of 10 basis sequences. The basis sequences are as in the following 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~~i = 0, …, 31.

The output bits are denoted by b_k, k = 0, 1, 2, …, 31.

In downlink, when the SF < 128 the encoded TFCI code words are repeated yielding 8 encoded TFCI bits per slot in normal mode and 16 encoded TFCI bits per slot in compressed mode. Mapping of repeated bits to slots is explained in subclause 4.3.5.

4.3.4 Operation of Transport-Format-Combination Indicator (TFCI) in Split Mode

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

The TFCI ~~bits are~~is encoded using a (16, 5) bi-orthogonal (or first order Reed-Muller) code. The coding procedure is as shown in figure 10.

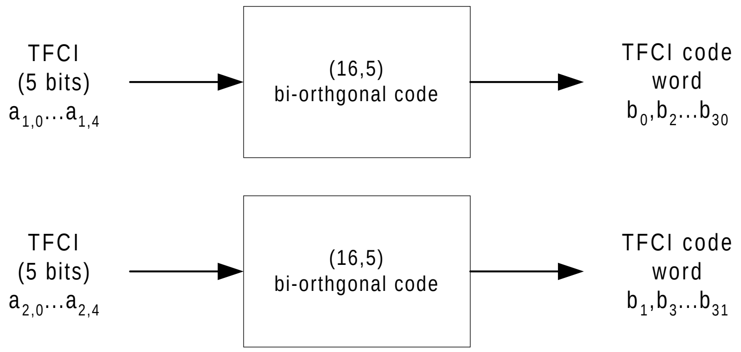


Figure 10: Channel coding of split mode TFCI information bits

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 a first set of TFCI information bits as $a_{1,0}$, $a_{1,1}$, $a_{1,2}$, $a_{1,3}$, $a_{1,4}$ ($a_{1,0}$ is LSB and $a_{1,4}$ is MSB). This set of 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 DCH CCTrCH in the associated DPCH radio frame.

Let's define a second set of -TFCI information bits as $a_{2,0}$, $a_{2,1}$, $a_{2,2}$, $a_{2,3}$, $a_{2,4}$ ($a_{2,0}$ is LSB and $a_{2,4}$ is MSB). This set of 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 associated DSCH CCTrCH in the corresponding PDSCH radio frame.

The output code word bits b_k are given by:

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

where ~~i~~ i = 0, …, 15~~, j=0,1~~.

The output bits are denoted by b_k, k = 0, 1, 2, …, 31.

4.3.5 Mapping of TFCI words

4.3.5.1 Mapping of TFCI word in ~~non compressed~~normal mode

The bits of the code word are directly mapped to the slots of the radio frame. Within a slot the bit with lower index -is transmitted before the bit with higher index. The coded bits b_k, are mapped to the transmitted TFCI bits d_k, according to the following formula:

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

For uplink physical channels regardless of the SF and downlink physical channels, if -SF ≥ 128, k = 0, 1, 2, …, 29.

~~NOTE:~~ Note that t~~T~~his means that bits b_{30} and b_{31} are not transmitted.

For downlink physical channels whose SF < 128, k = 0, 1, 2, …, 119. Note that this means that bits b_0 to b_{23} are transmitted four times and bits b_{24} to b_{31} are transmitted three times.

4.3.5.2 Mapping of TFCI word in compressed mode

The mapping of the TFCI bits in compressed mode is different for uplink, downlink with SF ≥ 128 and downlink with SF < 128.

4.3.5.2.1 Uplink compressed mode

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

Denote the number of bits available in the TFCI fields of one compressed radio frame by D and the number of bits in the TFCI field in a slot by ~~N_{TFCI}~~N_{TFCI}. ~~Denote by E the first bit to be repeated,~~ The parameter E is used to determine the number of the first TFCI bit to be repeated.

-E = ~~$N_{first}N_{TFCI}$~~ N_{first} N_{TFCI}, if the start of the transmission gap is allocated to the current frame.
E = 0, if the start of the transmission gap is allocated to the previous frame and the end of the transmission gap is allocated to the current frame.

~~. If $N_{last} \neq 14$, then E corresponds to the number of the first TFCI bit in the slot directly after the TG.~~ The TFCI coded bits b_k are mapped to the bits in the TFCI fields d_k. The following relations ~~then~~ define the mapping for each compressed frame.

$$d_k = b_k$$

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

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

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

where k = 0, …, ~~D~~D-33.

4.3.5.2.2 Downlink compressed mode

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

Denote the number of bits available in the TFCI fields of one compressed radio frame by D and the number of bits in the TFCI field in a slot by ~~N_{TFCI}~~N_{TFCI}. ~~Denote by E the first bit to be repeated~~The parameter E is used to determine the position of the first bit in the TFCI field on which DTX is used.

~~$E = N_{first}N_{TFCI}$, if $N_{first} + TGL \leq 15$, else $E = 0$~~

$E = N_{first}\ N_{TFCI}$, if the start of the transmission gap is allocated to the current frame.
$E = 0$, if the start of the transmission gap is allocated to the previous frame and the end of the transmission gap is allocated to the current frame.

~~If the transmission gap does not extend to the end of the frame then E corresponds to the number of the first TFCI bit in the slot directly after the TG.~~ Denote the total number of TFCI bits to be transmitted by ~~N_{tot}~~F. ~~If SF ≥ 128 then N_{tot}~~F = 32 for slot formats nA or nB, where n = 0, 1, …, 11 (see table 11 in [2]). Otherwise, ~~else N_{tot}~~F = 128. The TFCI coded bits b_k are mapped to the bits in the TFCI fields d_k. The following relations ~~then~~ define the mapping for each compressed frame.~~:~~

If $E > 0$,

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

where $k = 0, 1, 2, \ldots, \min(E, F) - 1$. ~~and,~~ ~~$\min(E, N_{tot})$~~

If $E < F$, ~~if $E < N_{tot}$~~

~~$d_{k+D-N_{tot}}$~~ $d_{k+D-F} = b_{k \bmod 32}$ ~~$b_{(k \bmod 32)}$~~

where $k = E, \ldots, F - 1$. ~~$k = E, \ldots, N_{tot} - 1$~~

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

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00-0775*
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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

25.212 CR 078r2 Current Version: 3.2.0

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

For submission to: TSG RAN #8	for approval	X	strategic		(for SMG
list expected approval meeting # here ↑	for information		non-strategic		use only)

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 [ ] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: TSG RAN WG1 **Date:** 25th, May 2000

Subject: Clarifying the rate matching parameter setting for the RACH and BCH

Work item: TS 25.212

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

F	Correction	X	**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature			Release 98	
D	Editorial modification			Release 99	X
				Release 00	

Reason for change: The rat matching description in 25.212 makes use of the Rate matching parameter (RM) which is usually set by higher layers signalling. For the RACH, no RM parameters is set in the RRC protocol as there is only one RACH transport channel in a RACH Transport format combination. So any value for the RM parameter would lead to the same results. This needs to be clarified in 25.212. In a similar way it should be clarified RM=1 for the BCH.

Clauses affected: Reference, Abbreviations

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 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 TrCH multiplexing is identical to the total channel bit rate of the allocated dedicated 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 and no uplink DPDCH will be selected in the case of uplink rate matching.

Notation used in subcaluse 4.2.7 and subclauses:

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 an 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 an 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.

$Np^{TTI,m}_{i,l}$, $m=0$ to $F_{max} / F_i - 1$:Positive or null: number of bits to be removed in TTI number *m* within the largest TTI, to create the required gaps in the compressed radio frames of this TTI, in case of compressed mode by puncturing, for TrCh *i* with transport format *l*. In case of fixed positions and compressed mode by puncturing, this value is noted $Np^{TTI,m}_{i,max}$ since it is calculated for all TrCh with their maximum number of bits; thus it is the same for all TFCs

Used in downlink only.

$Np^{n}_{i,l}$ $n=0$ to $F_{max} -1$:Positive or null: number of bits, in radio frame number *n* within the largest TTI, corresponding to the gap for compressed mode in this radio frame, for TrCH *i* with transport format *l*. The value will be null for the un-compressed radio frames. In case of fixed positions and compressed mode by puncturing, this value is noted $Np^{n}_{i,max}$ since it is calculated for all TrChs with their maximum number of bits; thus it is the same for all TFCs

Used in downlink only.

$N_{TGL}[k]$, $k=0$ to $F_i -1$: Positive or null: number of bits in each radio frame corresponding to the gap for compressed mode for the CCTrCh.

RM_i: Semi-static rate matching attribute for transport channel *i*. ~~Signalled from~~ RM_i is provided by higher layers or takes a value as indicated in section 4.2.13.

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*.

$F_{\max}$ Maximum number of radio frames in a transmission time interval used in the CCTrCH :

$$F_{\max} = \max_{1 \le i \le I} F_i$$

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*.

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

TFCS The set of transport format combination indexes *j*.

e_{ini} Initial value of variable *e* in the rate matching pattern determination algorithm of subclause 4.2.7.5.

e_{plus} Increment of variable *e* in the rate matching pattern determination algorithm of subclause4.2.7.5.

e_{minus} Decrement of variable *e* in the rate matching pattern determination algorithm of subclause 4.2.7.5.

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 subcaluse 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.

The * (star) notation is used to replace an index *x* when the indexed variable X_x does not depend on the index *x*. In the left wing of an assignment the meaning is that "$X_* = Y$" is equivalent to "**for all** *x* **do** $X_x = Y$ ". In the right wing of an assignment, the meaning is that "$Y = X_*$ " is equivalent to "**take any** *x* **and do** $Y = X_x$".

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

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

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

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

4.2.13 Restrictions on different types of CCTrCHs

Restrictions on the different types of CCTrCHs are described in general terms in TS 25.302[11]. In this subclause those restrictions are given with layer 1 notation.

4.2.13.1 Uplink Dedicated channel (DCH)

The maximum value of the number of TrCHs I in a CCTrCH, the maximum value of the number of transport blocks M_i on each transport channel, and the maximum value of the number of DPDCHs P are given from the UE capability class.

4.2.13.2 Random Access Channel (RACH)

- There can only be one TrCH in each RACH CCTrCH, i.e. I=1, $s_k = f_{1k}$ and $S = V_1$.
- The maximum value of the number of transport blocks M_1 on the transport channel is given from the UE capability class.
- The transmission time interval is either 10 ms or 20 ms.
- Only one PRACH is used, i.e. P=1, $u_{1k} = s_k$, and $U = S$.
- The Static rate matching parameter RM_1 is not provided by higher layer signalling on the System information as the other transport channel parameters. Any value may be used as there is one transport channel in the CCTrCH, hence one transport channel per Transport Format Combination and no need to do any balancing between multiple transport channels.

4.2.13.3 Common Packet Channel (CPCH)

- The maximum value of the number of TrCHs I in a CCTrCH, the maximum value of the number of transport blocks M_i on each transport channel, and the maximum value of the number of DPDCHs P are given from the UE capability class.

NOTE: Only the data part of the CPCH can be mapped on multiple physical channels (this note is taken from TS 25.302).

4.2.13.4 Downlink Dedicated Channel (DCH)

The maximum value of the number of TrCHs I in a CCTrCH, the maximum value of the number of transport blocks M_i on each transport channel, and the maximum value of the number of DPDCHs P are given from the UE capability class.

4.2.13.5 Downlink Shared Channel (DSCH) associated with a DCH

- The spreading factor is indicated with the TFCI or with higher layer signalling on DCH.
- The maximum value of the number of TrCHs I in a CCTrCH, the maximum value of the number of transport blocks M_I on the transport channel and the maximum value of the number of PDSCHs P are given from the UE capability class.

4.2.13.6 Broadcast channel (BCH)

- There can only be one TrCH in the BCH CCTrCH, i.e. I=1, $s_k = f_{1k}$, and $S = V_1$.
- There can only be one transport block in each transmission time interval, i.e. M_1 = 1.
- —All transport format attributes have predefined values. which are provided in [11] apart from the rate matching RM_1.

- The Static rate matching parameter RM_1 is not provided by higher layer signalling neither fixed. Any value may be used as there is one transport channel in the CCTrCH, hence one transport channel per Transport Format Combination and no need to do any balancing between multiple transport channels.

- Only one primary CCPCH is used, i.e. P=1.

4.2.13.7 Forward access and paging channels (FACH and PCH)

- The maximum value of the number of TrCHs I in a CCTrCH and the maximum value of the number of transport blocks M_i on each transport channel are given from the UE capability class.

- The transmission time interval for TrCHs of PCH type is always 10 ms.

- Only one secondary CCPCH is used per CCTrCH, i.e. P=1.

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

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 mod F_i = 0.

2) Only transport channels with the same active set can be mapped onto the same CCTrCH.

3) Different CCTrCHs cannot be mapped onto the same PhCH.

4) One CCTrCH shall be mapped onto one or several PhCHs. These physical channels shall all have the same SF.

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

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

There are hence two types of CCTrCH:

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

2) CCTrCH of common type, corresponding to the result of the coding and multiplexing of a common channel, RACH in the uplink, DSCH ,BCH, or FACH/PCH for the downlink.

4.2.14.1 Allowed CCTrCH combinations for one UE

4.2.14.1.1 Allowed CCTrCH combinations on the uplink

A maximum of one CCTrCH is allowed for one UE on the uplink. It can be either:

1) one CCTrCH of dedicated type;

2) one CCTrCH of common type.

4.2.14.1.2 Allowed CCTrCH combinations on the downlink

The following CCTrCH combinations for one UE are allowed:

- x CCTrCH of dedicated type + y CCTrCH of common typeThe allowed combination of CCTrCHs of dedicated and common type are given from UE radio access capabilities. There can be a maximum on one CCTrCH of common type for DSCH and a maximum of one CCTrCH of common type for FACH. With one CCTrCH of common type for DSCH, there shall be at least one CCTrCH of dedicated type.

NOTE 1: There is only one DPCCH in the uplink, hence one TPC bits flow on the uplink to control possibly the different DPDCHs on the downlink, part of the same or several CCTrCHs.

NOTE 2: There is only one DPCCH in the downlink, even with multiple CCTrCHs. With multiple CCTrCHs, the DPCCH is transmitted on one of the physical channels of that CCTrCH which has the smallest SF among the multiple CCTrCHs. Thus there is only one TPC command flow and only one TFCI word in downlink even with multiple CCTrCHs.

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00-0706*
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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

25.212 CR 080 Current Version: 3.2.0

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

For submission to: TSG RAN #8	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: TSG RAN WG1 **Date:** May 17, 2000

Subject: Clarification on BTFD utilisation (single CCTrCH)

Work item: TS 25.212

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: BTFD should only be used in very simple cases, i.e. when only one CCTrCH is has to be received by the UE.

Clauses affected: 4.3.1

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.

4.3.1 Blind transport format detection

When no TFCI is available then explicit blind detection or guided detection shall be performed on all TrCHs within the CCTrCH that have more than one transport format. The UE shall only be required to support blind transport format detection if all of the following restrictions are fulfilled:

1. only one CCTrCH is received by the UE.
2. ~~1.~~ the number of CCTrCH bits received per radio frame is 600 or less;
3. ~~2.~~ the number of transport format combinations of the CCTrCH is 64 or less;
4. ~~3.~~ fixed positions of the transport channels is used on the CCTrCH to be detected;
5. ~~4.~~ convolutional coding is used on all ~~explicitely~~explicitly detected TrCHs;
6. ~~5.~~ CRC is appended to all transport blocks on all ~~explicitely~~explicitly detected TrCHs;
7. ~~6.~~ the number of ~~explicitely~~explicitly detected TrCHs is 3 or less;
8. ~~7.~~ for all ~~explicitely~~explicitly detected TrCHs *i*, the number of code blocks in one TTI (C_i) shall not exceed 1;
9. ~~8.~~ the sum of the transport format set sizes of all ~~explicitely~~explicitly detected TrCHs, is 16 or less. The transport format set size is defined as the number of transport formats within the transport format set;
10. ~~9.~~ there is at least one TrCH that can be used as the guiding transport channel for all transport channels using guided detection.

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

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00-0741*
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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

25.212 **CR** **081** Current Version: 3.2.0

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

For submission to: TSG RAN#8
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 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: TSG RAN WG1 **Date:** 19th May 200

Subject: Correction of order of checking TFC during flexible position RM parameter determination

Work item: TS 25.212

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: The results of the parameter determination algorithm depends on the order in which the TFC are considered.

Clauses affected: 4.2.7.2.2.1

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:

4.2.7.2.2 Determination of rate matching parameters for flexible positions of TrCHs

4.2.7.2.2.1 Calculations for normal mode, compressed mode by higher layer scheduling, and compressed mode by spreading factor reduction

First an intermediate calculation variable N_{ij} is calculated for all transport channels *i* and all transport format combinations *j* by the following formula:

$$N_{i,j} = \frac{1}{F_i} \cdot N_{i,TF_i(j)}^{TTI}$$

Then rate matching ratios RF_i are calculated for each the transport channel *i* in order to minimise the number of DTX bits when the bit rate of the CCTrCH is maximum. The RF_i ratios are defined by the following formula:

$$RF_i = \frac{N_{data,*}}{\max\limits_{j \in TFCS} \sum_{i=1}^{i=I} \left(RM_i \cdot N_{i,j} \right)} \cdot RM_i$$

The computation of $\Delta N_{i,l}^{TTI}$ parameters is then performed in two phases. In a first phase, tentative temporary values of $\Delta N_{i,l}^{TTI}$ are computed, and in the second phase they are checked and corrected. The first phase, by use of the RF_i ratios, ensures that the number of DTX indication bits inserted is minimum when the CCTrCH bit rate is maximum, but it does not ensure that the maximum CCTrCH bit rate is not greater than $N_{data,*}$. per 10ms. The latter condition is ensured through the checking and possible corrections carried out in the second phase.

At the end of the second phase, the latest value of $\Delta N_{i,l}^{TTI}$ is the definitive value.

The first phase defines the tentative temporary $\Delta N_{i,l}^{TTI}$ for all transport channel *i* and any of its transport format *l* by use of the following formula:

$$\Delta N_{i,l}^{TTI} = F_i \cdot \left\lceil \frac{RF_i \cdot N_{i,l}^{TTI}}{F_i \cdot} \right\rceil - N_{i,l}^{TTI} = F_i \cdot \left\lceil \frac{N_{data,*} \cdot RM_i \cdot N_{i,l}^{TTI}}{F_i \cdot \max\limits_{j \in TFCS} \sum_{i=1}^{I} \left(RM_i \cdot N_{i,j} \right)} \right\rceil - N_{i,l}^{TTI}$$

The second phase is defined by the following algorithm:

for all j in *TFCS* <u>in ascending order of TFCI</u> do -- for all TFC

$$D = \sum_{i=1}^{i=I} \frac{N_{i,TF_i(j)}^{TTI} + \Delta N_{i,TF_i(j)}^{TTI}}{F_i}$$ -- CCTrCH bit rate (bits per 10ms) for TFC *l*

if $D > N_{data,*}$ then

for *i* = 1 to *I* do -- for all TrCH

$\Delta N = F_i \cdot \Delta N_{i,j}$ -- $\Delta N_{i,j}$ is derived from $N_{i,j}$ by the formula given at subclause 4.2.7.

if $\Delta N_{i,TF_i(j)}^{TTI} > \Delta N$ then

$\Delta N_{i,TF_i(j)}^{TTI} = \Delta N$

end-if

end-for

end-if

end-for

~~NOTE: The order in which the transport format combinations are checked does not change the final result.~~

If $\Delta N_{i,l}^{TTI} = 0$ then, for TrCH *i* at TF *l*, the output data of the rate matching is the same as the input data and the rate matching algorithm of subclause 4.2.7.5 does not need to be executed.

If $\Delta N_{i,l}^{TTI} \neq 0$ the parameters listed in subclauses 4.2.7.2.2.2 and 4.2.7.2.2.3 shall be used for determining e_{ini}, e_{plus}, and e_{minus}.

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00-0743*
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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

25.212 CR 082 Current Version: 3.2.0

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

For submission to:	TSG RAN #8	for approval	X	Strategic	*(for SMG use only)*
list expected approval meeting # here ↑		For information		non-strategic	

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

Source: TSG RAN WG1 **Date:** 24-May-2000

Subject: Editorial corrections in channel coding section

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: To give editorial corrections on descriptions of Turbo code internal interleaver in channel coding section.

Clauses affected: 4.2.3.2.3.2 of TS25.212

Other specs affected:			
	Other 3G core specifications		→ List of CRs:
	Other GSM core specifications		→ List of CRs:
	MS test specifications		→ List of CRs:
	BSS test specifications		→ List of CRs:
	O&M specifications		→ List of CRs:

Other comments:

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:

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

(3) Let $q_0 = 1$ be the first prime integer in $\{q_j\}$, and select the consecutive minimum prime integers $\{q_j\}$ ($j = 1, 2, \ldots, R - 1$) 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 ~~$T(j)$ indicates the original row position of the j-th permuted row, and~~ $T(j)$ ($j = 0, 1, 2, \ldots, R - 1$) 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.

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

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 ($j = 0, 1, 2, \ldots, R - 1$) intra-row permutation as:

if ($C = p$) then

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

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

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

end if

end if

if ($C = p$ - 1) then

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

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 $T(j)$ ($j = 0, 1, 2, \ldots, R - 1$), 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, …, 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:

$R \times C - K$.

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00-0744*
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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

25.212 CR 083 Current Version: V3.2.0

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

For submission to:	TSG-RAN #8	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: TSG RAN WG1 **Date:** May 17th, 2000

Subject: Correction for bit separation and bit 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: In downlink, rate matching is performed over TTI. Therefore current specification should be corrected to reflect this.

Clauses affected: 4.2.7.4.1 Bit separation
4.2.7.4.2 Bit collection

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:

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

4.2.7.4.1 Bit separation

The bits input to the rate matching are denoted by $c_{i1}, c_{i2}, c_{i3}, \ldots, c_{iE_i}$, where *i* is the TrCH number and E_i is the number of bits input to the rate matching block. Note that E_i is a multiple of 3 for turbo encoded TrCHs and that the transport format ~~combination number~~ ~~j~~*l* for simplicity has been left out in the bit numbering, i.e. E_i=~~N_{ij}~~ N_{il}^{TTI} . 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 c_{ik} and x_{bik} is given below.

For turbo encoded TrCHs with puncturing:

$x_{1,i,k} = c_{i,3(k-1)+1}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = E_i /3$

$x_{2,i,k} = c_{i,3(k-1)+2}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = E_i /3$

$x_{3,i,k} = c_{i,3(k-1)+3}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = E_i /3$

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

$x_{1,i,k} = c_{i,k}$ $k = 1, 2, 3, \ldots, X_i$ $X_i = E_i$

4.2.7.4.2 Bit collection

The bits x_{bik} are input to the rate matching algorithm described in section 4.2.7.5. 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 $g_{i1}, g_{i2}, g_{i3}, \ldots, g_{iG_i}$, where *i* is the TrCH number and G_i= ~~N_{ij}~~ N_{il}^{TTI} +~~ΔN_{ij}~~ ΔN_{il}^{TTI} . The relations between y_{bik}, z_{bik}, and g_{ik} are given below.

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

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

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

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

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

3GPP TSG RAN Meeting #8
Düsseldorf, Germany, 21-23 June 2000

Document *R1-00-0776*
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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

25.212 CR 084r1 Current Version: 3.2.0

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

For submission to: TSG RAN #8	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 [ ] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: TSG RAN WG1   **Date:** 25th May 2000

Subject: Correction on the spreading factor selection for the RACH

Work item: TS 25.212

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: As currently specified the SF selection for a given Transport format combination or equivalently a transport format for a RACH CCTrCH is based on SET0. SET0 represents the intersection between what the UE is able to do and what is allowed by the UTRAN. However the UTRAN is not aware or the UE capability at the time it receives the RACH. This may lead to inconsistent operation of the UTRAN and UE for some transport format if the UE does not support the minimum allowed SF as provided in the PRACH information in the system information

Clauses affected: Reference, Abbreviations

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 in uplink

4.2.7.1.1 Determination of SF and number of PhCHs needed

In uplink, puncturing can be applied to match the CCTrCH bit rate to the PhCH bit rate. The bit rate of the PhCH(s) is limited by the UE capability and restrictions imposed by UTRAN, through limitations on the PhCH spreading factor. The maximum amount of puncturing that can be applied is signalled from higher layers and denoted by *PL*. The number of available bits in the radio frames of one PhCH for all possible spreading factors is given in [2]. Denote these values by N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, and N_4, where the index refers to the spreading factor. The possible number of bits available to the CCTrCH on all PhCHs, N_{data}, then are $\{ N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, N_4, 2N_4, 3N_4, 4N_4, 5N_4, 6N_4\}$.

For a RACH CCTrCH SET0 represents the set of N_{data} values allowed by the UTRAN, as set by the minimum SF provided by higher layers. SET0 may be a sub-set of $\{ N_{256}, N_{128}, N_{64}, N_{32} \}$. SET0 does not take into account the UE's capability.

For other CCTrCHs, SET0 denotes the set of N_{data} values allowed by the UTRAN and supported by the UE, as part of the UE's capability.~~Depending on the UE capability and the restrictions from UTRAN, the allowed set of N_{data} , denoted~~ SET0~~,~~ can be a subset of $\{ N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, N_4, 2N_4, 3N_4, 4N_4, 5N_4, 6N_4\}$.

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

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

If SET1 is not empty and the smallest element of SET1 requires just one PhCH then

$N_{data,j}$ = min SET1

else

SET2 = { N_{data} in SET0 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 }

Sort SET2 in ascending order

N_{data} = min SET2

While N_{data} is not the max of SET2 and the follower of N_{data} requires no additional PhCH do

N_{data} = follower of N_{data} in SET2

End while

$N_{data,j} = N_{data}$

End if

For a RACH CCTrCH, if $N_{data,j}$ is not part of the UE's capability then the TFC *j* cannot be used.