TSG-RAN Meeting #6 **_TSGRP#6(99)680_**
Nice, France, 13 – 15 December 1999

Title: **Agreed CRs of category "C" (Modification) and "F" (Correction) to TS 25.212**

Source: **TSG-RAN WG1**

Agenda item: **5.1.3**

Spec	CR	Rev	Phase	Subject	Cat	Version-Current	Version-New	Doc
25.212	001	3	R99	Correction of rate matching parameters for repetition	F	3.0.0	3.1.0	R1-99j97
25.212	004	-	R99	Changing the initial offset value for convolutional code	C	3.0.0	3.1.0	R1-99j11
25.212	009	-	R99	Removal of SFN multiplexing	F	3.0.0	3.1.0	R1-99i53
25.212	010	1	R99	Clarification of bit separation and collection	F	3.0.0	3.1.0	R1-99j25
25.212	011	2	R99	Connection between TTI and CFN	F	3.0.0	3.1.0	R1-99l26
25.212	012	2	R99	Zero length transport blocks	F	3.0.0	3.1.0	R1-99l27
25.212	016	-	R99	Removal of TrCH restriction in DSCH CCTrCH	F	3.0.0	3.1.0	R1-99i36
25.212	018	-	R99	Minimum SF in UL	C	3.0.0	3.1.0	R1-99i59
25.212	024	-	R99	Rate matching parameter determination in DL and fixed	F	3.0.0	3.1.0	R1-99k09
25.212	026	1	R99	Corrections to TS 25.212	F	3.0.0	3.1.0	R1-99k43

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

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

Document R1-99j97
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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25.212 CR 001rev3 Current Version: 3.0.0

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

For submission to:	RAN #6	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑		for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

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

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

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

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

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

Other specs affected:

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

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

4.2.7 Rate matching

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

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

Notation used in section 4.2.7 and subsections:

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

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

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

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

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

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

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

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

Used in downlink only.

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

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

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

I: Number of TrCHs in the CCTrCH.

Z_{ij}: Intermediate calculation variable.

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

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

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

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

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

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

4.2.7.1.2 Determination of parameters needed for calculating the rate matching pattern

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

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

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

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

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

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

For convolutional codes,

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

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

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

else

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

endif

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

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

if q is even

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

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

else

q' = q

endif

for x = 0 to F_i-1

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

end for

TSG-RAN Working Group 1(Radio) meeting #9 ***TSGR1#9(99) j11***

30 November – 3 December 1999, Dresden, Germany

Source : LGIC

Title : Revised CR to 25.212 for initial offset value change for convolutional code rate matching

Document for : Approval

1 Introduction

In WG1 #8 in New York, the proposal of changing the current initial offset value of rate matching algorithm for convolutional code[Tdoc R1-99g85] was approved in the plenary. But it was pointed out that the format of CR was wrong and was requested to be revised according to the CR rule with CR number.

The purpose of this document is to provide the revised CR of original Tdoc R1-99g85.

2 Text Proposal

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

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

CHANGE REQUEST

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25.212	**CR**	**004**	Current Version:	3.0.0

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

For submission to:	TSG-RAN #6	for approval	X	strategic		*(for SMG use only)*
list expected approval meeting # here ↑		for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG   The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

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

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

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

Work item:

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

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

Release:

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

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

Clauses affected:
4.2.7.1.2 Determination of parameters needed for calculating the rate matching pattern
4.2.7.2.1 Determination of rate matching parameters for fixed positions of TrCHs
4.2.7.2.2 Determination of rate matching parameters for flexible positions of TrCHs

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:

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

4.2.7.1.2 Determination of parameters needed for calculating the rate matching pattern

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

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

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

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

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

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

For convolutional codes,

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

if q is even

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

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

else

q' = q

endif

for x = 0 to F_i-1

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

end for

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

a = 2

For each radio frame, the rate-matching pattern is calculated with the algorithm in section 4.2.7.4, where :

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

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

$e_{plus} = a \cdot N$

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

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

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

If puncturing is to be performed, parameters are as follows.

a=2 for *Y* sequence, and

a=1 for *Y'* sequence.

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

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

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

if($q \leq 2$)

for x=0 to F_i-1

if(Y sequence)

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

if(Y’ sequence)

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

end for

else

if q is even

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

else q’ = q

endif

for x=0 to F_i -1

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

if(Y sequence)

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

if(Y’ sequence)

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

endfor

endif

For each radio frame, the rate-matching pattern is calculated with the algorithm in section 4.2.7.4, where:

N is as above,

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

$e_{plus} = a \cdot N$

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

puncturing for ΔN<0, repeating otherwise.

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.

4.2.7.2.1 Determination of rate matching parameters for fixed positions of TrCHs

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

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

The computation of the $\Delta N_{i,l}^{TTI}$ parameters is then performed in for all TrCH *i* and all TF *l* by the following formula, where $\Delta N_{i,*}$ is derived from $N_{i,*}$ by the formula given at section 4.2.7:

$$\Delta N_{i,*}^{TTI} = F_i \cdot \Delta N_{i,*}$$

If $\Delta N_{i,*}^{TTI} = 0$ then, for TrCH *i*, the output data of the rate matching is the same as the input data and the rate matching algorithm of section 4.2.7.4 does not need to be executed.

Otherwise, for determining e_{ini}, e_{plus}, e_{minus}, and N the following parameters are needed:

For convolutional codes,

$$\Delta N = \Delta N_{i,*}^{TTI}$$

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 section 4.2.7.4. The following parameters are used as input:

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

$$e_{ini} = 1 \, e_{plus} = a \cdot N_{max}$$

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

Puncturing if $\Delta N < 0$, repetition otherwise.

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

a=2 for *Y* sequence,

a=1 for *Y'* sequence.

The X bits shall not be punctured.

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

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

For each transmission time interval of TrCH *i* with TF *l*, the rate-matching pattern is calculated with the algorithm in section 4.2.7.4. The following parameters are used as input:

$$N = \lfloor N_{il}^{TTI} / 3 \rfloor$$

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

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

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

Puncturing if $\Delta N < 0$, repetition otherwise.

4.2.7.2.2 Determination of rate matching parameters for flexible positions of TrCHs

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:

$$\Delta N_{i,l}^{TTI} = F_i \cdot \left\lceil \frac{RF_i \cdot N_{i,l}^{TTI}}{F_i} \right\rceil - N_{i,l}^{TTI}$$

The second phase is defined by the following algorithm:

for all j in *TFCS* 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 section 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 section 4.2.7.4 does not need to be executed.

Otherwise, for determining e_{ini}, e_{plus}, e_{minus}, and N the following parameters are needed:

For convolutional codes,

$$\Delta N = \Delta N_{il}^{TTI}$$

$a=2$

For each transmission time interval of TrCH *i* with TF *l*, the rate-matching pattern is calculated with the algorithm in section 4.2.7.4. The following parameters are used as input:

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

$$e_{ini} = 1$$

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

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

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

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

$a=2$ for *Y* sequence,

$a=1$ for *Y'* sequence.

X bits shall not be punctured.

$$\Delta N = \begin{cases} \lfloor \Delta N_{il}^{TTI} / 2 \rfloor \text{for Y sequence} \\ \lceil \Delta N_{il}^{TTI} / 2 \rceil \text{for Y' sequence} \end{cases}$$

For each transmission time interval of TrCH *i* with TF *l*, the rate-matching pattern is calculated with the algorithm in section 4.2.7.4. The following parameters are used as input:

$N = \lfloor N_{il}^{TTI} / 3 \rfloor$,

$e_{ini} = N$,

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

$$e_{\min us} = a \cdot |\Delta N|$$

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

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

Document R1-99i53
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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25.212 CR 009 Current Version: 3.0.0

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

For submission to:	TSG-RAN #6	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑		for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from:* ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

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

Source: Ericsson **Date:** 1999-11-19

Subject: Removal of SFN multiplexing

Work item: TS25.212

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	
				Release 00	

Reason for change: WG1 and WG2 agreed that the SFN is not a L1 parameter, but it is handled by higher layers. The section on SFN multiplexing is removed from TS25.212.

Clauses affected: 4.2.15 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:

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TSG-RAN Working Group 1 meeting #9 **_TSGR1#9(99)j25_**

Dresden, Germany
November 30 – December 3, 1999

Agenda item:

Source: Ericsson

Title: CR 25.212-010r1: Clarification of bit separation and collection

Document for: Decision

This document contains a revised version of CR 25.212-010 (Tdoc TSGR1#9(99)i54). The following changes have been made:

1) ***Page 27:*** $N_{max} = \max_{l \in TFS(i)} (N_{il}^{TTI}/3)$ ~~$N_{max} = \max_{l \in TFS(i)} \lfloor N_{il}^{TTI}/3 \rfloor$~~ ***Not needed since always a multiple of 3.***

2) ***Page 31:*** $z_{i,3\lfloor N_i/3 \rfloor + k} = y_{1,i,\lfloor N_i/3 \rfloor + k}$ ~~$z_{i,3\lfloor N_i/3 \rfloor + k} = y_{i,\lfloor N_i/3 \rfloor + k}$~~ ***Typo***

Bit separation and bit collection is currently not sufficiently described in 25.212. Modifications were proposed in TSGR1#8(99)f28. It is proposed that instead of making the limited changes proposed in f28, the section should be rewritten with a notation more similar to the rest of 25.212. The changes proposed in this document are listed below.

Entire section 4.2.7	The following notation is currently used for the number of bits before rate matching: UL: $N = N_i = N_{ij}$ DL: $N = E_i = N_{il}^{TTI}$ It is proposed that N is replaced by X_i so that it is possible to distinguish between different TrCHs. Similarly, it is proposed that ΔN is replaced by ΔN_i.
Entire section 4.2.7	Index b is introduced to indicate systematic or parity bits.
Section 4.2.7.1.2 / 4.2.7.2.1 / 4.2.7.2.2	Divided into subsections to ease understanding. (Note that current text does not define rate matching for uncoded TrCHs.)
Section 4.2.7.1.2 / 4.2.7.2.1 / 4.2.7.2.2	Minor correction: N (X_i) is known not determined.
Section 4.2.7.1.2.2 / 4.2.7.2.1.2 / 4.2.7.2.2.2	Last row removed. Only puncturing is used in this section.
Section 4.2.7.2.1.2 / 4.7.2.2.2	Removed round down since N_{il}^{TTI} always is a multiple of three.
Section 4.2.7.3	Completely rewritten. A new notation is introduced for the bits. The section is divided into subsections. Clearly states what happens in UL when N_{ij} is not a multiple of three (the last 1 or 2 bits can not be punctured).
Section 4.2.7.5 / 4.2.7.6	Removed since they are now covered in 4.2.7.3

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

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

CHANGE REQUEST

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

25.212	**CR**	**010r1**	Current Version:	3.0.0

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

For submission to:	TSG-RAN #6	for approval	X	Strategic		(for SMG use only)
list expected approval meeting # here ↑		for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

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

Source:	Ericsson	**Date:**	1999-11-24
Subject:	Clarification of bit separation and collection		
Work item:			

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

Reason for change:	Current description of bit separation and collection can easily be misinterpreted.
Clauses affected:	4.2.7

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

Other comments:	

help.doc

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

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

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

where

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

x_{ik} is the k^th^ bit of the input bit sequence and

y_{i,n_ik} is the k^th^ bit of the output bit sequence corresponding to the n^th^ radio frame

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

4.2.6.1 Relation between input and output of the radio frame segmentation block in uplink

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

The output bit sequence corresponding radio frame n_i is denoted by $e_{i1}, e_{i2}, e_{i3}, \ldots, e_{iN_i}$, where i is the TrCH number and N_i is the number of bits. Hence, $e_{i,k} = y_{i,n_ik}$ and $N_i = Y_i$.

4.2.6.2 Relation between input and output of the radio frame segmentation block in downlink

The bits input to the radio frame segmentation are denoted by $q_{i1}, q_{i2}, q_{i3}, \ldots, q_{iQ_i}$, where i is the TrCH number and Q_i the number of bits. Hence, $x_{ik} = q_{ik}$ and $X_i = Q_i$.

The output bit sequence corresponding to radio frame n_i is denoted by $f_{i1}, f_{i2}, f_{i3}, \ldots, f_{iV_i}$, where i is the TrCH number and V_i is the number of bits. Hence, $f_{i,k} = y_{i,n_ik}$ and $V_i = Y_i$.

4.2.7 Rate matching

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

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

Notation used in section 4.2.7 and subsections:

N_{ij}: 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.

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

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

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

I: Number of TrCHs in the CCTrCH.

Z_{ij}: Intermediate calculation variable.

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

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

q: Average puncturing distance. 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 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 section 4.2.7.44.2.7.5.

e_{plus} Increment of variable *e* in the rate matching pattern determination algorithm of section 4.2.7.44.2.7.5.

e_{minus} Decrement of variable *e* in the rate matching pattern determination algorithm of section 4.2.7.44.2.7.5.

Xb: Indicates systematic and parity bits
b=1: Systematic bit. *X(t)* in section 4.1.3.2.1.
Y: *b*=2: 1st parity bit (from the upper Turbo constituent encoder). *Y(t)* in section 4.1.3.2.1.
Y': *b*=3: 2nd parity bit (from the lower Turbo constituent encoder). *Y'(t)* in section 4.1.3.2.1.

NOTE: Time index t in section 4.1.3.2.1 is omitted for simplify the rate matching description.

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:

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

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

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

4.2.7.1 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 used to avoid multicode or to enable the use of a higher spreading factor when this is needed because the UE does not support SF down to 4. 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 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 values of N_{data} then are $\{ N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, N_4, 2N_4, 3N_4, 4N_4, 5N_4, 6N_4\}$.Depending on the UE capabilities, the supported 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 $N_{data} - \sum_{x=1}^{I} \frac{RM_{x,}}{\min_{1 \le y \le I}\{RM_y\}} \cdot N_{x,j}$ 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 $N_{data} - PL \cdot \sum_{x=1}^{I} \frac{RM_x}{\min_{1 \le y \le I}\{RM_y\}} \cdot N_{x,j}$ is non negative }

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

4.2.7.1.2 Determination of parameters needed for calculating the rate matching pattern

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

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

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

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

If $\Delta N_{ij} = 0$ then the output data of the rate matching is the same as the input data and the rate matching algorithm of section 4.2.7.44.2.7.5 does not need to be executed.

If $\Delta N_{ij} \neq 0$ the parameters listed in sections 4.2.7.1.2.1 and 4.2.7.1.2.2 shall be used forOtherwise, for determining e_{ini}, e_{plus}, and e_{minus}, and N the following parameters are needed (regardless if the radio frame is compressed or not).:

For convolutional codes,

4.2.7.1.2.1 Uncoded and convolutionally encoded TrCHs

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

if q is even

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

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

else

$q' = q$

endif

for x = 0 to F_i-1

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

end for

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

a = 2

For each radio frame, the rate-matching pattern is calculated with the algorithm in section 4.2.7.44.2.7.5, where :

NX$_i$ = $N_{i,j}$., and

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

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

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

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

4.2.7.1.2.2 Turbo encoded TrCHs

For turbo codes, if repetition is to be performed, such as $\Delta N_{i,j} > 0$, parameters for turbo codes are the same as parameter for convolutional codes. If repetition is to be performed on turbo encoded TrCHs, i.e. $\Delta N_{i,j} > 0$, the parameters in section 4.2.7.1.2.1 are used.

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

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

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

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

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

q = $\lfloor$ NX$_i$ /|ΔN_i| $\rfloor$

if(q$\leq$2)

for x=0 to F_i-1

S[I$_F$[(3x+b-1) mod F$_i$]] = x mod 2; if(Y sequence)

S[I$_F$[(3x+1) mod F$_i$]] = x mod 2;

if(Y' sequence)

S[I$_F$ [(3x+2) mod F$_i$]] = x mod 2;

end for

else

if q is even

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

else q' = q

endif

for x=0 to F_i -1

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

S[I$_F$[(3r+b-1) mod F$_i$]] = $\lceil$ x*q' $\rceil$ div F$_i$;if(Y sequence)

S[I$_F$[(3r+1) mod F$_i$]] = $\lceil$ x*q' $\rceil$ div F$_i$;

if(Y' sequence)

S[I$_F$[(3r+2) mod F$_i$]] = $\lceil$ x*q' $\rceil$ div F$_i$;

endfor

endif

For each radio frame, the rate-matching pattern is calculated with the algorithm in section 4.2.7.44.2.7.5, where:

NX_i is as above,

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

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

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

puncturing for ΔN<0, repeating otherwise.

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.

4.2.7.2.1 Determination of rate matching parameters for fixed positions of TrCHs

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

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

The computation of the $\Delta N_{i,l}^{TTI}$ parameters is then performed in for all TrCH *i* and all TF *l* by the following formula, where $\Delta N_{i,*}$ is derived from $N_{i,*}$ by the formula given at section 4.2.7:

$$\Delta N_{i,*}^{TTI} = F_i \cdot \Delta N_{i,*}$$

If $\Delta N_{i,*}^{TTI} = 0$ then, for TrCH *i*, the output data of the rate matching is the same as the input data and the rate matching algorithm of section 4.2.7.44.2.7.5 does not need to be executed.

If $\Delta N_{i,*}^{TTI} \neq 0$ the parameters listed in sections 4.2.7.2.1.1 and 4.2.7.2.1.2 shall be usedOtherwise, for determining e_{ini}, e_{plus}, and e_{minus}., and *N* the following parameters are needed:

For convolutional codes,

4.2.7.2.1.1 Uncoded and convolutionally encoded TrCHs

$$\Delta N_i = \Delta N_{i,*}^{TTI}$$

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 section 4.2.7.44.2.7.5. The following parameters are used as input:

$$X_i = N_{il}^{TTI} \quad N = N_{il}^{TTI}$$

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

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

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

Puncturing if $\Delta N_i < 0$ $\Delta N < 0$, repetition otherwise.

4.2.7.2.1.2 Turbo encoded TrCHs

For turbo codes, if repetition is to be performed, such as $\Delta N_{i,*}^{TTI} > 0$, parameters for turbo codes are the same as parameter for convolutional codes. If repetition is to be performed on turbo encoded TrCHs, i.e. $\Delta N_{i,*}^{TTI} > 0$, the parameters in section 4.2.7.2.1.1 are used.

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

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

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

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

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

$$N_{max} = \max_{l \in TFS(i)} (N_{il}^{TTI} / 3) \quad N_{max} = \max_{l \in TFS(i)} \left\lfloor N_{il}^{TTI} / 3 \right\rfloor$$

For each transmission time interval of TrCH *i* with TF *l*, the rate-matching pattern is calculated with the algorithm in section 4.2.7.44.2.7.5. The following parameters are used as input:

$$X_i = N_{il}^{TTI} / 3 \quad N = \left\lfloor N_{il}^{TTI} / 3 \right\rfloor$$

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

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

$$e_{minus} = a \cdot \left| \Delta N_i \right| \quad e_{minus} = a \cdot \left| \Delta N \right|$$

Puncturing if $\Delta N < 0$, repetition otherwise.

4.2.7.2.2 Determination of rate matching parameters for flexible positions of TrCHs

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:

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

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:

$$\Delta N_{i,l}^{TTI} = F_i \cdot \left\lceil \frac{RF_i \cdot N_{i,l}^{TTI}}{F_i} \right\rceil - N_{i,l}^{TTI}$$

The second phase is defined by the following algorithm:

for all j in *TFCS* 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 section 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 section ~~4.2.7.4~~4.2.7.5 does not need to be executed.

If $\Delta N_{i,l}^{TTI} \neq 0$ the parameters listed in sections 4.2.7.2.2.1 and 4.2.7.2.2.2 shall be used~~Otherwise,~~ for determining e_{ini}, e_{plus}, and e_{minus}~~, and *N* the following parameters are needed:~~

~~For convolutional codes,~~

4.2.7.2.2.1 Uncoded and convolutionally encoded TrCHs

$\Delta N_i = \Delta N_{il}^{TTI}$ ~~$\Delta N = \Delta N_{il}^{TTI}$~~

a=2

For each transmission time interval of TrCH *i* with TF *l*, the rate-matching pattern is calculated with the algorithm in section ~~4.2.7.4~~4.2.7.5. The following parameters are used as input:

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

$e_{ini} = N_{il}^{TTI}$ ~~$e_{ini} = N$~~

$e_{plus} = a \cdot N_{il}^{TTI}$ ~~$e_{plus} = a \cdot N$~~

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

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

4.2.7.2.2.2 Turbo encoded TrCHs

For turbo codes, if repetition is to be performed, such as $\Delta N_{il}^{TTI} > 0$, parameters for turbo codes are the same as parameter for convolutional codes. If repetition is to be performed on turbo encoded TrCHs, i.e. $\Delta N_{il}^{TTI} > 0$, the parameters in section 4.2.7.2.2.1 are used.

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

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

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

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

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

For each transmission time interval of TrCH *i* with TF *l*, the rate-matching pattern is calculated with the algorithm in section 4.2.7.44.2.7.5. The following parameters are used as input:

$X_i = N_{il}^{TTI} / 3$ $N = \lfloor N_{il}^{TTI} / 3 \rfloor$,

$e_{ini} = X_i$ $e_{ini} = N$,

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

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

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

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. The systematic bit, first parity bit, and second parity bit in the bit sequence input to the rate matching block are therefore separated from each other. Puncturing is only applied to the parity bits and systematic bits used for trellis termination.

The bit separation function is transparent for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition. The bit separation and bit collection are illustrated in figures 6 and 7.

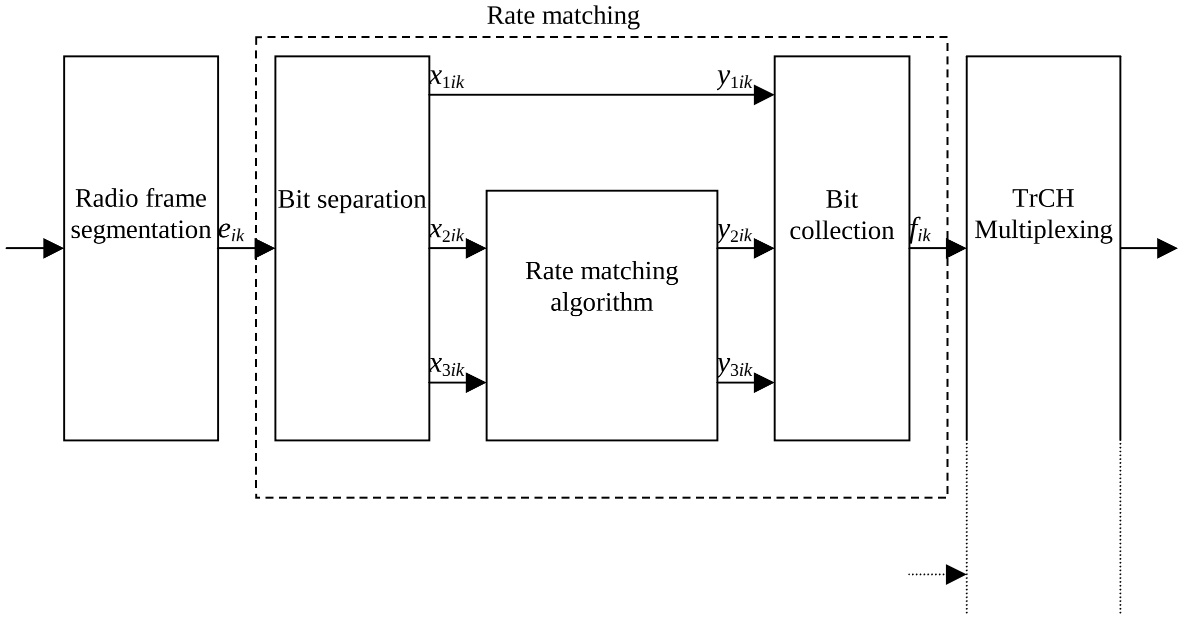

Figure 6: Puncturing of turbo encoded TrCHs

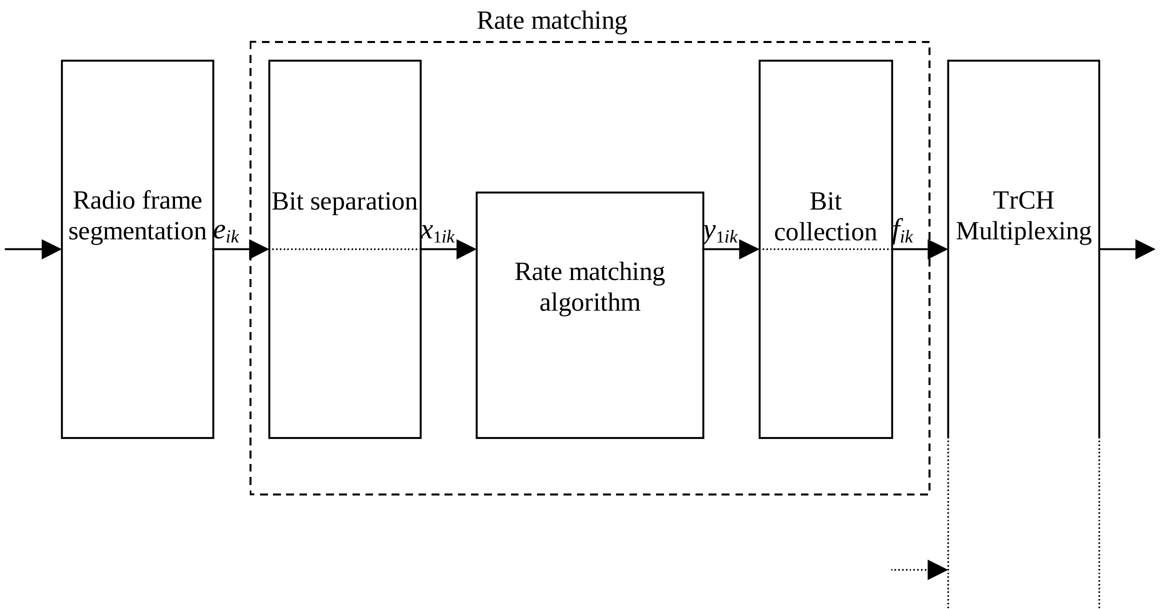

Figure 7: Rate matching for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition.

The bit separation is dependent on the 1st interleaving and offsets are used to define the separation for different TTIs. The offsets α_b for the systematic (b=1) and parity bits ($b\in\{2, 3\}$) are listed in table 4.

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. 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 $V_i = N_{ij}+\Delta N_{ij}$. The relations between y_{bik}, z_{bik}, and f_{ik} are given below.

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

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

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

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

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

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

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

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

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 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.

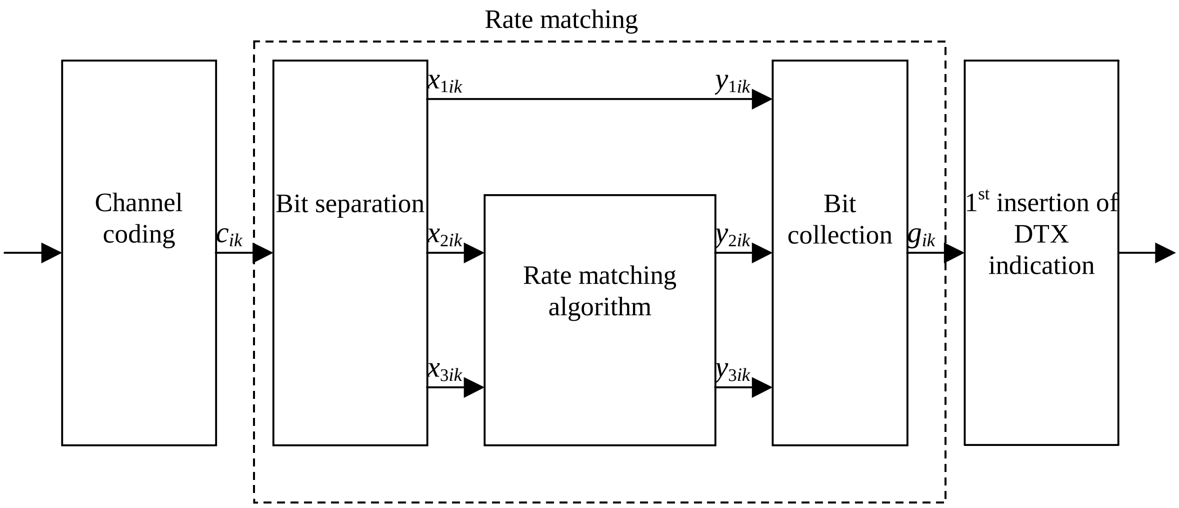

Figure 6: Puncturing of turbo encoded TrCHs

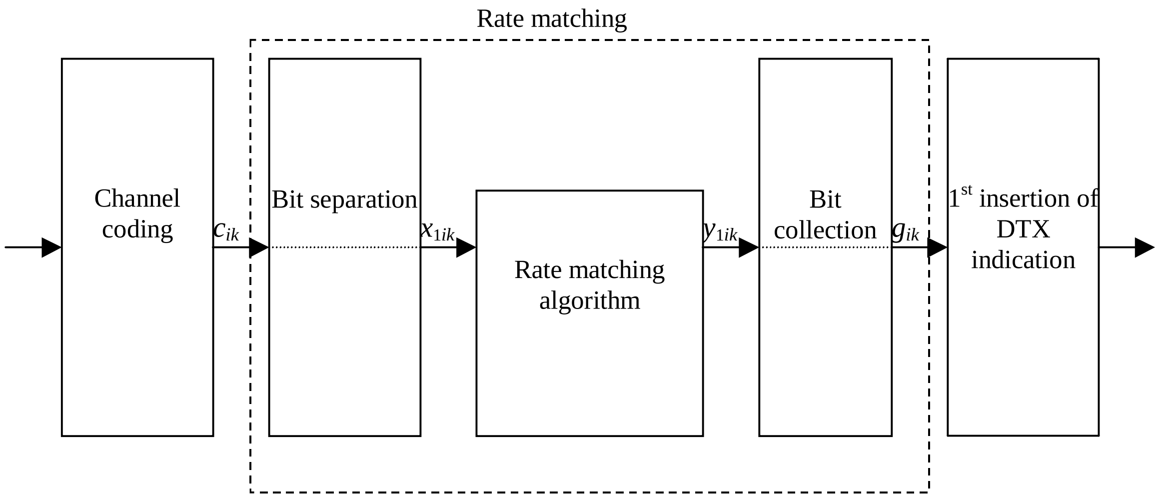

Figure 7: Rate matching for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition.

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. 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 $G_i= N_{ij}+\Delta N_{ij}$. 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.

4.2.7.3 Bit separation for rate matching

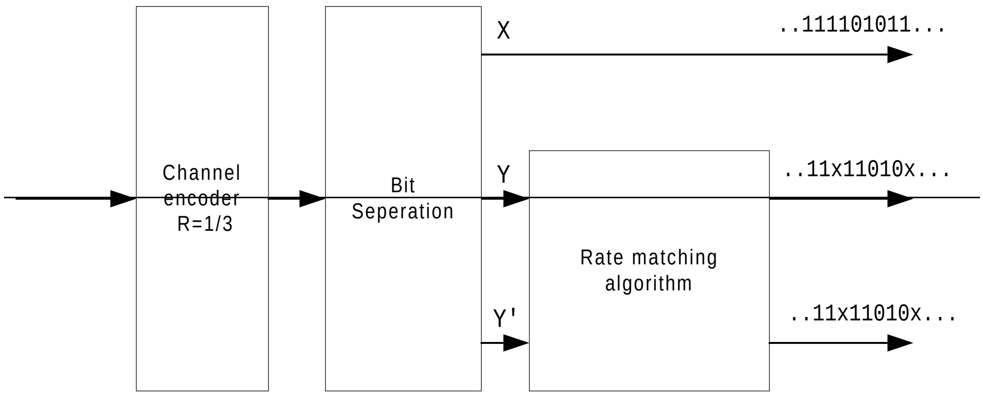

Figure 6: Overall rate matching block diagram before first interleaving where x denotes punctured bit

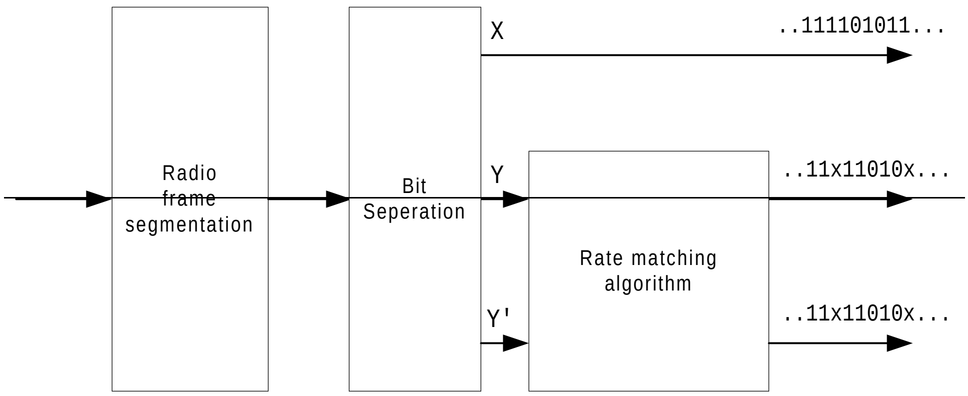

Figure 7: Overall rate matching block diagram after first interleaving where x denotes punctured bit

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

For uplink, there are two different alternation patterns in bit stream from radio frame segmentation according to the TTI of a TrCH as shown in table 4.

Table 4: Alternation patterns of bits from radio frame segmentation in uplink

TTI (msec)	Alternation patterns
10, 40	... *X,Y,Y'*,...
20, 80	... *X,Y',Y*,...

In addition, each radio frame of a TrCH starts with different initial parity type. Table 5 shows the initial parity type of each radio frame of a TrCH with TTI = {10, 20, 40, 80} msec.

Table 5: Initial parity type of radio frames of TrCH in uplink

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

~~Table 4 and table 5 defines a complete output bit pattern from radio frame segmentation.~~

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

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

~~Therefore, bit separation is achieved with the alternative selection of bits with the initial parity type and alternation pattern specified in table 4 and table 5 according to the TTI and n_i of a TrCH.~~

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

~~For downlink, output bit sequence pattern from Turbo encoder is always X, Y, Y', X, Y, Y', …. Therefore, bit separation is achieved with the alternative selection of bits from Turbo encoder.~~

4.2.7.5~~4~~ Rate matching pattern determination

Denote the bits before rate matching by:

$x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$ ~~$x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iN}$~~, where *i* is the TrCH number and ~~N~~X_i is the -parameter given in sections 4.2.7.1 and 4.2.7.2.

The rate matching rule is as follows:

if puncturing is to be performed

e = e_{ini} -- initial error between current and desired puncturing ratio

m = 1 -- index of current bit

do while m <= X_i~~N~~

e = e – e_{minus} -- update error

if e <= 0 then -- check if bit number m should be punctured

~~puncture~~set bit $x_{i,m}$ to δ where $\delta \notin \{0, 1\}$

e = e + e_{plus} -- update error

end if

m = m + 1 -- next bit

end do

else

e = e_{ini} -- initial error between current and desired puncturing ratio

m = 1 -- index of current bit

do while m <= X_i~~N~~

e = e – e_{minus} -- update error

do while e <= 0 -- check if bit number m should be repeated

repeat bit $x_{i,m}$

e = e + e_{plus} -- update error

end do

m = m + 1 -- *next bit*

end do

end if

A repeated bit is placed directly after the original one.

~~4.2.7.5 Relation between input and output of the rate matching block in uplink~~

~~The bits input to the rate matching are denoted by $e_{i1}, e_{i2}, e_{13}, \ldots, e_{iN_i}$, where *i* is the TrCH.~~

~~Hence, $x_{ik} = e_{ik}$ and $N = N_{ij} = N_i$.~~

~~The bits output from the rate matching are denoted by $f_{i1}, f_{i2}, f_{13}, \ldots, f_{iV_i}$, where *i* is the TrCH number and $V_i = N + \Delta N = N_{ij} + \Delta N_{ij}$.~~

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

~~4.2.7.6 Relation between input and output of the rate matching block in downlink~~

~~The bits input to the rate matching are denoted by $c_{i1}, c_{i2}, c_{13}, \ldots, c_{iE_i}$, where *i* is the TrCH number and *l* the transport format number. Hence, $x_{ik} = e_{ik}$ and $N = N_{il}^{TTI} = E_i$.~~

~~The bits output from the rate matching are denoted by $g_{i1}, g_{i2}, g_{13}, \ldots, g_{iG_i}$, where *i* is the TrCH number and $G_i = N + \Delta N = N_{il}^{TTI} + \Delta N_{il}^{TTI}$.~~

~~Note that the transport format number *l* for simplicity has been left out in the bit numbering.~~

4.2.8 TrCH multiplexing

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

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

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

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

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

…

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

4.2.9 Insertion of discontinuous transmission (DTX) indication bits

In the downlink, DTX is used to fill up the radio frame with bits. The insertion point of DTX indication bits depends on whether fixed or flexible positions of the TrCHs in the radio frame are used. It is up to the UTRAN to decide for each

TSG-RAN Working Group 1 meeting #9 **TSGR1#9(99)l26**
Dresden, Germany
November 30 – December 3, 1999

Agenda item:

Source: Ericsson

Title: CR 25.212-011r2: Connection between TTI and CFN

Document for: Decision

Transport channels within one CCTrCH shall have aligned transmission time instants as illustrated in figure 8 in TS 25.212. Figure 8 is equivalent with the following equation, using the connection frame number CFN (defined in TS 25.402) as reference:

$CFN_i \bmod F_i = 0$.

CFN_i denotes the connection frame number of the first radio frame within transmission time interval TTI_i of transport channel *i*. This relation gives a first requirement on the start timing of transport channels that are multiplexed into one CCTrCH.

Due to downlink rate matching rules, the rate matching calculations per TrCH are performed once per transmission time interval for the downlink. This results in the limitation that the transport format combination of one CCTrCH can be changed only each TTI in the downlink. Hence, new TrCHs can only be added into one CCTrCH or reconfigured within the CCTrCH at these time instants.

This can be expressed as:

$CFN_i \bmod F_{max} =0$, 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 the new transport channel *i*.

By defining when transport channels may be started, the alignment of the transport channel's TTI timing follows directly.

It is proposed to replace figure 8 with the equation $CFN_i \bmod F_{max} =0$ and to add a reference to TS 25.402 where CFN is defined.

<u>Changes from CR25.212-11 (R1-99i55):</u>

1. The description of the situation when alignment between TTI and CFN is needed has been corrected from “adding a new TrCH into a CCTrCH” to “changing the TFCS of a CCTrCH because a TrCH i is added to the CCTrCH or reconfigured within the CCTrCH”

2. TTI_i/10ms can be expressed by F_i.

3. The possible start timing for the TTIs of transport channels after they have been added or reconfigured is added by including the equation $CFN_i \bmod (F_i) = 0$.

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

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

CHANGE REQUEST

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

25.212 CR 011r2 Current Version: 3.0.0

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

For submission to:	TSG-RAN #6	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑		for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

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

Source: Ericsson **Date:** 1999-12-02

Subject: Connection between TTI and CFN

Work item:

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

F	Correction	X	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	

Release: see above

Reason for change: Figure 8 does not specify the exact timing for addition of TrCHs that are multiplexed into one CCTrCH with respect to CFN and TTI.

Clauses affected: 2, 4.2.14

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.

1 Scope

This specification describes the documents being produced by the 3GPP TSG RAN WG1and first complete versions expected to be available by end of 1999. This specification describes the characteristics of the Layer 1 multiplexing and channel coding in the FDD mode of UTRA.

The 25.2xx series specifies Um point for the 3G mobile system. This series defines the minimum level of specifications required for basic connections in terms of mutual connectivity and compatibility.

2 References

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

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

[1] 3GPP RAN TS 25.201: "Physical layer – General Description"

[2] 3GPP RAN TS 25.211: "Transport channels and physical channels (FDD)"

[3] 3GPP RAN TS 25.213: "Spreading and modulation (FDD)"

[4] 3GPP RAN TS 25.214: "Physical layer procedures (FDD)"

[5] 3GPP RAN TS 25.215: "Measurements (FDD)"

[6] 3GPP RAN TS 25.221: "Transport channels and physical channels (TDD)"

[7] 3GPP RAN TS 25.222: "Multiplexing and channel coding (TDD)"

[8] 3GPP RAN TS 25.223: "Spreading and modulation (TDD)"

[9] 3GPP RAN TS 25.224: "Physical layer procedures (TDD)"

[10] 3GPP RAN TS 25.225: "Measurements (TDD)"

[11] 3GPP RAN TS 25.302: "Services Provided by the Physical Layer"

[12] 3GPP RAN TS 25.402: “Synchronisation in UTRAN, Stage 2”

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 shallould have co-ordinated timings. in the sense that transport blocks arriving from higher layers on different transport channels of potentially different transmission time intervals shall have aligned transmissionWhen the TFCS of a CCTrCH is changed because a transport channel *i* is added to the CCTrCH or reconfigured within the CCTrCH, the TTI of transport channel *i* may only start in radio frames with CFN fulfilling the relation

$CFN_i \bmod F_{max} = 0$,

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 transport channel *i* which is added or reconfigured, and CFN_i denotes the connection frame number of the first radio frame within the transmission time interval of transport channel *i*.

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

$CFN_i \bmod F_i = 0$.

time instants as shown in figure 8.

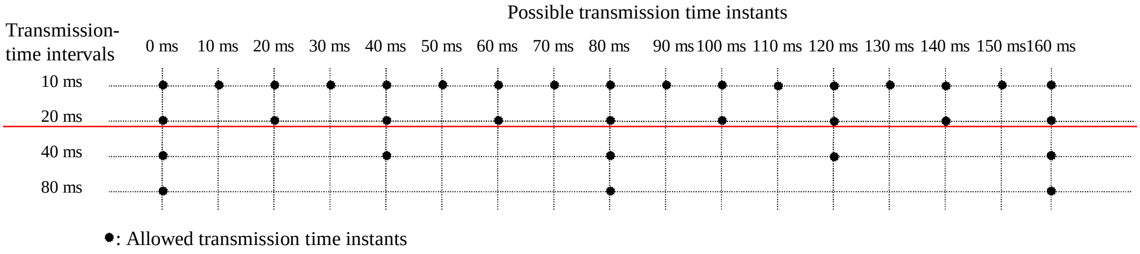

Figure 8: Possible transmission time instants regarding CCTrCH

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 type

The allowed combination of CCTrCHs of dedicated and common type are FFS.

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.

TSG-RAN Working Group 1 meeting #9 **TSGR1#9(99)l27**
Dresden, Germany
November 30 – December 3, 1999

Agenda item:

Source: Ericsson

Title: CR 25.212-012r2: Zero length transport blocks

Document for: Decision

The coding and multiplexing needs to handle transport block numbers of zero, i.e. the case when no transport blocks arrive for transmission in the TTI. Efficient handling of zero transport blocks is important, but exactly how to handle them is not clearly specified in all parts of TS 25.212.

Another scenario can be a whole CCTrCH that has zero transport blocks on all TrCHs. Also this case needs to be handled.

Clearly, one do not want to send any bits at all when there is no data to be transmitted, i.e. no CRC shall be attached, no tail bits shall be added, no coding shall be performed, etc.

The impact on the downlink and uplink functions for the cases with zero length transport blocks is listed below.

Downlink:

- **CRC attachment**: If no transport blocks are available (M_i = 0), the function shall be transparent.
- **TrBk concatenation/code block segmentation**: The function can handle the case of no input bits.
- **Channel coding**: If no code blocks are available (C_i = 0), the function shall be transparent (E_i = 0).
- **Rate matching**: The function can handle the case of TrCHs having zero length transport blocks as long as not all TrCHs within the CCTrCH have zero length. If no input bits are available from all TrCHs within the CCTrCH, the function shall be transparent
- **Insertion of DTX indication with fixed positions**: The function can handle the case of no input bits.
- **1st interleaving**: The function can handle the case of no input bits which is possible for flexible positions.
- **Radio frame segmentation**: The function can handle the case of no input bits which is possible for flexible positions.
- **TrCH multiplexing**: The function can handle the special case for all TrCHs within a CCTrCH having zero bits which is possible for flexible positions.
- **Insertion of DTX indication with flexible positions**: The function can handle the case of no input bits.
- **Physical channel segmentation**: No impact since there will always be at least DTX indication bits.
- **2nd interleaving**: No impact since there will always be at least DTX indication bits.
- **Physical channel mapping**: The function can handle the case of CCTrCHs containing only DTX indication bits.

Uplink:

- **CRC**: If no transport blocks are available (M_i = 0), the function shall be transparent.

- **TrBk concatenation/code block segmentation**: The function can handle the case of no input bits.
- **Channel coding**: If no code blocks are available (C_i = 0), the function shall be transparent (E_i = 0).
- **Radio frame size equalisation**: The function can handle the special case of no input bits.
- **1st interleaving**: The function can handle the special case of no input bits.
- **Radio frame segmentation**: The function can handle the special case of no input bits.
- **Rate matching**: The function can handle the case of TrCHs having zero length transport blocks as long as not all TrCHs within the CCTrCH have zero length. If no input bits are available from all TrCHs within the CCTrCH, the function shall be transparent and no uplink DPDCH shall be selected.
- **TrCH multiplexing**: The function can handle the special case of all TrCHs within a CCTrCH having zero length.
- **Physical channel segmentation**: The function can handle the special case of all TrCHs within a CCTrCH having zero length.
- **2nd interleaving**: The function can handle the special case of all TrCHs within a CCTrCH having zero length.
- **Physical channel mapping**: The function can handle the special case of all TrCHs within a CCTrCH having zero length, i.e. no uplink physical channel is selected in this case.

From the above list, it can be noted that some additional information is needed in 25.212 to handle the special cases with zero length transport blocks.

It is proposed to include the case of zero length transport blocks into the descriptions of CRC attachment (4.2.1.1), channel coding (4.2.3) and rate matching (4.2.7).

Changes from CR 25.212-012 (R1-99i56):

1. Section 4.2.1.1 (CRC Calculation): "If no transport blocks are input to the CRC calculation (M_i = 0), no CRC attachment shall be done."
2. Section 4.2.3 (Channel coding): "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."
3. Section 4.2.7 (Rate Matching): "…and no uplink DPDCH will be selected in the case of uplink rate matching."

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

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

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25.212	**CR**	**012r2**	Current Version:	3.0.0

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

For submission to:	TSG-RAN #6	for approval	X	b		*(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: Ericsson **Date:** 1999-12-02

Subject: Zero length transport blocks

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: The handling of zero length transport blocks is not described in all parts of the current version of TS 25.212.

Clauses affected: 4.2.1.1, 4.2.3, 4.2.7

Other specs affected:

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

Other comments:

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

4.2.1 Error detection

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

4.2.1.1 CRC Calculation

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

If no transport blocks are input to the CRC calculation ($M_i = 0$), no CRC attachment shall be done.

4.2.1.1.1 Relation between input and output of the Cyclic Redundancy Check

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

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

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

blocks on TrCH i is denoted by M_i. The bits after concatenation are denoted by $x_{i1}, x_{i2}, x_{i3}, \ldots, x_{iX_i}$, where i is the TrCH number and $X_i=M_iB_i$. They are defined by the following relations:

$x_{ik} = b_{i1k}$ k = 1, 2, …, B_i

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

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

…

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

4.2.2.2 Code block segmentation

Segmentation of the bit sequence from transport block concatenation is performed if $X_i>Z$. The code blocks after segmentation are of the same size. The number of code blocks on TrCH i is denoted by C_i. If the number of bits input to the segmentation, X_i, is not a multiple of C_i, filler bits are added to the last 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: $K_i = \lceil X_i / C_i \rceil$

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

If $X_i \le Z$, then $o_{i1k} = x_{ik}$, and $K_i = X_i$.

If $X_i \ge Z$, then

$o_{i1k} = x_{ik}$ k = 1, 2, …, K_i

$o_{i2k} = x_{i,(k+K_i)}$ k = 1, 2, …, K_i

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

…

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

$o_{iC_ik} = 0$ $k = (K_i - Y_i) + 1, (K_i - Y_i) + 2, \ldots, K_I$

4.2.3 Channel coding

Code blocks are delivered to the channel coding block. They are denoted by $o_{ir1}, o_{ir2}, o_{ir3}, \ldots, o_{irK_i}$, where i is the TrCH number, r is the code block number, and K_i is the number of bits in each code block. The number of code blocks on TrCH i is denoted by C_i. After encoding the bits are denoted by $y_{ir1}, y_{ir2}, y_{ir3}, \ldots, y_{irY_i}$. The encoded blocks are serially multiplexed so that the block with lowest index *r* is output first from the channel coding block. 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:

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

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

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

$$\ldots$$

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

The relation between o_{irk} and y_{irk} and between K_i and Y_i is dependent on the channel coding scheme.

The following channel coding schemes can be applied to TrCHs:

- Convolutional coding
- Turbo coding
- No channel coding

The values of Y_i in connection with each coding scheme:

- Convolutional coding, ½ rate: $Y_i = 2*K_i + 16$; 1/3 rate: $Y_i = 3*K_i + 24$
- Turbo coding, 1/3 rate: $Y_i = 3*K_i + 12$
- No channel coding, $Y_i = K_i$

Table 1: Error Correction Coding Parameters

Transport channel type	Coding scheme	Coding rate
BCH	Convolutional code	1/2
PCH		
FACH		
RACH		
CPCH		1/3, 1/2 or no coding
DCH		
CPCH	Turbo Code	1/3 or no coding
DCH		

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

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

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

where

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

x_{ik} is the k[th] bit of the input bit sequence and

y_{i,n_ik} is the k[th] bit of the output bit sequence corresponding to the n[th] radio frame

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

4.2.6.1 Relation between input and output of the radio frame segmentation block in uplink

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

The output bit sequence corresponding radio frame n_i is denoted by $e_{i1}, e_{i2}, e_{i3}, \ldots, e_{iN_i}$, where i is the TrCH number and N_i is the number of bits. Hence, $e_{i,k} = y_{i,n_ik}$ and $N_i = Y_i$.

4.2.6.2 Relation between input and output of the radio frame segmentation block in downlink

The bits input to the radio frame segmentation are denoted by $q_{i1}, q_{i2}, q_{i3}, \ldots, q_{iQ_i}$, where i is the TrCH number and Q_i the number of bits. Hence, $x_{ik} = q_{ik}$ and $X_i = Q_i$.

The output bit sequence corresponding to radio frame n_i is denoted by $f_{i1}, f_{i2}, f_{i3}, \ldots, f_{iV_i}$, where i is the TrCH number and V_i is the number of bits. Hence, $f_{i,k} = y_{i,n_ik}$ and $V_i = Y_i$.

4.2.7 Rate matching

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

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

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 section 4.2.7 and subsections:

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

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

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

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

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

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

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

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

Used in downlink only.

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

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

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

I: Number of TrCHs in the CCTrCH.

Z_{ij}: Intermediate calculation variable.

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

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

q: Average puncturing distance. 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 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 section 4.2.7.4.

e_{plus} Increment of variable *e* in the rate matching pattern determination algorithm of section 4.2.7.4.

e_{minus} Decrement of variable *e* in the rate matching pattern determination algorithm of section 4.2.7.4.

X: Systematic bit in section 4.1.3.2.1.

Y: 1st parity bit (from the upper Turbo constituent encoder) in section 4.1.3.2.1.

Y': 2nd parity bit (from the lower Turbo constituent encoder) in section 4.1.3.2.1.

NOTE: Time index t in section 4.1.3.2.1 is omitted for simplify the rate matching description.

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:

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

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

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

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Document R1-99i36
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

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25.212	**CR**	**016**	Current Version:	3.0.0

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

For submission to:	TSG-RAN #6	for approval	X	strategic		*(for SMG use only)*
list expected approval meeting # here ↑		for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG   The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: *(at least one should be marked with an X)*

(U)SIM	ME	UTRAN / Radio	Core Network
	X	X	

Source:	Nokia	**Date:**	24.11.99
Subject:	Removal of TrCH restriction in DSCH CCTrCH		
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: RAN WG2 and RAN WG1 have agreed that there is no restrictions about the number of Transport Channels in DSCH CCTrCH

Clauses affected: 4.2.13.5

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:

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

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 section 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 always 10 ms, i.e. $e_{1k} = c_{1k}$ and $N_1 = E_1$.
- At initial RACH transmission the rate matching attribute has a predefined value.
- Only one PRACH is used, i.e. P=1, $u_{1k} = s_k$, and $U = S$.

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.
- ~~There can only be one TrCH in each DSCH 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 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.
- 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.

TSG-RAN Working Group 1 meeting #9
Dresden, Germany
November 30 – December 3, 1999

TSGR1#9(99)i59

Agenda item:

Source: Ericsson

Title: CR 25.212-018: Minimum SF in uplink

Document for: Decision

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1 Introduction

In uplink, the spreading factor (SF) and the number of codes are selected in order to satisfy the following criteria given by order of priority:

i. The number of used DPDCHs is minimised, or the SF is constrained to be greater than or equal to the minimum value supported by the UE

ii. The puncturing is minimised, provided that constraint (i) still holds

iii. The SF is maximised provided that constraints (i) and (ii) still hold.

This is described with the relations in section 4.2.7.1.1 of [1]. Using the above criteria, there is no need to signal the SF. However, there could be situations where UTRAN prefers to use puncturing and a higher SF. Consider for example the case when 10% puncturing would enable a higher SF. If the base station is short of resources it is preferable from an UTRAN perspective to use the higher SF rather then rejecting the UE's request.

In the physical channel information elements (section 10.2.6.8 of [2]) there is a SF parameter called DPDCH channelization code. The name is not very suitable but it could be used for signalling the minimum SF that the UE is allowed to use. The criteria for choosing SF would then be changed to:

i. The number of used DPDCHs is minimised, or the SF is constrained to be greater than or equal to the minimum value supported by the UE *and allowed by UTRAN*.

ii. The puncturing is minimised, provided that constraint (i) still holds

iii. The SF is maximised provided that constraints (i) and (ii) still hold.

This means that the definition of SET0 in section 4.2.7.1.1 of [1] needs to be modified. A CR with this change is attached.

2 References

[1] TSG RAN WG1, "TS 25.212 Multiplexing and channel coding (FDD)".

[2] TSG RAN WG2, "TS 25.331 RRC Protocol Specification".

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25.212	**CR**	**018**	Current Version:	3.0.0

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

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

Source:	Ericsson	**Date:**	1999-11-18
Subject:	Minimum SF in UL		
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	X		Release 98	
with an X)	D	Editorial modification			Release 99	X
					Release 00	

Reason for change:	SF for UL can be signalled according to 25.331. 25.212 does not take this into account.
Clauses affected:	4.2.7.1.1

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:	

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

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

4.2.7.1 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.In uplink puncturing can be used to avoid multicode or to enable the use of a higher spreading factor when this is needed because the UE does not support SF down to 4. 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 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 values of N_{data} then are $\{ N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, N_4, 2N_4, 3N_4, 4N_4, 5N_4, 6N_4\}$.Depending on the UE capabilityies and the restrictions from UTRAN, the supportedallowed 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 $N_{data} - \sum_{x=1}^{I} \frac{RM_{x,}}{\min_{1 \le y \le I}\{RM_y\}} \cdot N_{x,j}$ 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 $N_{data} - PL \cdot \sum_{x=1}^{I} \frac{RM_x}{\min_{1 \le y \le I}\{RM_y\}} \cdot N_{x,j}$ is non negative }

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

4.2.7.1.2 Determination of parameters needed for calculating the rate matching pattern

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

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

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3G25.212	**CR**	**024**	Current Version:	3.0.0.

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

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

Source: Mitsubishi Electric (MCRD) **Date:** 30th November 99

Subject: Rate matching parameter determination in DL and fixed positions

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: The current description is ambiguous, as it seems that the block size variation $\Delta N_{i,l}^{TTI}$ does not depend on the TF *l*.

Clauses affected: 4.2.7.2.1

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:

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4.2.7.2.1 Determination of rate matching parameters for fixed positions of TrCHs

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

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

The computation of the $\Delta N_{i,l}^{TTI}$ parameters is then performed in for all TrCH *i* and all TF *l* by the following formula, where $\Delta N_{i,*}$ is derived from $N_{i,*}$ by the formula given at section 4.2.7:

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

If EMBED $\Delta N_{max} = 0$ then, for TrCH *i*, the output data of the rate matching is the same as the input data and the rate matching algorithm of section 4.2.7.4 does not need to be executed. In this case we have :

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

Otherwise, for determining e_{ini}, e_{plus}, e_{minus}, and N the following parameters are needed:

For convolutional codes,

EMBED $\Delta N = \Delta N_{max}$

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 section 4.2.7.4. The following parameters are used as input:

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

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

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

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

Puncturing if $\Delta N < 0$, repetition otherwise. The values of $\Delta N_{i,l}^{TTI}$ may be computed by counting repetitions or puncturing when the algorithm of section 4.2.7.4 is run.

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

a=2 for *Y* sequence,

a=1 for *Y'* sequence.

The X bits shall not be punctured.

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

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

For each transmission time interval of TrCH *i* with TF *l*, the rate-matching pattern is calculated with the algorithm in section 4.2.7.4. The following parameters are used as input:

$$N = \left\lfloor N_{il}^{TTI} / 3 \right\rfloor$$

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

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

$$e_{\min us} = a \cdot \left| \Delta N \right|$$

Puncturing if $\Delta N < 0$, repetition otherwise.

The values of $\Delta N_{i,l}^{TTI}$ may be computed by counting repetitions or puncturing when the algorithm of section 4.2.7.4 is run.

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25.212	**CR**	**026r1**	Current Version:	V3.0.0

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

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Proposed change affects: *(at least one should be marked with an X)*

(U)SIM		ME	X	UTRAN / Radio	X	Core Network	

Source: Panasonic **Date:** 1 Dec 1999

Subject: Corrections to TS 25.212

Work item: TS25.212

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: Table 1 is updated. Turbo coding for FACH is not limited. It will gain in FER/BER in FACH, to reduce UE complexity and to get network flexibility.

Clauses affected:

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: We proposed to send liaison treating this topic. Tdoc No. is R1-99K20.

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4.2.1 Channel coding

Code blocks are delivered to the channel coding block. They are denoted by $o_{ir1}, o_{ir2}, o_{ir3}, \ldots, o_{irK_i}$, where i is the TrCH number, r is the code block number, and K_i is the number of bits in each code block. The number of code blocks on TrCH i is denoted by C_i. After encoding the bits are denoted by $y_{ir1}, y_{ir2}, y_{ir3}, \ldots, y_{irY_i}$. The encoded blocks are serially multiplexed so that the block with lowest index r is output first from the channel coding block. 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:

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

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

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

$$\ldots$$

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

The relation between o_{irk} and y_{irk} and between K_i and Y_i is dependent on the channel coding scheme.

The following channel coding schemes can be applied to TrCHs:

- Convolutional coding
- Turbo coding
- No channel coding

The values of Y_i in connection with each coding scheme:

- Convolutional coding, ½ rate: $Y_i = 2*K_i + 16$; 1/3 rate: $Y_i = 3*K_i + 24$
- Turbo coding, 1/3 rate: $Y_i = 3*K_i + 12$
- No channel coding, $Y_i = K_I$

Table 1: Error Correction Coding Parameters

~~Transport channel type~~	~~Coding scheme~~	~~Coding rate~~
~~BCH~~	~~Convolutional code~~	~~1/2~~
~~PCH~~		
~~FACH~~		
~~RACH~~		
~~CPCH~~		~~1/3, 1/2 or no coding~~
~~DCH~~		
~~CPCH~~	~~Turbo Code~~	~~1/3 or no coding~~
~~DCH~~		

Transport channel type	Coding scheme	Coding rate
BCH	Convolutional code	1/2
PCH		
~~FACH~~		
RACH		
CPCH, DCH, DSCH,FACH		1/3, 1/2
	Turbo Code	1/3
	No coding	