TSG-RAN Working Group 1 meeting #15 ***TSGR1#15(00)0986***
Berlin, Germany
August 22 –25, 2000

Agenda item: AH 99
Source: InterDigital Comm. Corp, Mitsubishi Electric.
Title: Correction to section on bit separation and collection for rate matching in 25.212 CR –092 and 25.222 CR – 043
Document for: Decision

In TS25.212 section in the uplink there was an error in the description: it was omitted that, when the number of bits is not a multiple of 3, some of the second and third parity bits from the turbo encoded TrCHs can go to the 1st sequence instead of to the 2nd and 3rd sequences.
In the downlink the change is purely editorial to align the description style with that of the uplink. This way the difference between UL and DL is more clear.
This CR clarifies the description of bit separation. The functionality is affected.

The same correction of an error in the decription

3GPP TSG RAN WG1 Meeting #15
Berlin, Germany, 22-25 August, 2000

Document R1-00-0986
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or for SMG, use the format P-99-xxx

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25.212	**CR**	**092**	Current Version:	3.3.0

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

For submission to: RAN #9 *list expected approval meeting # here ↑*

for approval [X]
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strategic [ ]
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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 [X] Core Network [ ]

Source: InterDigital Comm. Corp., Mitsubishi Electric **Date:** August 23, 2000

Subject: Bit separation and collection for rate matching

Work item: TS 25.212

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

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

Release:

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

Reason for change:

In the uplink there was an error in the description : it was omitted that, when the number of bits is not a multiple of 3, some of the second and third parity bits from the turbo encoded TrCHs can go to the 1st sequence instead of to the 2nd and 3rd sequences.
In the downlink the change is purely editorial to align the description style with that of the uplink. This way the difference between UL and DL is more clear.

Clauses affected: 4.2.7.3, 4.2.7.3.1, 4.2.7.3.1, 4.2.7.4, 4.2.7.4.1

Other specs affected:

Other 3G core specifications	[ ]	→ List of CRs:	25.222 CR-043
Other GSM core specifications	[ ]	→ List of CRs:	
MS test specifications	[ ]	→ List of CRs:	
BSS test specifications	[ ]	→ List of CRs:	
O&M specifications	[ ]	→ List of CRs:	

Other comments:

4.2.7.3 Bit separation and collection in uplink

The systematic bits of turbo encoded TrCHs shall not be punctured, the other bits ~~, however, systematic bits for trellis termination~~ may be punctured. The systematic bits, first parity bits, and second parity bits in the bit sequence input to the rate matching block are therefore separated into three sequences.

The first sequence contains :

- All of the systematic bits that are from turbo encoded TrCHs.
- None or some first and/or second parity bits that are from turbo encoded TrCHs. These bits come into the first sequence when the total number of bits in a block after radio frame segmentation is not a multiple of three.
- Some of the systematic, first parity and second parity bits that are for treillis termination.

The second sequence contains :

- All of the first parity bits that are from turbo encoded TrCHs, except those that go into the first sequence when the total number of bits is not a multiple of three.
- Some of the systematic, first parity and second parity bits that are for treillis termination.

The third sequence contains :

- All of the second parity bits that are from turbo encoded TrCHs, except those that go into the first sequence when the total number of bits is not a multiple of three.
- Some of the systematic, first parity and second parity bits that are for treillis termination.

~~, one sequence containing all of the systematic bits and some systematic, first and second parity trellis termination bits; the second sequence containing all of the first parity bits and some systematic, first and second parity trellis termination bits and the third sequence containing all of the second parity bits and some systematic, first and second parity trellis termination bits.~~ The second and third sequences shall be of equal length, whereas the first sequence can contain from 0 to 2 more bits. Puncturing is ~~only~~ applied only to the second and to the third sequences.

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

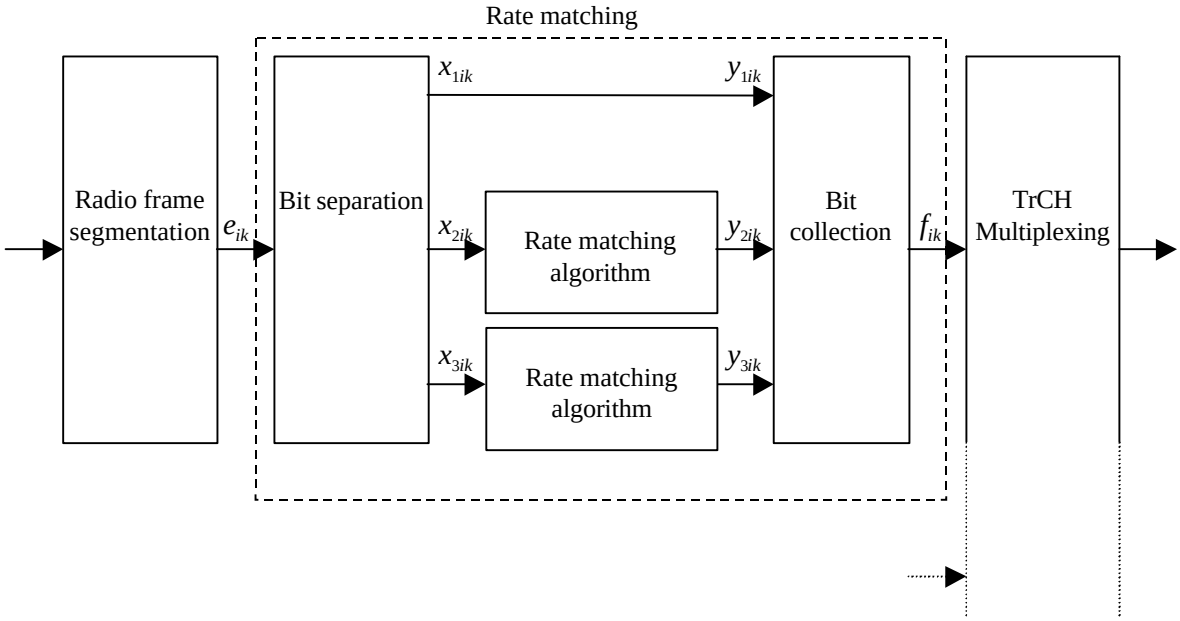

Figure 5: Puncturing of turbo encoded TrCHs in uplink

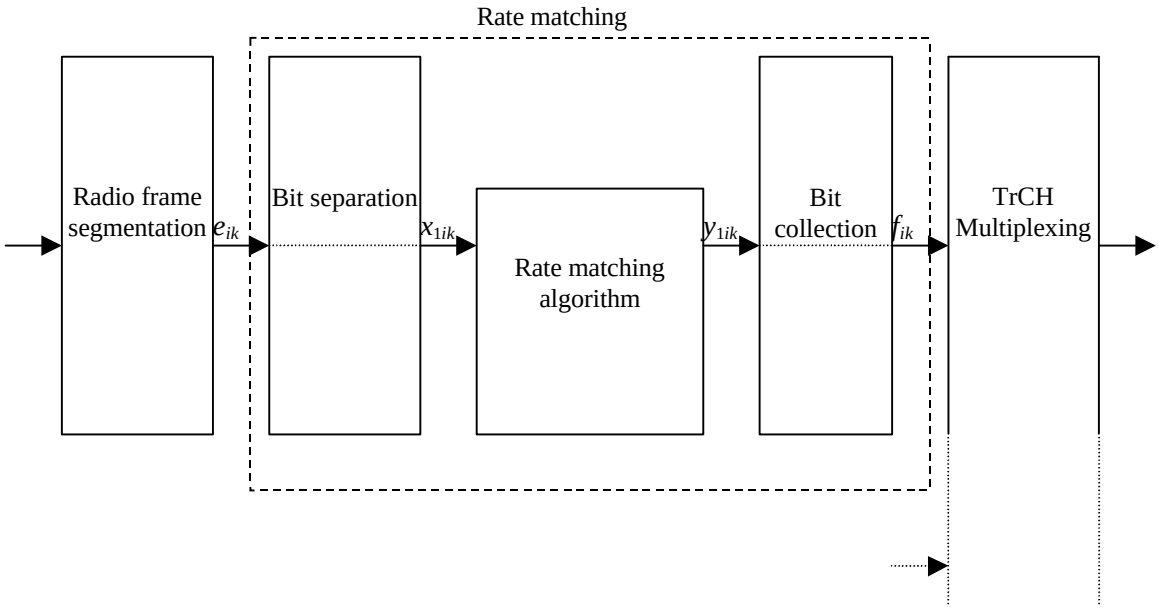

Figure 6: Rate matching for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition in uplink

The bit separation is dependent on the 1st interleaving and offsets are used to define the separation for different TTIs. *b* indicates the three sequences defined in this section, with *b*=1 indicating the first sequence, *b* = 2 the second one, and *b* = 3 the third one. ~~The sequence denoted as b=1 contains all of the systematic bits and some systematic, first and second parity trellis termination bits; the sequence denoted as b=2 contains all of the first parity bits and some systematic, first and second parity trellis termination bits; the~~

~~sequence denoted as b=3 contains all of the second parity bits and some systematic, first and second parity trellis termination bits~~. The offsets a_b for these sequences are listed in table 4.

Table 4: TTI dependent offset needed for bit separation

TTI (ms)	a_1	a_2	a_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 b_{n_i} .

Table 5: Radio frame dependent offset needed for bit separation

TTI (ms)	b_0	b_1	b_2	b_3	b_4	b_5	b_6	b_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 the three sequences defined in section 4.2.7.3 , with *b*=1 indicating the first sequence, and so forth.~~The sequence denoted as b=1 contains all of the systematic bits and some systematic, first and second parity trellis termination bits; the sequence denoted as b=2 contains all of the first parity bits and some systematic, first and second parity trellis termination bits; the sequence denoted as b=3 contains all of the second parity bits and some systematic, first and second parity trellis termination bits.~~ For all other cases *b* is defined to be 1. X_i is the number of bits in each separated bit sequence. The relation between e_{ik} and x_{bik} is given below.

For turbo encoded TrCHs with puncturing:

$x_{1,i,k} = e_{i,3(k-1)+1+(a_1+b_{n_i}) \bmod 3}$ k = 1, 2, 3, …, X_i $X_i = \lfloor N_i/3 \rfloor$

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

$x_{2,i,k} = e_{i,3(k-1)+1+(a_2+b_{n_i}) \bmod 3}$ k = 1, 2, 3, …, X_i $X_i = \lfloor N_i/3 \rfloor$

$x_{3,i,k} = e_{i,3(k-1)+1+(a_3+b_{n_i}) \bmod 3}$ k = 1, 2, 3, …, X_i $X_i = \lfloor N_i/3 \rfloor$

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

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

4.2.7.3.2 Bit collection

The bits x_{bik} are input to the rate matching algorithm described in subclause 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 $V_i = N_{ij} + DN_{ij}$. The relations between y_{bik}, z_{bik}, and f_{ik} are given below.

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

$z_{i,3(k-1)+1+(a_1+b_{n_i}) \bmod 3} = y_{1,i,k}$ $\quad k = 1, 2, 3, \ldots, Y_i$

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

$z_{i,3(k-1)+1+(a_2+b_{n_i}) \bmod 3} = y_{2,i,k}$ $\quad k = 1, 2, 3, \ldots, Y_i$

$z_{i,3(k-1)+1+(a_3+b_{n_i}) \bmod 3} = y_{3,i,k}$ $\quad k = 1, 2, 3, \ldots, Y_i$

After the bit collection, bits $z_{i,k}$ with value d, where d Ï {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 d, where d Ï {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 of turbo encoded TrCHs shall not be punctured, , the other bits ~~however, systematic bits for trellis termination~~ may be punctured.

The systematic bits, first parity bits and second parity bits in the bit sequence input to the rate matching block are therefore separated into three sequences of equal lengths.

The first sequence contains :

- All of the systematic bits that are from turbo encoded TrCHs.
- Some of the systematic, first parity and second parity bits that are for treillis termination.

The second sequence contains :

- All of the first parity bits that are from turbo encoded TrCHs.
- Some of the systematic, first parity and second parity bits that are for treillis termination.

The third sequence contains :

- All of the second parity bits that are from turbo encoded TrCHs.

Some of the systematic, first parity and second parity bits that are for treillis termination~~, one sequence containing all of the systematic bits and some systematic, first and second~~

~~parity trellis termination bits; the second sequence containing all of the first parity bits and some systematic, first and second parity trellis termination bits and the third sequence containing all of the second parity bits and some systematic, first and second parity trellis termination bits~~. ~~P~~uncturing is ~~only~~ applied only to these two ~~the second and third~~ sequences.

The bit separation function is transparent for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition. The bit separation and bit collection are illustrated in figures 7 and 8.

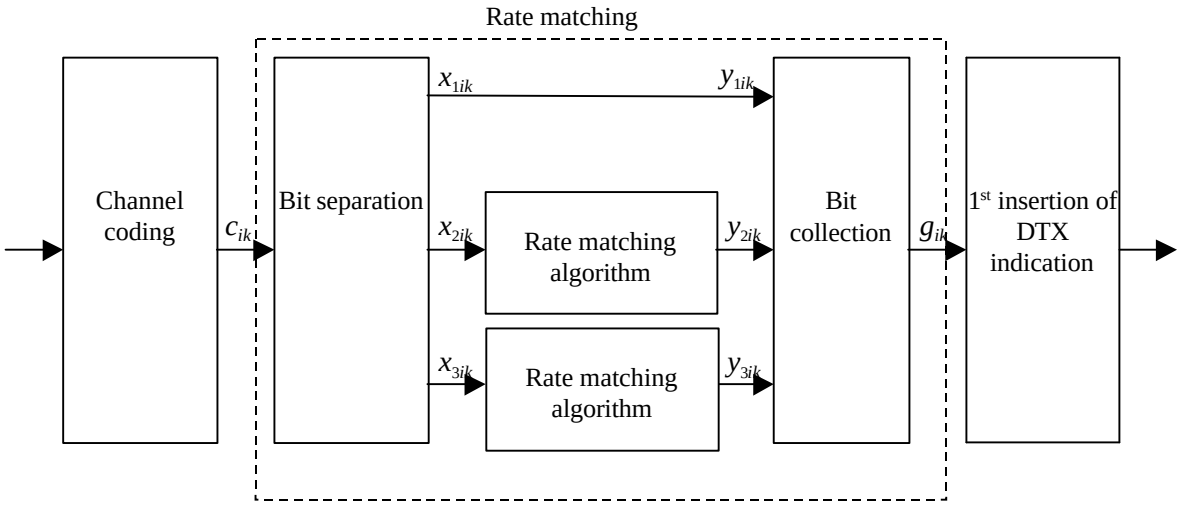

Figure 7: Puncturing of turbo encoded TrCHs in downlink

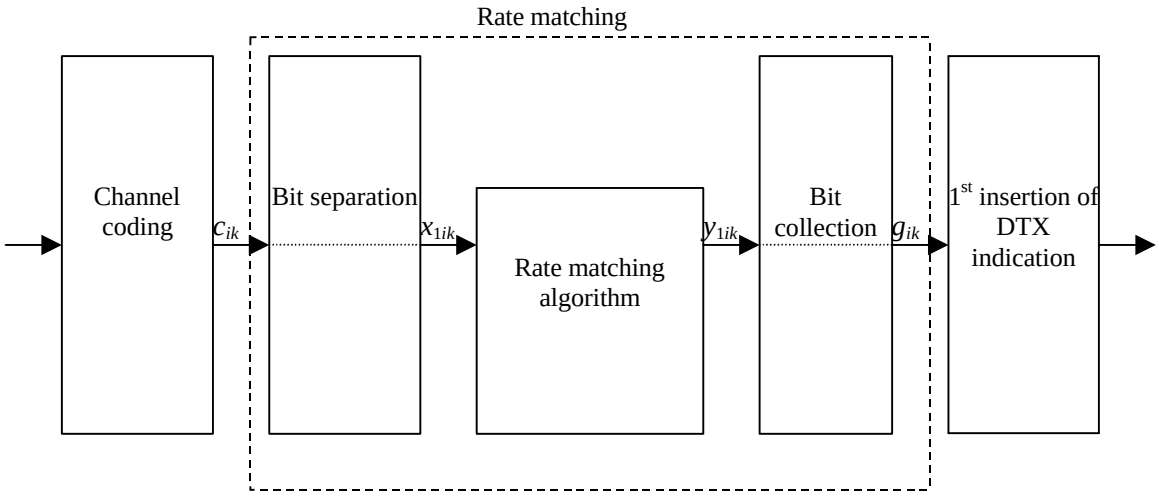

Figure 8: Rate matching for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition in downlink

4.2.7.4.1 Bit separation

The bits input to the rate matching are denoted by $c_{i1}, c_{i2}, c_{i3}, \ldots, c_{iE_i}$, where i is the TrCH number and E_i is the number of bits input to the rate matching block. Note that E_i is a multiple of 3 for turbo encoded TrCHs and that the transport format l for simplicity has been left out in the bit numbering, i.e. $E_i = N_{il}^{TTI}$. The bits after separation are denoted by $x_{bi1}, x_{bi2}, x_{bi3}, \ldots, x_{biX_i}$. For turbo encoded TrCHs with puncturing, b indicates the three sequences defined in section 4.2.7.4, with b=1 indicating the first sequence, and so forth. For all other cases b is defined to be 1. X_i is the number of bits in each separated bit sequence. The relation between c_{ik} and x_{bik} is given below.

For turbo encoded TrCHs with puncturing:

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

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

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

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

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

3GPP TSG RAN WG1 Meeting #15
Berlin, Germany, 22-25 August, 2000

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or for SMG, use the format P-99-xxx

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25.222 **CR** **043** Current Version: 3.3.0

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

For submission to: RAN #9 *list expected approval meeting # here ↑*

for approval [X]
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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 [X] Core Network [ ]

Source: InterDigital Comm. Corp., Mitsubishi Electric **Date:** August 23,2000

Subject: Bit separation and collection for rate matching

Work item: TS25.222

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

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

Release:

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

Reason for change: In the section describing the bit separation there was an error in the description: it was omitted that, when the number of bits is not a multiple of 3, some of the second and third parity bits from the turbo encoded TrCHs can go to the 1st sequence instead of to the 2nd and 3rd sequences.

Clauses affected: 4.2.7.2, 4.2.7.2.1

Other specs affected:

Other 3G core specifications	[ ]	→ List of CRs: 25.212 CR -092
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.

4.2.7.2 Bit separation and collection for rate matching

The systematic bits of turbo encoded TrCHs shall not be punctured, the other bits ~~however systematic bits for trellis termination~~ may be punctured. The systematic bits, first parity bits, and second parity bits in the bit sequence input to the rate matching block are therefore separated into three sequences.

The first sequence contains :

- All of the systematic bits that are from turbo encoded TrCHs.
- None or some first and/or second parity bits that are from turbo encoded TrCHs. These bits come into the first sequence when the total number of bits in a block after radio frame segmentation is not a multiple of three.
- Some of the systematic, first parity and second parity bits that are for treillis termination.

The second sequence contains :

- All of the first parity bits that are from turbo encoded TrCHs, except those that go into the first sequence when the total number of bits is not a multiple of three.
- Some of the systematic, first parity and second parity bits that are for treillis termination.

The third sequence contains :

- All of the second parity bits that are from turbo encoded TrCHs, except those that go into the first sequence when the total number of bits is not a multiple of three.
- Some of the systematic, first parity and second parity bits that are for treillis termination.

~~, one sequence containing all of the systematic bits and some systematic, first and second parity trellis termination bits; the second sequence containing all of the first parity bits and some systematic, first and second parity trellis termination bits and the third sequence containing all of the second parity bits and some systematic, first and second parity trellis termination bits.~~ The second and third sequences shall be of equal length, whereas the first sequence can contain from 0 to 2 more bits. Puncturing is ~~only~~ applied only to the second and to the third sequences.

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

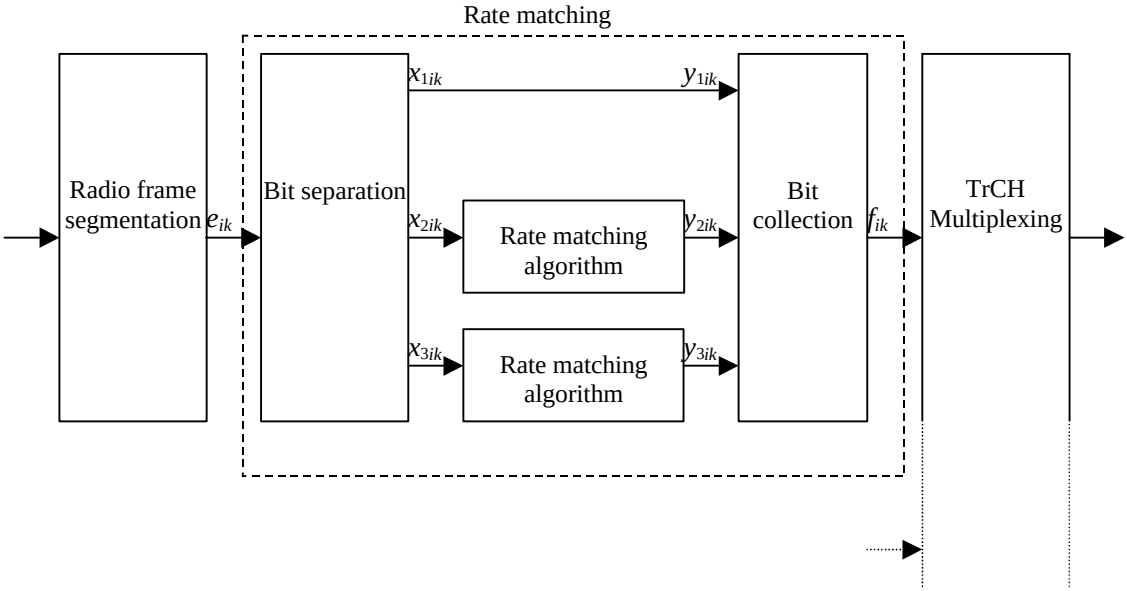

Figure 4: Puncturing of turbo encoded TrCHs

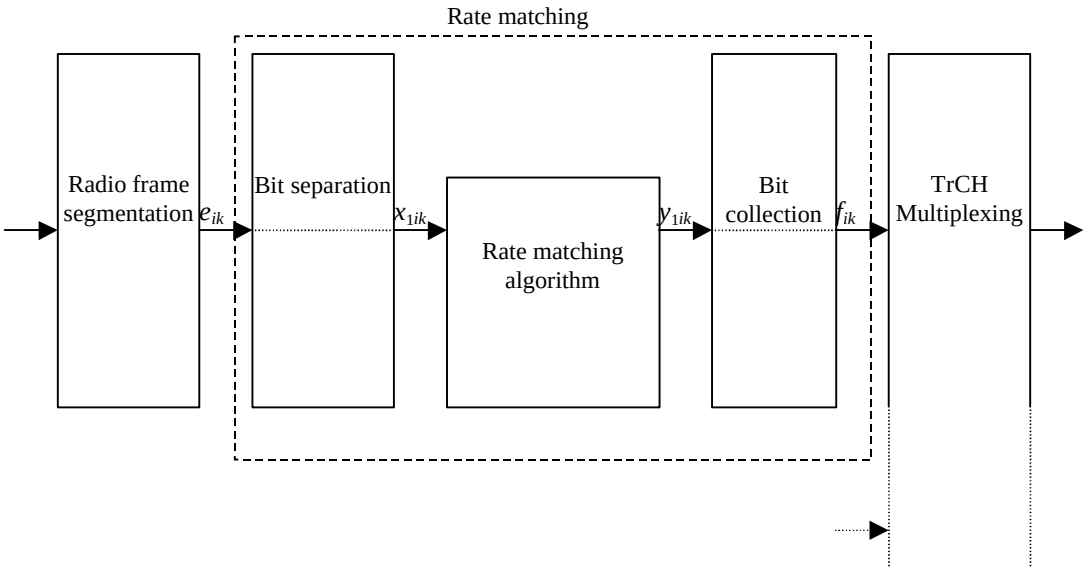

Figure 5: Rate matching for uncoded TrCHs, convolutionally encoded TrCHs, and for turbo encoded TrCHs with repetition

The bit separation is dependent on the 1st interleaving and offsets are used to define the separation for different TTIs. *b* indicates the three sequences defined in this section, with *b*=1 indicating the first sequence, *b* = 2 the second one, and *b* = 3 the third one.
~~The sequence denoted as b=1 contains all of the systematic bits and some systematic, first and second parity trellis termination bits; the sequence denoted as b=2 contains all of the first parity bits and some systematic, first and second parity trellis termination bits; the sequence denoted as b=3 contains all of the second parity bits and some systematic, first~~

~~and second parity trellis termination bits.~~ The offsets a_b for these sequences are listed in table 4.

Table 4: TTI dependent offset needed for bit separation

TTI (ms)	a_1	a_2	a_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 b_{n_i}.

Table 5: Radio frame dependent offset needed for bit separation

TTI (ms)	b_0	b_1	b_2	b_3	b_4	b_5	b_6	b_7
10	0	NA	NA	NA	NA	NA	NA	NA
20	0	1	NA	NA	NA	NA	NA	NA
40	0	1	2	0	NA	NA	NA	NA
80	0	1	2	0	1	2	0	1

4.2.7.2.1 Bit separation

The bits input to the rate matching are denoted by $e_{i1}, e_{i2}, e_{i3}, \ldots, e_{iN_i}$, where *i* is the TrCH number and N_i is the number of bits input to the rate matching block. Note that the transport format combination number *j* for simplicity has been left out in the bit numbering, i.e. N_i=N_{ij}. The bits after separation are denoted by $x_{bi1}, x_{bi2}, x_{bi3}, \ldots, x_{biX_i}$. For turbo encoded TrCHs with puncturing, *b* indicates the three sequences defined in section 4.2.7.2, with *b*=1 indicating the first sequence, and so forth.~~ The sequence denoted as b=1 contains all of the systematic bits and some systematic, first and second parity trellis termination bits; the sequence denoted as b=2 contains all of the first parity bits and some systematic, first and second parity trellis termination bits; the sequence denoted as b=3 contains all of the second parity bits and some systematic, first and second parity trellis termination bits.~~ For all other cases *b* is defined to be 1. X_i is the number of bits in each separated bit sequence. The relation between e_{ik} and x_{bik} is given below.

For turbo encoded TrCHs with puncturing:

$x_{1,i,k} = e_{i,3(k-1)+1+(a_1+b_{n_i}) \bmod 3}$ $\quad k = 1, 2, 3, \ldots, X_i$ $\quad X_i = \lfloor N_i/3 \rfloor$

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

$x_{2,i,k} = e_{i,3(k-1)+1+(a_2+b_{n_i}) \bmod 3}$ $\quad k = 1, 2, 3, \ldots, X_i$ $\quad X_i = \lfloor N_i/3 \rfloor$

$x_{3,i,k} = e_{i,3(k-1)+1+(a_3+b_{n_i}) \bmod 3}$ $\quad k = 1, 2, 3, \ldots, X_i$ $\quad X_i = \lfloor N_i/3 \rfloor$

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

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