

3G CHANGE REQUEST

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

25.222 CR 007

Current Version: **3.0.0**

3G specification number ↑

↑ CR number as allocated by 3G support team

For submission to TSG **RAN #6** for approval (only one box should
 list TSG meeting no. here ↑ for information be marked with an X)

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

Proposed change affects: USIM ME UTRAN Core Network
 (at least one should be marked with an X)

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

Subject: Update of rate matching rule for TDD

3G Work item: TS 25.222

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

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

Clauses affected: 4.2.7, 4.2.7.1

Other specs affected: Other 3G core specifications → List of CRs:
 Other 2G core specifications → List of CRs:
 MS test specifications → List of CRs:
 BSS test specifications → List of CRs:
 O&M specifications → List of CRs:

Other comments:



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

4.2.7 Rate matching

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

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

Notation used in section 4.2.7 and subsections:

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

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

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

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

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

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

P : maximum number of physical channels for a CTrCH.

I : Number of TrCHs in a CTrCH.

Z_{mj} : Intermediate calculation variable.

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

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

Q : Average puncturing distance.

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

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

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

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

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

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

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

X : Systematic bit in 4.2.3.2.1.

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

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

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

4.2.7.1 Determination of rate matching parameters

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

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

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

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

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

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

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

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

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

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

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

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

For convolutional codes,

$$a = 2$$

$$\Delta N = \Delta N_{ij}$$

$$N = N_{ij}$$

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

If q is even

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

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

else

```

    q' = q
  endif
  for x = 0 to Fi-1
    S(IF (⌈ x*q' ⌉ mod Fi)) = (⌈ x*q' ⌉ div Fi)–
  End for
  eini = (a·S(ni)·|ΔN| + N) mod a·N, if eini = 0 then eini = a·N.
  eplus = a·N
  eminus = a·DN/

```

puncturing for $DN < 0$, repeating otherwise.

For turbo codes, if repetition is to be performed, such as $DN_{i,j} > 0$, 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.

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

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

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

if ($q \leq 2$)

```

  for x=0 to Fi-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, Fi) / Fi -- where gcd(q, Fi) means greatest common divisor of q and Fi

```

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

```

  else q' = q

```

```

endif

```

```

for x=0 to Fi - 1

```

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

```

if(Y sequence)

```

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

if(Y' sequence)

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

endif

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

N is as above,

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

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

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

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