3GPP TSG RAN WG1 Meeting #12
Seoul, Korea, 10-13 April 2000

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

CHANGE REQUEST

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

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

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

For submission to:	TSG RAN #8	for approval	X	strategic		*(for SMG 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: NEC **Date:** 11 April 2000

Subject: Editorial modifications

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		
D	Editorial modification	X	

Release:

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

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

Clauses affected: 4.2.3.3, 4.2.5.2, 4.2.7, 4.2.11

Other specs affected:

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

Other comments:

4.2.3.3 Concatenation of encoded blocks

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

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

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

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

$$\ldots$$

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

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

4.2.5.2 1st interleaver operation

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

(1) Select the number of columns C_I from table 3.

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

$$R_I = X_i/C_I$$

(3) Write the input bit sequence into the $R_I \times C_I$ rectangular matrix row by row starting with bit $x_{i,1}$ in the first column of the first row and ending with bit $x_{i,(R_I C_I)}$ in column C_I of row R_I:

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

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

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

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

Table 3 Inter-column permutation patterns for 1st interleaving

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

4.2.7 Rate matching

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

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

If no bits are input to the rate matching for all TrCHs within a CCTrCH, the rate matching shall output no bits for all TrCHs within the CCTrCH and no uplink DPDCH will be selected in the case of uplink rate matching.

Notation used in subcaluse 4.2.7 and subclauses:

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

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

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

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

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

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

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

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

Used in downlink only.

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

Used in downlink only.

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

Used in downlink only.

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

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

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

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

I: Number of TrCHs in the CCTrCH.

Z_{ij}: Intermediate calculation variable.

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

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

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

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

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

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

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

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

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

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

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

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

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

b: Indicates systematic and parity bits

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

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

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

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

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

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

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

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

4.2.11 2nd interleaving

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

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

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

$U \leq R_2 C_2$.

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

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

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

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

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

Table 6 Inter-column permutation pattern for 2nd interleaving

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