TSG-RAN Meeting #11
Palm Springs, CA, U.S.A., 13-16 March 2001

RP-010063

Title: **Agreed CRs to TS 25.222**

Source: **TSG-RAN WG1**

Agenda item: **5.1.3**

No.	R1 T-doc	Spec	CR	Rev	Subject	Cat	V_old	V_new
1	R1-01-0019	25.222	051	1	Bit Scrambling for TDD	F	3.5.0	3.6.0
2	R1-01-0242	25.222	054	1	Corrections & Clarifications for TS25.222	F	3.5.0	3.6.0

CR-Form-v3

CHANGE REQUEST

⌘ **TS25.222** CR **051** ⌘ rev **1** ⌘ Current version: **3.5.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM ☐ ME/UE ☐ Radio Access Network ☐ Core Network ☐

Title: ⌘	Bit Scrambling for TDD	
Source: ⌘	TSG RAN WG1	
Work item code: ⌘		*Date:* ⌘ 10.1.01
Category: ⌘ **F**		*Release:* ⌘ R99

Use <u>one</u> of the following categories:
F (essential correction)
A (corresponds to a correction in an earlier release)
B (Addition of feature),
C (Functional modification of feature)
D (Editorial modification)
Detailed explanations of the above categories can
be found in 3GPP TR 21.900.

Use <u>one</u> of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
REL-4 (Release 4)
REL-5 (Release 5)

Reason for change: ⌘	In specific situations, when the transmitted data contain a lot of the same symbols the data bursts will contain a DC offset that leads to not acceptable degradations in the link level performance if it is discarded.
Summary of change: ⌘	Bit Scrambling is used to avoid possible DC offsets.
Consequences if not approved: ⌘	Not tolerable restrictions in implementation or not acceptable degradations in the link level performance.

Clauses affected: ⌘	4.2; 4.2.8 - 4.2.14; 4.3.2
Other specs affected: ⌘	**X** Other core specifications ⌘ CR221-037r1
	☐ Test specifications
	☐ O&M Specifications
Other comments: ⌘	

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://www.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2000-09 contains the specifications resulting from the September 2000 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.
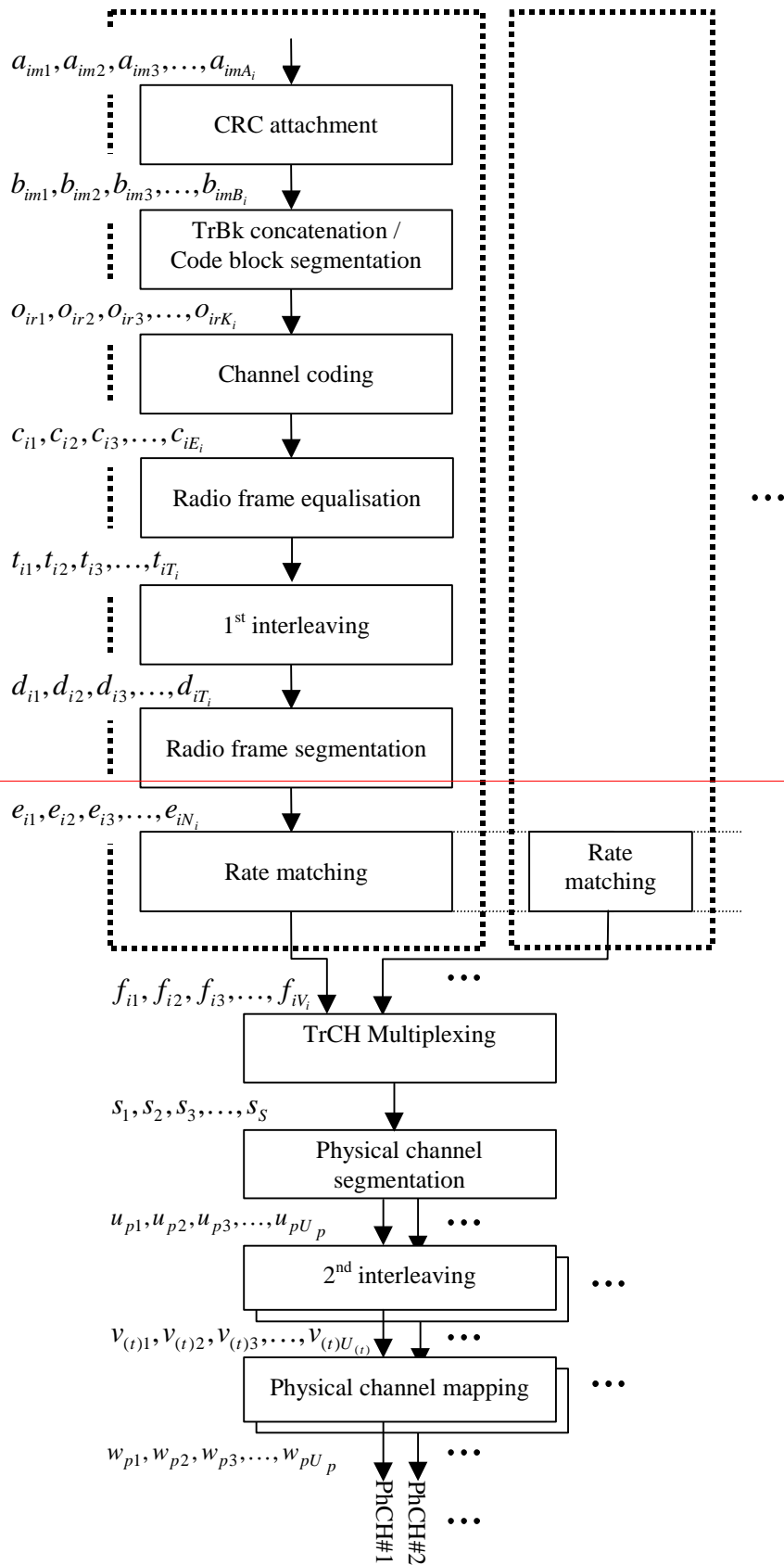
4.2   Transport channel coding/multiplexing

Figure 1 illustrates the overall concept of transport-channel coding and multiplexing. Data arrives to the coding/multiplexing unit in form of transport block sets, once every transmission time interval. The transmission time interval is transport-channel specific from the set {10 ms, 20 ms, 40 ms, 80 ms}.

The following coding/multiplexing steps can be identified:

-      add CRC to each transport block (see subclause 4.2.1);

-      TrBk concatenation / Code block segmentation (see subclause 4.2.2);

-      channel coding (see subclause 4.2.3) ;

-      radio frame size equalization (see subclause 4.2.4);

-      interleaving (two steps, see subclauses 4.2.5 and 4.2.10);

-      radio frame segmentation (see subclause 4.2.6);

-      rate matching (see subclause 4.2.7);

-      multiplexing of transport channels (see subclause 4.2.8);

-      bit scrambling (see subclause 4.2.9);

-      physical channel segmentation (see subclause 4.2.109);

-      mapping to physical channels (see subclause 4.2.1112).

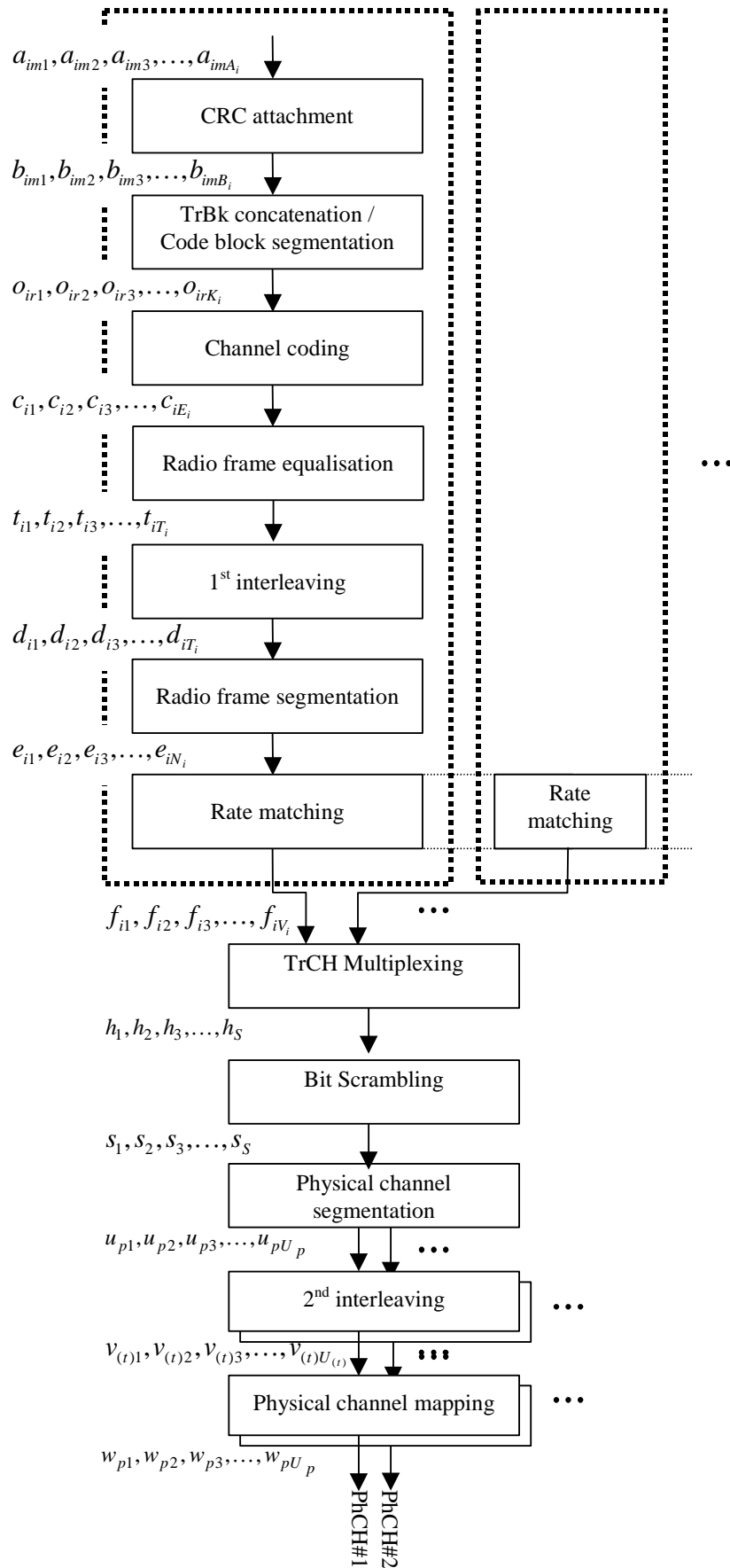The coding/multiplexing steps for uplink and downlink are shown in figure 1.

$$a_{im1}, a_{im2}, a_{im3}, \ldots, a_{imA_i}$$

CRC attachment

$$b_{im1}, b_{im2}, b_{im3}, \ldots, b_{imB_i}$$

TrBk concatenation / Code block segmentation

$$o_{ir1}, o_{ir2}, o_{ir3}, \ldots, o_{irK_i}$$

Channel coding

$$c_{i1}, c_{i2}, c_{i3}, \ldots, c_{iE_i}$$

Radio frame equalisation

$$t_{i1}, t_{i2}, t_{i3}, \ldots, t_{iT_i}$$

1st interleaving

$$d_{i1}, d_{i2}, d_{i3}, \ldots, d_{iT_i}$$

Radio frame segmentation

$$e_{i1}, e_{i2}, e_{i3}, \ldots, e_{iN_i}$$

Rate matching

Rate matching

$$f_{i1}, f_{i2}, f_{i3}, \ldots, f_{iV_i}$$

...

TrCH Multiplexing

$$s_1, s_2, s_3, \ldots, s_S$$

Physical channel segmentation

$$u_{p1}, u_{p2}, u_{p3}, \ldots, u_{pU_p}$$

...

2nd interleaving

...

$$v_{(t)1}, v_{(t)2}, v_{(t)3}, \ldots, v_{(t)U_{(t)}}$$

...

Physical channel mapping

...

$$w_{p1}, w_{p2}, w_{p3}, \ldots, w_{pU_p}$$

...

PhCH#1 PhCH#2

...

$a_{im1}, a_{im2}, a_{im3}, \ldots, a_{imA_i}$

CRC attachment

$b_{im1}, b_{im2}, b_{im3}, \ldots, b_{imB_i}$

TrBk concatenation /
Code block segmentation

$o_{ir1}, o_{ir2}, o_{ir3}, \ldots, o_{irK_i}$

Channel coding

$c_{i1}, c_{i2}, c_{i3}, \ldots, c_{iE_i}$

Radio frame equalisation

$t_{i1}, t_{i2}, t_{i3}, \ldots, t_{iT_i}$

1st interleaving

$d_{i1}, d_{i2}, d_{i3}, \ldots, d_{iT_i}$

Radio frame segmentation

$e_{i1}, e_{i2}, e_{i3}, \ldots, e_{iN_i}$

Rate matching

Rate matching

$\cdots$

$f_{i1}, f_{i2}, f_{i3}, \ldots, f_{iV_i}$

$\cdots$

TrCH Multiplexing

$h_1, h_2, h_3, \ldots, h_S$

Bit Scrambling

$s_1, s_2, s_3, \ldots, s_S$

Physical channel segmentation

$u_{p1}, u_{p2}, u_{p3}, \ldots, u_{pU_p}$ $\cdots$

2nd interleaving

$\cdots$

$v_{(t)1}, v_{(t)2}, v_{(t)3}, \ldots, v_{(t)U_{(t)}}$ $\cdots$

Physical channel mapping

$\cdots$

$w_{p1}, w_{p2}, w_{p3}, \ldots, w_{pU_p}$

PhCH#1

PhCH#2

Figure 1: Transport channel multiplexing structure for uplink and downlink

Primarily, transport channels are multiplexed as described above, i.e. into one data stream mapped on one or several physical channels. However, an alternative way of multiplexing services is to use multiple CCTrCHs (Coded Composite Transport Channels), which corresponds to having several parallel multiplexing chains as in figure 1, resulting in several data streams, each mapped to one or several physical channels.

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 $f_{i,1}, f_{i,2}, f_{i,3}, \ldots, f_{i,V_i}$, 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 $s_1, s_2, s_3, \ldots, s_S$ $h_1, h_2, h_3, \ldots, h_S$, where S is the number of bits, i.e. $S = \sum_i V_i$. The TrCH multiplexing is defined by the following relations:

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

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

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

…

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

$(V_1+V_2+\ldots+V_{I-1})+V_I$

4.2.9   Bit Scrambling

The bits output from the TrCH multiplexer are scrambled in the bit scrambler. The bits input to the bit scrambler are denoted by $h_1, h_2, h_3, \ldots, h_S$, where S is the number of bits input to the bit scrambling block equal to the total number of bits on the CCTrCH. The bits after bit scrambling are denoted $s_1, s_2, s_3, \ldots, s_S$.

Bit scrambling is defined by the following relation:

$s_k = h_k \oplus p_k$ $k = 1, 2 \ldots, S$

and p_k results from the following operation:

$$p_k = \left(\sum_{i=1}^{16} g_i \cdot p_{k-i} \right) \bmod 2 \; ; \; p_k = 0; k < 1 \; ; \; p_1 = 1 \; ; \; g = \{0,0,0,0,0,0,0,0,0,0,1,0,1,1,0,1\}$$

4.2.10~~9~~ Physical channel segmentation

When more than one PhCH is used, physical channel segmentation divides the bits among the different PhCHs. The bits input to the physical channel segmentation are denoted by $s_1, s_2, s_3, \ldots, s_S$, where S is the number of bits input to the physical channel segmentation block. The number of PhCHs is denoted by P.

The bits after physical channel segmentation are denoted $u_{p,1}, u_{p,2}, u_{p,3}, \ldots, u_{p,U_p}$, where p is PhCH number and U_p is the in general variable number of bits in the respective radio frame for each PhCH. The relation between s_k and $u_{p,k}$ is given below.

Bits on first PhCH after physical channel segmentation:

$u_{1,k} = s_k$ $k = 1, 2, \ldots, U_1$

Bits on second PhCH after physical channel segmentation:

$$u_{2,k} = s_{(k+U_1)} \qquad k = 1, 2, \ldots, U_2$$

…

Bits on the Pth PhCH after physical channel segmentation:

$$u_{P,k} = s_{(k+U_1+\ldots+U_{P-1})} \qquad k = 1, 2, \ldots, U_P$$

4.2.11̶0̶ 2nd interleaving

The 2nd interleaving is a block interleaver and consists of bits input to a matrix with padding, the inter-column permutation for the matrix and bits output from the matrix with pruning. The 2nd interleaving can be applied jointly to all data bits transmitted during one frame, or separately within each timeslot, on which the CCTrCH is mapped. The selection of the 2nd interleaving scheme is controlled by higher layer.

4.2.11̶0̶.1   Frame related 2nd interleaving

In case of frame related 2nd interleaving, the bits input to the block interleaver are denoted by $x_1, x_2, x_3, \ldots, x_U$, where U is the total number of bits after TrCH multiplexing transmitted during the respective radio frame with $S = U = \sum_p U_p$.

The relation between x_k and the bits $u_{p,k}$ in the respective physical channels is given below:

$$x_k = u_{1,k} \qquad k = 1, 2, \ldots, U_1$$

$$x_{(k+U_1)} = u_{2,k} \qquad k = 1, 2, \ldots, U_2$$

…

$$x_{(k+U_1+\ldots+U_{P-1})} = u_{P,k} \qquad k = 1, 2, \ldots, U_P$$

The following steps have to be performed once for each CCTrCH:

(1) Assign C2 = 30 to be the number of columns of the matrix. The columns of the matrix are numbered 0, 1, 2, …, C2 - 1 from left to right.

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

$U \leq$ R2 $\times$ C2.

The rows of rectangular matrix are numbered 0, 1, 2, …, R2 - 1 from top to bottom.

(3) Write the input bit sequence $x_1, x_2, x_3, \ldots, x_U$ into the R2 $\times$ C2 matrix row by row starting with bit y_1 in column 0 of row 0:

$$\begin{bmatrix} y_1 & y_2 & y_3 & \cdots & y_{C2} \\ y_{(C2+1)} & y_{(C2+2)} & y_{(C2+3)} & \cdots & y_{(2\times C2)} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ y_{((R2-1)\times C2+1)} & y_{((R2-1)\times C2+2)} & y_{((R2-1)\times C2+3)} & \cdots & y_{(R2\times C2)} \end{bmatrix}$$

where $y_k = x_k$ for k = 1, 2, …, U and if R2 $\times$ C2 > U, the dummy bits are padded such that y_k = 0 or 1 for k = U + 1, U + 2, …, R2 $\times$ C2. These dummy bits are pruned away from the output of the matrix after the inter-column permutation.

(4) Perform the inter-column permutation for the matrix based on the pattern $\langle P2(j)\rangle_{j\in\{0,1,\ldots,C2-1\}}$ that is shown in table 7, 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'_k.

$$
\begin{bmatrix}
y'_1 & y'_{(R2+1)} & y'_{(2\times R2+1)} & \cdots & y'_{((C2-1)\times R2+1)} \\
y'_2 & y'_{(R2+2)} & y'_{(2\times R2+2)} & \cdots & y'_{((C2-1)\times R2+2)} \\
\vdots & \vdots & \vdots & \cdots & \vdots \\
y'_{R2} & y'_{(2\times R2)} & y'_{(3\times R2)} & \cdots & y'_{(C2\times R2)}
\end{bmatrix}
$$

(5) The output of the block interleaver is the bit sequence read out column by column from the inter-column permuted R2 × C2 matrix. The output is pruned by deleting dummy bits that were padded to the input of the matrix before the inter-column permutation, i.e. bits y'_k that corresponds to bits y_k with $k > U$ are removed from the output. The bits after frame related 2nd interleaving are denoted by $v_1, v_2, \ldots, v_U$, where v_1 corresponds to the bit y'_k with smallest index k after pruning, v_2 to the bit y'_k with second smallest index k after pruning, and so on.

4.2.11.2   Timeslot related 2nd interleaving

In case of timeslot related 2nd interleaving, the bits input to the block interleaver are denoted by $x_{t,1}, x_{t,2}, x_{t,3}, \ldots, x_{t,U_t}$, where t refers to a certain timeslot, and U_t is the number of bits transmitted in this timeslot during the respective radio frame.

In each timeslot t the relation between $x_{t,k}$ and $u_{t,p,k}$ is given below with P_t refering to the number of physical channels within the respective timeslot:

$$x_{t,k} = u_{t,1,k} \quad k = 1, 2, \ldots, U_{t1}$$

$$x_{t,(k+U_{t1})} = u_{t,2,k} \quad\quad k = 1, 2, \ldots, U_{t2}$$

$$\ldots$$

$$x_{t,(k+U_{t1}+\ldots+U_{t(P_t-1)})} = u_{t,P_t,k} \quad\quad k = 1, 2, \ldots, U_{tP_t}$$

The following steps have to be performed for each timeslot t, on which the respective CCTrCH is mapped:

(1) Assign C2 = 30 to be the number of columns of the matrix. The columns of the matrix are numbered 0, 1, 2, …, C2 - 1 from left to right.

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

$$U_t \leq R2 \times C2.$$

The rows of rectangular matrix are numbered 0, 1, 2, …, R2 - 1 from top to bottom.

(3) Write the input bit sequence $x_{t,1}, x_{t,2}, x_{t,3}, \ldots, x_{t,U_t}$ into the R2 × C2 matrix row by row starting with bit $y_{t,1}$ in column 0 of row 0:

$$
\begin{bmatrix}
y_{t,1} & y_{t,2} & y_{t,3} & \cdots & y_{t,C2} \\
y_{t,(C2+1)} & y_{t,(C2+2)} & y_{t,(C2+3)} & \cdots & y_{t,(2\times C2)} \\
\vdots & \vdots & \vdots & \cdots & \vdots \\
y_{t,((R2-1)\times C2+1)} & y_{t,((R2-1)\times C2+2)} & y_{t,((R2-1)\times C2+3)} & \cdots & y_{t,(R2\times C2)}
\end{bmatrix}
$$

where $y_{t,k} = x_{t,k}$ for $k = 1, 2, \ldots, U_t$ and if $R2 \times C2 > U_t$, the dummy bits are padded such that $y_{t,k} = 0$ or 1 for $k = U_t + 1, U_t + 2, \ldots, R2 \times C2$. These dummy bits are pruned away from the output of the matrix after the inter-column permutation.

(4) Perform the inter-column permutation for the matrix based on the pattern $\langle P2(j) \rangle_{j \in \{0,1,\ldots,C2-1\}}$ that is shown in table 7, where P2(j) is the original column position of the j-th permuted column. After permutation of the columns, the bits are denoted by $y'_{t,k}$.

$$\begin{bmatrix} y'_{t,1} & y'_{t,(R2+1)} & y'_{t,(2\times R2+1)} & \cdots & y'_{t,((C2-1)\times R2+1)} \\ y'_{t,2} & y'_{t,(R2+2)} & y'_{t,(2\times R2+2)} & \cdots & y'_{t,((C2-1)\times R2+2)} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ y'_{t,R2} & y'_{t,(2\times R2)} & y'_{t,(3\times R2)} & \cdots & y'_{t,(C2\times R2)} \end{bmatrix}$$

(5) The output of the block interleaver is the bit sequence read out column by column from the inter-column permuted R2 × C2 matrix. The output is pruned by deleting dummy bits that were padded to the input of the matrix before the inter-column permutation, i.e. bits $y'_{t,k}$ that corresponds to bits $y_{t,k}$ with $k > U_t$ are removed from the output. The bits after time slot 2nd interleaving are denoted by $v_{t,1}, v_{t,2}, \ldots, v_{t,U_t}$, where $v_{t,1}$ corresponds to the bit $y'_{t,k}$ with smallest index k after pruning, $v_{t,2}$ to the bit $y'_{t,k}$ with second smallest index k after pruning, and so on.

Table 7 Inter-column permutation pattern for 2nd interleaving

Number of Columns C2	Inter-column permutation pattern < P2(0), P2(1), …, P2(C2-1) >
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>

4.2.12~~1~~ Physical channel mapping

The PhCH for both uplink and downlink is defined in [6]. The bits after physical channel mapping are denoted by $w_{p,1}, w_{p,2}, \ldots, w_{p,U_p}$, where p is the PhCH number and U_p is the number of bits in one radio frame for the respective PhCH. The bits $w_{p,k}$ are mapped to the PhCHs so that the bits for each PhCH are transmitted over the air in ascending order with respect to k.

The mapping of the bits $v_{(t),1}, v_{(t),2}, \ldots, v_{(t),U_{(t)}}$ is performed like block interleaving, writing the bits into columns, but a PhCH with an odd number is filled in forward order, were as a PhCH with an even number is filled in reverse order.

The mapping scheme, as described in the following subclause, shall be applied individually for each timeslot t used in the current frame. Therefore, the bits $v_{t,1}, v_{t,2}, \ldots, v_{t,U_t}$ are assigned to the bits of the physical channels $w_{t,1,1\ldots U_{t1}}, w_{t,2,1\ldots U_{t2}}, \ldots, w_{t,P_t,1\ldots U_{tP_t}}$ in each timeslot.

In uplink there are at most two codes allocated ($P \leq 2$). If there is only one code, the same mapping as for downlink is applied. Denote SF1 and SF2 the spreading factors used for code 1 and 2, respectively. For the number of consecutive bits to assign per code bs_k the following rule is applied:

if

SF1 >= SF2 then $bs_1 = 1$; $bs_2 = $ SF1/SF2 ;

else

SF2 > SF1 then $bs_1 = $ SF2/SF1; $bs_2 = 1$;

end if

In the downlink case bs_p is 1 for all physical channels.

4.2.~~11~~12.1   Mapping scheme

Notation used in this subclause:

P_t: number of physical channels for timeslot t , $P_t = 1..2$ for uplink ; $P_t = 1...16$ for downlink

$U_{t,p}$:   capacity in bits for the physical channel p in timeslot t

U_t: total number of bits to be assigned for timeslot t

bs_p: number of consecutive bits to assign per code

       for downlink all $bs_p = 1$

       for uplink   if SF1 >= SF2 then $bs_1 = 1$; $bs_2 = $ SF1/SF2 ;

                 if SF2 > SF1 then $bs_1 = $ SF2/SF1; $bs_2 = 1$;

fb_p: number of already written bits for each code

pos: intermediate calculation variable

for p=1 to P_t -- reset number of already written bits for every physical channel

     $fb_p = 0$

end for

p = 1   -- start with PhCH #1

for k=1 to U_t

     do while ($fb_p == U_{t,p}$)   -- physical channel filled up already ?

         $p = (p \bmod P_t) + 1$;

     end do

     if (p mod 2) == 0

         $pos = U_{t,p} - fb_p$ -- reverse order

     else

         $pos = fb_p + 1$ -- forward order

     endif

     $w_{t,p,pos} = v_{t,k}$ -- assignment

     $fb_p = fb_p + 1$ -- Increment number of already written bits

     if ($fb_p \bmod bs_p$) == 0   -- Conditional change to the next physical channel

         $p = (p \bmod P_t) + 1$;

     end if

end for

4.2.~~12~~13 Multiplexing of different transport channels onto one CCTrCH, and mapping of one CCTrCH onto physical channels

Different transport channels can be encoded and multiplexed together into one Coded Composite Transport Channel (CCTrCH). The following rules shall apply to the different transport channels which are part of the same CCTrCH:

1) Transport channels multiplexed into one CCTrCh shall have co-ordinated timings. When the TFCS of a CCTrCH is changed because one or more transport channels are added to the CCTrCH or reconfigured within the CCTrCH, or removed from the CCTrCH, the change may only be made at the start of a radio frame with CFN fulfilling the relation

CFN mod F_{max} = 0,

where F_{max} denotes the maximum number of radio frames within the transmission time intervals of all transport channels which are multiplexed into the same CCTrCH, including any transport channels i which are added reconfigured or have been removed, and CFN denotes the connection frame number of the first radio frame of the changed CCTrCH.

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

CFN_i mod F_i = 0.

2) Different CCTrCHs cannot be mapped onto the same physical channel.

3) One CCTrCH shall be mapped onto one or several physical channels.

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

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

6) Each CCTrCH carrying a BCH shall carry only one BCH and shall not carry any other Transport Channel.

7) Each CCTrCH carrying a RACH shall carry only one RACH and shall not carry any other Transport Channel.

Hence, there are two types of CCTrCH.

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

CCTrCH of common type, corresponding to the result of the coding and multiplexing of a common channel, i.e. RACH and USCH in the uplink and DSCH, BCH, FACH or PCH in the downlink, respectively.

Transmission of TFCI is possible for CCTrCH containing Transport Channels of:

- dedicated type;

- USCH type;

- DSCH type;

- FACH and/or PCH type.

4.2.~~12~~13.1   Allowed CCTrCH combinations for one UE

4.2.~~12~~13.1.1   Allowed CCTrCH combinations on the uplink

The following CCTrCH combinations for one UE are allowed, also simultaneously:

1) several CCTrCH of dedicated type;

2) several CCTrCH of common type.

4.2.~~12~~13.1.2   Allowed CCTrCH combinations on the downlink

The following CCTrCH combinations for one UE are allowed, also simultaneously:

3) several CCTrCH of dedicated type;

4) several CCTrCH of common type.

4.2.~~13~~14 Transport format detection

Transport format detection can be performed both with and without Transport Format Combination Indicator (TFCI). If a TFCI is transmitted, the receiver detects the transport format combination from the TFCI. When no TFCI is transmitted, so called blind transport format detection may be used, i.e. the receiver side uses the possible transport format combinations as a priori information.

4.2.~~13~~14.1 Blind transport format detection

Blind Transport Format Detection is optional both in the UE and the UTRAN. Therefore, for all CCTrCH a TFCI shall be transmitted, including the possibilty of a TFCI length zero, if only one TFC is defined.

4.2.~~13~~14.2 Explicit transport format detection based on TFCI

4.2.~~13~~14.2.1 Transport Format Combination Indicator (TFCI)

The Transport Format Combination Indicator (TFCI) informs the receiver of the transport format combination of the CCTrCHs. As soon as the TFCI is detected, the transport format combination, and hence the individual transport channels' transport formats are known, and decoding of the transport channels can be performed.

4.3.2 Coding and Bit Scrambling of the Paging Indicator

The paging indicator P_q, $q = 0, ..., N_{PI}-1$, $P_q \in \{0, 1\}$ is an identifier to instruct the UE whether there is a paging message for the groups of mobiles that are associated to the PI, calculated by higher layers, and the associated paging indicator P_q. The length L_{PI} of the paging indicator is $L_{PI}=2$, $L_{PI}=4$ or $L_{PI}=8$ symbols. $N_{PIB} = 2*N_{PI}*L_{PI}$ bits are used for the paging indicator transmission in one radio frame. The mapping ~~coding~~ of the paging indicators to the bits e_i, $i = 1, ..., N_{PIB}$ is shown in table 10.

Table 10: Mapping ~~Coding~~ of the paging indicator

~~Bits~~	~~Paging Indicator~~	~~Content~~
~~All '0'~~	~~Not set, P_q='0'~~	~~There is no necessity to receive PCH~~
~~All '1'~~	~~Set, P_q='1'~~	~~There is necessity to receive PCH~~

P_q	Bits $\{e_{2Lpi*q+1}, e_{2Lpi*q+2}, ... , e_{2Lpi*(q+1)}\}$	Meaning
0	{0, 0, ..., 0}	There is no necessity to receive the PCH
1	{1, 1, ..., 1}	There is the necessity to receive the PCH

If the number S of bits in one radio frame available for the PICH is bigger than the number N_{PIB} of bits used for the transmission of paging indicators, the sequence $e = \{e_1, e_2, ..., e_{NPIB}\}$ is extended by $S-N_{PIB}$ bits that are set to zero, resulting in a sequence $h = \{h_1, h_2, ..., h_S\}$:

$$h_k = e_k, \quad k = 1, ..., N_{PIB}$$
$$h_k = 0, \quad k = N_{PIB}, ..., S$$

The bits h_k, $k = 1, ..., S$ on the PICH then undergo bit scrambling as defined in section 4.2.9.

The bits s_k, $k = 1, ..., S$ output from the bit scrambler are then transmitted over the air as shown in [7].

CR-Form-v3

CHANGE REQUEST

| ⌘ | **TS25.222** | **CR** | **054** | ⌘ | rev | **1** | ⌘ | Current version: | **3.5.0** | ⌘ |

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM ☐ ME/UE **X** Radio Access Network **X** Core Network ☐

Title:	⌘	Corrections & Clarifications for TS25.222
Source:	⌘	TSG RAN WG1
Work item code:	⌘	**Date:** ⌘ 22.2.2001
Category:	⌘ **F**	**Release:** ⌘ R99

Use *one* of the following categories:
F *(essential correction)*
A *(corresponds to a correction in an earlier release)*
B *(Addition of feature),*
C *(Functional modification of feature)*
D *(Editorial modification)*
Detailed explanations of the above categories can
be found in 3GPP TR 21.900.

Use *one* of the following releases:
2   (GSM Phase 2)
R96   (Release 1996)
R97   (Release 1997)
R98   (Release 1998)
R99   (Release 1999)
REL-4   (Release 4)
REL-5   (Release 5)

Reason for change:	⌘	Some information on SF selection in the RM section is missing and following recent discussions the TPC coding section should be moved from TS25.222 to TS25.221 to be in line with the corresponding FDD specifications.
Summary of change:	⌘	• Clarifies that SF selection in DL is fixed (1 or 16) • Clarifies the order of physical channel numbers in 4.2.11 • Removes TPC coding section to TS25.221
Consequences if not approved:	⌘	Inconsistent description & specifications

Clauses affected:	⌘	2; 4.2.7.1; 4.2.11; 4.3.3

Other specs affected:	⌘	**X**	Other core specifications	⌘	CR221-041
		☐	Test specifications		
		☐	O&M Specifications		

Other comments:	⌘	

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://www.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2000-09 contains the specifications resulting from the September 2000 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

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 TS 25.202: "UE capabilities".

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

[3]　　　　　3GPP TS 25.212: "Multiplexing and channel coding (FDD)".

[4]　　　　　3GPP TS 25.213: "Spreading and modulation (FDD)".

[5]　　　　　3GPP TS 25.214: "Physical layer procedures (FDD)".

[6]　　　　　3GPP TS 25.215: "Physical layer – Measurements (FDD)".

[7]　　　　　3GPP TS 25.221: "Transport channels and physical channels (TDD)".

[9]　　　　　3GPP TS 25.223: "Spreading and modulation (TDD)".

[10]　　　　3GPP TS 25.224: "Physical layer procedures (TDD)".

[11]　　　　3GPP TS 25.225: "Measurements".

[12]　　　　~~3GPP TS S2.01: "Radio Interface Protocol Architecture"~~3GPP TS25.331: "RRC Protocol Specification".

4.2.7.1 Determination of rate matching parameters

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

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

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

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

Puncturing can be used to minimise the required transmission capacity. The maximum amount of puncturing that can be applied is 1-Pl, PL is signalled from higher layers. The possible values for N_{data} depend on the number of physical channels P_{max}, allocated to the respective CCTrCH, and on their characteristics (spreading factor, length of midamble and TFCI, usage of TPC and multiframe structure), which is given in [7].

Denote the number of data bits in each physical channel by $U_{p,Sp}$, where p refers to the sequence number $1 \le p \le P_{max}$ of this physical channel as detailed in section 4.2.11 ~~in the allocation message~~, and the second index Sp indicates the spreading factor with the possible values {$16, 8, 4, 2, 1$}, respectively. For each physical channel an individual minimum spreading factor Sp_{min} is transmitted by means of the higher layers. ~~There are two options to determine the number N_{data} from the number of possible physical channels and the minimum spreading factor. The option is signalled by means of the higher layers.~~

~~If the UE shall increase the spreading factor autonomously~~ Then, for N_{data} one of the following values in ascending order can be chosen:

$$\left\{ U_{1,16}, ..., U_{1,S1_{min}}, U_{1,S1_{min}} + U_{2,16}, ..., U_{1,S1_{min}} + U_{2,S2_{min}}, ..., U_{1,S1_{min}} + U_{2,S2_{min}} + ... + U_{P_{max},16}, ..., U_{1,S1_{min}} + U_{2,S2_{min}} + ... + U_{P_{max},(SP_{max})_{min}} \right\}$$

$$\left\{ U_{1,S1_{min}}, U_{1,S1_{min}} + U_{2,S2_{min}}, U_{1,S1_{min}} + U_{2,S2_{min}} + ... + U_{P_{max},(SP_{max})_{min}} \right\}$$

Optionally, if indicated by higher layers for the UL ~~If~~ the UE shall vary ~~only use~~ the ~~minimum~~ spreading factor autonomously, so that ~~for~~ N_{data} is one of the following values in ascending order ~~can be chosen~~:

$$\left\{ U_{1,S1_{min}}, U_{1,S1_{min}} + U_{2,S2_{min}}, U_{1,S1_{min}} + U_{2,S2_{min}} + ... + U_{P_{max},(SP_{max})_{min}} \right\}$$

$$\left\{ U_{1,16}, ..., U_{1,S1_{min}}, U_{1,S1_{min}} + U_{2,16}, ..., U_{1,S1_{min}} + U_{2,S2_{min}}, ..., U_{1,S1_{min}} + U_{2,S2_{min}} + ... + U_{P_{max},16}, ..., U_{1,S1_{min}} + U_{2,S2_{min}} + ... + U_{P_{max},(SP_{max})_{min}} \right\}$$

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

$$\text{SET1} = \left\{ N_{data} \text{ such that } \left(\min_{1 \le y \le I} \{ RM_y \} \right) \times N_{data} - PL \times \sum_{x=1}^{I} RM_x \times N_{x,j} \text{ is non negative } \right\}$$

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

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

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

Otherwise, the rate matching pattern is calculated with the algorithm described in subclause 4.2.7.3. For this algorithm the parameters e_{ini}, e_{plus}, e_{minus}, and X_i are needed, which are calculated according to the equations in subclauses 4.2.7.1.1 and 4.2.7.1.2.

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 $f_{i,1}, f_{i,2}, f_{i,3}, \ldots, f_{i,V_i}$, where i is the TrCH id 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:

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

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

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

…

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

4.2.11 Physical channel mapping

The PhCH for both uplink and downlink is defined in [6]. The bits after physical channel mapping are denoted by $w_{p,1}, w_{p,2}, \ldots, w_{p,U_p}$, where p is the PhCH number corresponding to the sequence number $1 \leq p \leq P_{max}$ of this physical channel as detailed below, and U_p is the number of bits in one radio frame for the respective PhCH. The bits $w_{p,k}$ are mapped to the PhCHs so that the bits for each PhCH are transmitted over the air in ascending order with respect to k.

The physical channel sequence number p are to be allocated by the physical layer in ascending order of the timeslots in which they appear. If more than one physical channel appears in a timeslot, they shall be allocated the sequence number in order of the timeslot first and then of their channelisation codes. The channelisation codes shall be ordered in ascending order of the spreading Factor (Q) and then channelisation index (k), as shown in [9].

The mapping of the bits $v_{(t),1}, v_{(t),2}, \ldots, v_{(t),U_{(t)}}$ is performed like block interleaving, writing the bits into columns, but a PhCH with an odd number is filled in forward order, were as a PhCH with an even number is filled in reverse order.

The mapping scheme, as described in the following subclause, shall be applied individually for each timeslot t used in the current frame. Therefore, the bits $v_{t,1}, v_{t,2}, \ldots, v_{t,U_t}$ are assigned to the bits of the physical channels $w_{t,1,1\ldots U_{t1}}, w_{t,2,1\ldots U_{t2}}, \ldots, w_{t,P_t,1\ldots U_{tP_t}}$ in each timeslot.

In uplink there are at most two codes allocated (P≤2). If there is only one code, the same mapping as for downlink is applied. Denote SF1 and SF2 the spreading factors used for code 1 and 2, respectively. For the number of consecutive bits to assign per code bs_k the following rule is applied:

if

    SF1 >= SF2 then $bs_1 = 1$; $bs_2 = $ SF1/SF2 ;

else

    SF2 > SF1 then $bs_1 = $ SF2/SF1; $bs_2 = 1$;

end if

In the downlink case bs_p is 1 for all physical channels.

4.3.3 Coding of Transmit Power Control (TPC)

The TPC command is an identifier sent in uplink transmission only, to instruct the NodeB whether Tx power has to be increased or decreased. The length of the TPC command is one symbol. The coding of the TPC command is shown in table 11.

Table 11: Coding of the TPC

TPC	TPC Bits	Meaning
'Down'	00	Decrease Tx Power
'Up'	11	Increase Tx Power