TSG-RAN Working Group1 meeting #6 *TSGR1#6(99)892*
Espoo, Finland, 13-16, July 1999

Agenda Item:
Source: SAMSUNG Electronics Co.
Title: Detailed descriptions of Radio frame segmentation to 2nd interleaver (Text proposal)
Document for: Decision

1 Introduction

For both downlink and uplink, there are still missing details in [1] on how to deliver bit-streams from radio frame segmentation block to 2nd interleavers. This paper details them both with Figures and bit-wise input-output descriptions for each functional block and proposes texts for the corresponding subsections in [1].

2 Text proposal

4.2.5 Radio frame segmentation

~~<Editor's note: Exact specification is FFS. >~~

Each transport channel with transmission time interval 10, 20, 40, or 80 msec is segmented into 10 msec equi-sized data blocks. Those segmented 1, 2, 4, or 8 blocks, depending on transmission time interval, are output to rate matching for uplink and 2nd multiplexing for downlink in block-wise order at every 10 msec.

Figure A-3 and A-4 illustrate data flow from 1st interleaver down to 2nd interleaver in both uplink and downlink channel coding and multiplexing chains. In the figures, it is assumed that there are N different channel coding and multiplexing chains. The following subsections describe input-output relationship of radio frame segmentation in bit-wise manner, referring to the notations in Figure A-3 and A-4, where the notations in each data block, for examples L_1, R_1, K_1, P/M, etc., indicate number of bits of the data block.

Define some notations:
L_i = Size of i^{th} transport channel data in bits to radio frame segmentation
T_i = Transmission Time Interval of i^{th} channel coding and multiplexing chain (msec) / 10 (msec)
So, T_i Î $\{1, 2, 4, 8\}$ for $i = 0, 1, 2, \ldots, N$

4.2.5.1 Radio frame size equalization

i^{th} transport channel data of size L_i is segmented into radio frames of size L_i/T_i. Since the size of radio frame, L_i/T_i is not necessarily an integer, some of T_i the radio frames will contain one bit less than others. For systematic process of the proceeding functional blocks, the radio frame sizes are equalized to be one finite size by considering the number of proper filler bits. Note that maximum possible filler bits are 7 for transmission time interval of 80 msec. These filler bits are evenly distributed over the one-bit short radio frames. Following is the algorithm of radio frame size equalization.

t = radio frame index $(1, 2, 3, \ldots, T_i)$ for a given i^{th} channel coding and multiplexing chain
$r_i = T_i - (L_i \bmod T_i)$ Î $\{0, 1, 2, \ldots, T_i-1\}$ // number of filler bits

$(L_i + r_i)/ T_i = R_i$ // *Target radio frame size for uplink*
$(L_i + r_i)/ T_i = K_i$ // *Target radio frame size for downlink*

If r_i *¹ 0 then*
For each t (³ T_i*-*r_i*+1)*
Add one filler bit to the end of t^{th} *radio frame*
End
End If

4.2.5.2 Radio frame segmentation rule

Parameter r_i for segmentation are determined in radio frame size equalization.

The bits before radio frame segmentation for i^{th} channel coding and multiplexing chain are denoted by:
$b_{i1}, b_{i2}, \ldots\ b_{iL_i}$

Bits after radio frame segmentation block are 10 msec-based and denoted by:
$c_{i1}, \ldots\ c_{i,(L_i+r_i)/T_i}$
and related to the input bits to radio frame segmentation as follows.

Bits after radio frame segmentation in the first 10 msec time interval: *(t=1)*
$c_{ij} = b_{ij}$ $j=1,2,\ldots, (L_i+r_i)/T_i$
$((L_i+ r_i)/T_i$ equals to R_i and K_i for uplink and downlink, respectively.)
Bits after radio frame segmentation in the second 10 msec time interval: *(t=2)*
$c_{ij} = b_{i,(j+(L_i+r_i)/T_i)}$ $j=1,2, \ldots, (L_i+r_i)/T_i$
…

Bits after radio frame segmentation in the $(T_i - r_i)^{th}$ 10 msec time interval: $(t=T_i - r_i)$
$c_{ij} = b_{i,(j+(T_i-r_i-1)\ (L_i+r_i)/T_i)}$ $j=1,2, \ldots, (L_i+r_i)/T_i$

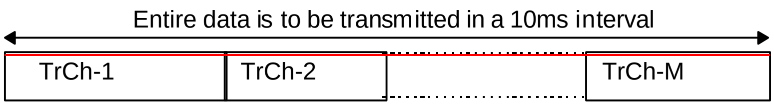
Bits after radio frame segmentation in the $(T_i - r_i + 1)^{th}$ 10 msec time interval: $(t=T_i - r_i + 1)$
$c_{ij} = b_{i,(j+(T_i-r_i)\ (L_i+r_i)/T_i)}$ $j=1,2, \ldots, (L_i+r_i)/T_i-1$
c_{ij} = *filler_bit(0/1)* $j= (L_i+r_i)/T_i$ *(filler bit)*
…

Bits after radio frame segmentation in the T_i^{th} 10 msec time interval: $(t=T_i)$
$c_{ij} = b_{i,(j+(T_i-1)\ (L_i+r_i)/T_i)}$ $j=1,2, \ldots, (L_i+r_i)/T_i-1$
c_{ij} = *filler_bit(0/1)* $j=(L_i+r_i)/T_i$ *(filler bit)*

4.2.8 2nd Multiplexing

~~*<Editor's note: This section needs to be updated since it does not take into account that transport channels may have been multiplexed before coding.>*~~

~~The coded transport channels are serially multiplexed within one radio frame. The output after the multiplexer (before physical channel segmentation) will thus be according to Figure 4-1.~~



~~*Figure 4-1. Transport channel multiplexing.*~~

For both uplink and downlink, radio frames in each channel coding and multiplexing chains are serially multiplexed into a 10 msec coded composite transport channel.

Figure A-3 and A-4 illustrate data flow from 1st interleaver down to 2nd interleaver in both uplink and downlink channel coding and multiplexing chains. In the figures, it is assumed that there are N different channel coding and multiplexing chains. Following subsection describes the input-output relationship of 2nd multiplexing in bit-wise manner, referring to the notations in Figure A-3 and A-4, where the notation in each data block, for examples L_1, R_1, K_1, P/M, etc., indicate number of bits of the data block.

4.2.8.1 Second multiplexing in uplink

The bits before second multiplexing in uplink are described as follows:

Bits from rate matching 1: $c_{11}, c_{12}, \ldots c_{1K_1}$

Bits from rate matching 2: $c_{21}, c_{22}, \ldots c_{2K_2}$

Bits from rate matching 3: $c_{31}, c_{32}, \ldots c_{3K_3}$

...

Bits from rate matching N: $c_{N1}, c_{N2}, \ldots c_{NK_N}$

The bits after second multiplexing are denoted by $d_1, d_2, \ldots, d_P$ and defined by the following relationships:

For $j=1,2,3 \ldots,P$ where $P=K_1+K_2+ \ldots +K_N$

$d_j = c_{1j}$ $\quad j=1,2, \ldots K_1$

$d_j = c_{2,(j-K_1)}$ $\quad j= K_1+1, K_1+2, \ldots, K_1+K_2$

$d_j = c_{3,(j-(K_1+K_2))}$ $\quad j=(K_1+K_2)+1, (K_1+K_2)+2, \ldots, (K_1+K_2)+ K_3$

...

$d_j = c_{N,(j-(K_1+K_2+\ldots+K_{N-1}))}$ $\quad j=(K_1+K_2+\ldots+ K_{N-1})+1, (K_1+K_2+\ldots+ K_{N-1})+2, \ldots, (K_1+K_2+\ldots+ K_{N-1})+K_N$

4.2.8.2 Second multiplexing in downlink

The bits before second multiplexing in downlink are described as follows:

Bits from radio frame segmentation 1: $c_{11}, c_{12}, \ldots c_{1K_1}$

Bits from radio frame segmentation 2: $c_{21}, c_{22}, \ldots c_{2K_2}$

Bits from radio frame segmentation 3: $c_{31}, c_{32}, \ldots c_{3K_3}$

...

Bits from radio frame segmentation N: $c_{N1}, c_{N2}, \ldots c_{NK_N}$

The bits after second multiplexing are denoted by $d_1, d_2, \ldots, d_P$
and defined by the following relationship:

For $j=1,2,3 \ldots,P$ where $P=K_1+K_2+ \ldots +K_N$

$d_j = c_{1j}$ $\quad j=1,2,\ldots K_1$
$d_j = c_{2,(j-K_1)}$ $\quad j= K_1+1, K_1+2, \ldots, K_1+K_2$
$d_j = c_{3,(j-(K_1+K_2))}$ $\quad j=(K_1+K_2)+1, (K_1+K_2)+2, \ldots, (K_1+K_2)+ K_3$
…
$d_j = c_{N,(j-(K_1+K_2+\ldots+K_{N-1}))}$ $\quad j=(K_1+K_2+\ldots+ K_{N-1})+1, (K_1+K_2+\ldots+ K_{N-1})+2, \ldots, (K_1+K_2+\ldots+ K_{N-1})+K_N$

4.2.9 Physical channel segmentation

<Editor's note: for physical channel segmentation, it is assumed that the segmented physical channels use the same SF>

Data after multiplexing of transport channels with different QoS can get segmented into multiple physical channels, which are transmitted in parallel during 10ms interval.

Figure A-3 and A-4 illustrate data flow from 1st interleaver down to 2nd interleaver in both uplink and downlink channel coding and multiplexing chains. In the figures, it is assumed that there are N different channel coding and multiplexing chains, and M physical channels. The following subsection describes input-output relationship of physical channel segmentation in bit-wise manner, referring to the notations in Figure A-3 and A-4, where the notation in each data block, for examples L_1, R_1, K_1, P/M, etc., indicate number of bits of the data block.

The bits before physical channel segmentation are described as follows:
Bits from second multiplexing: $d_1, d_2, \ldots , d_P$

M is the number of physical channel

The bits after physical channel segmentation are defined by the following relationship:

The first physical channel bits after physical channel segmentation:
$e_{1j} = d_j$ $\quad j=1,2,\ldots,P/M$

The second physical channel bits after physical channel segmentation:
$e_{2j} = d_{(j+P/M)}$ $\quad j=1,2, \ldots, P/M$
…

The M^{th} physical channel bits after physical channel segmentation:
$e_{Mj} = d_{(j+(M-1)P/M)}$ $\quad j=1,2, \ldots, P/M$

A.3 Data Flow from Radio Frame Segmentation to Physical Channel Segmentation

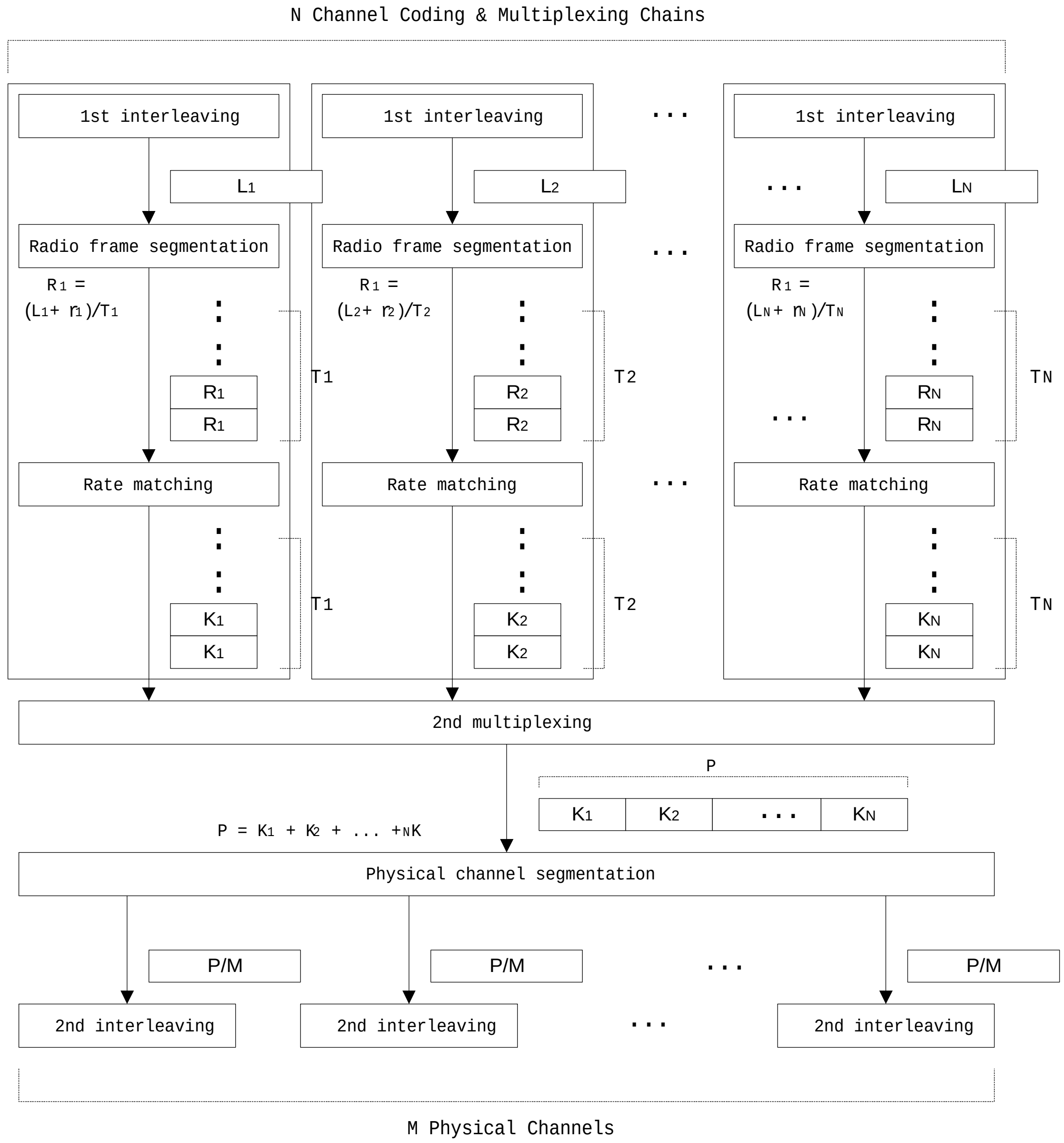


Figure A-3 Part of uplink channel coding and multiplexing chains

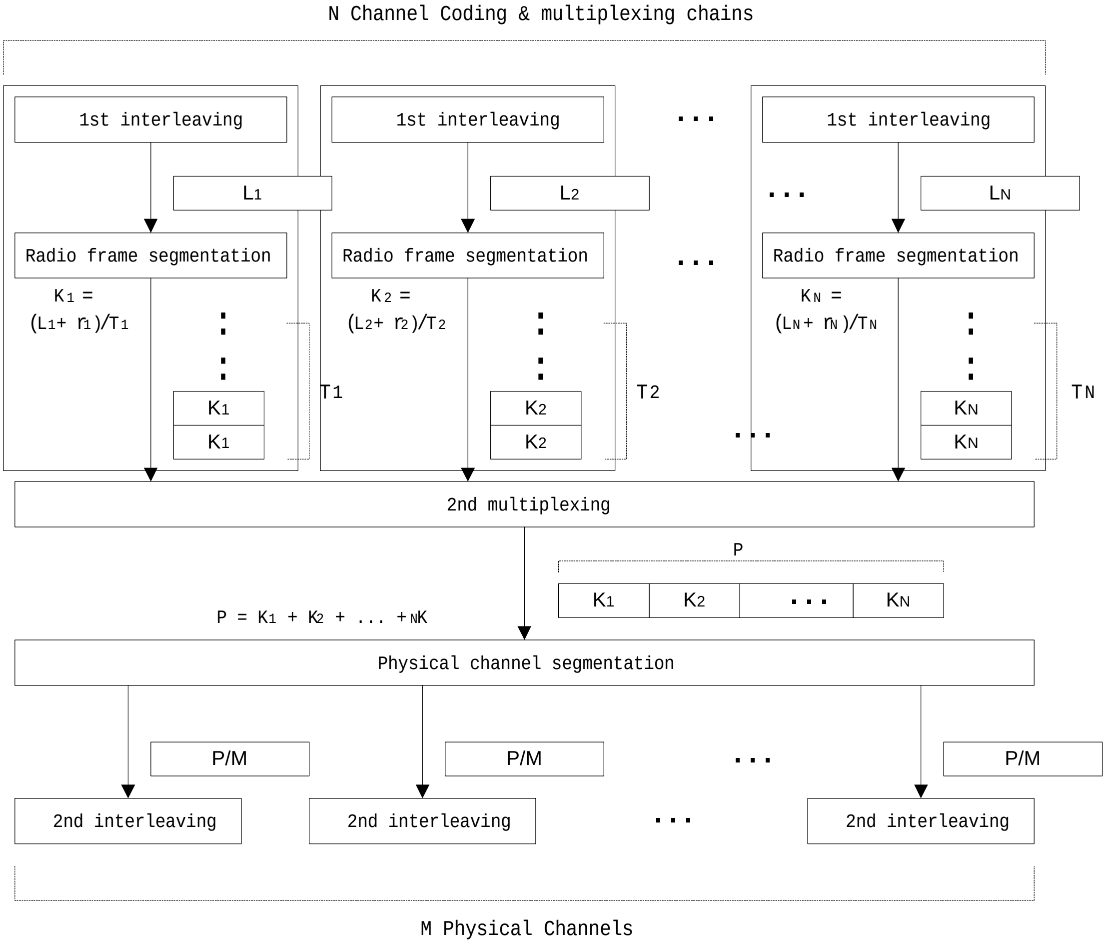


Figure A-4. Part of downlink channel coding and multiplexing chains

3 References

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