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Title: Text Proposal for Support of Hybrid ARQ Type II/III in the Physical Layer

Document for: Decision

Introduction

A detailed description of the operation of Hybrid ARQ Type II/III from the viewpoint of the physical layer has been presented in [7]. This paper presents a text proposal to reflect the Hybrid ARQ Type II/III operation in the multiplexing and channel coding documents S1.12 and S1.22.

1 Update of the Chapter "Automatic Repeat Request (ARQ)"

The text in S1.22, "TDD multiplexing, channel coding and interleaving description", Chapter 7.3 Automatic Repeat Request (ARQ), should be replaced to reflect the discussion about Hybrid ARQ Type II/III operation in the Physical Layer:

~~*<Editor's note: this chapter is unchanged from ETSI xx.10 document.>*~~

~~The details of the UTRA ARQ schemes are not yet specified. Therefore, the impact on layer 1, e.g. if soft combining of retransmitted packets is to take place, is not yet fully specified.~~

In UTRA, two Automatic Repeat Request (ARQ) schemes are available: ARQ Type I and Hybrid ARQ Type II/III. ARQ operation is managed in the RLC layer for both ARQ Type I and Hybrid ARQ Type II/III. The physical layer supports the RLC protocol by providing some functions related to error correction and error detection.

ARQ Type I operation requires the functions CRC generation, Channel Coding, Channel Decoding, and CRC check from the physical layer.

Hybrid ARQ Type II/III operation requires the functions CRC generation, Channel Coding, Redundancy Selection, Buffering and Combining, Channel Decoding, and CRC check from the physical layer.

The functions CRC generation, Channel Coding and Redundancy Selection are described in the relevant chapters.

Buffering in the physical layer for Hybrid ARQ Type II/III is necessary to combine retransmitted PDUs with the data from previous transmissions. This buffering is associated with the PDU numbers and the redundancy versions. The entries are deleted from the buffer upon successful decoding (CRC check) or after the expiry of a predefined time period. There is no explicit buffer control by higher layers.

The buffering has to work on soft decision values of the channel coded data. The required quantisation accuracy is 4 bit to enable a sufficient accuracy.

The buffer size depends on the maximum data rate which has to be supported. For a low cost mobile which supports a data rate of 64 kbits/s a buffer size of about [64 kByte] will be sufficient. For high-end mobiles with a possible data rate of up to 2 Mbit/s a buffer size of [1 Mbyte] should be provided. The exact values depend on the design of the RLC protocol. If the buffer in the physical layer is full, a status information should be signalled to the higher layers, indicating which PDUs could not be kept in memory.

The buffer is controlled by the physical layer. The physical layer is informed about the PDU number and redundancy version of each received PDU. This information is used to control the buffer. The following table summarises the basic events which trigger a certain operation of the buffer.

	Event	**Operation for buffer**
1	Receiving of a new PDU (first transmission)	· If CRC check is successful, discard PDU data. · If CRC check fails, save PDU data associated with PDU number, redundancy version
2	Receiving of a retransmission of a PDU with new redundancy	· Output buffered versions of the PDU for combining and channel decoding. · If CRC check of combined data is successful, discard all redundancy versions of this PDU. · If CRC check of combined data fails, save new redundancy version and keep buffered versions.
3	Receiving of a retransmission of a PDU with repeated redundancy	· Output buffered version of the received redundancy level of the PDU for maximum ratio combing. · Output all other buffered versions of the PDU for combining and channel decoding. · If CRC check of combined data is good, discard all redundancy versions of this PDU. · If CRC check of combined data is bad, save maximum ratio combined data of the received redundancy version.

This information should also be included in the document S1.12, “Multiplexing and Channel coding(FDD)”, to keep both documents aligned.

2 Introduction of Redundancy Selection in the current multiplexing scheme

We propose to incorporate a new box named ‘Redundancy Selection’ directly after the channel coding box of the multiplexing scheme on the transmitting side as depicted in the figure 1.

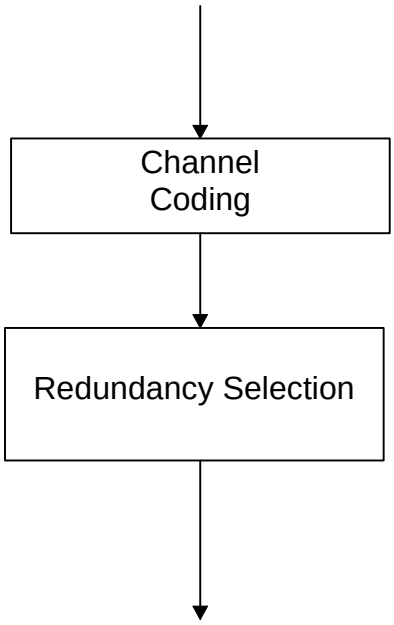

*Figure **Error! Unknown switch argument.**: Introduction of Hybrid ARQ Type II/III in the multiplexing scheme for the transmitting (left) and receiving side (right)*

This box has to be included into the document S1.12, “Multiplexing and Channel coding(FDD)” in the figures “Figure 4-1. Transport channel multiplexing structure for uplink.” and “Figure 4-2. Transport channel multiplexing structure for downlink.”. The update figures are shown below.

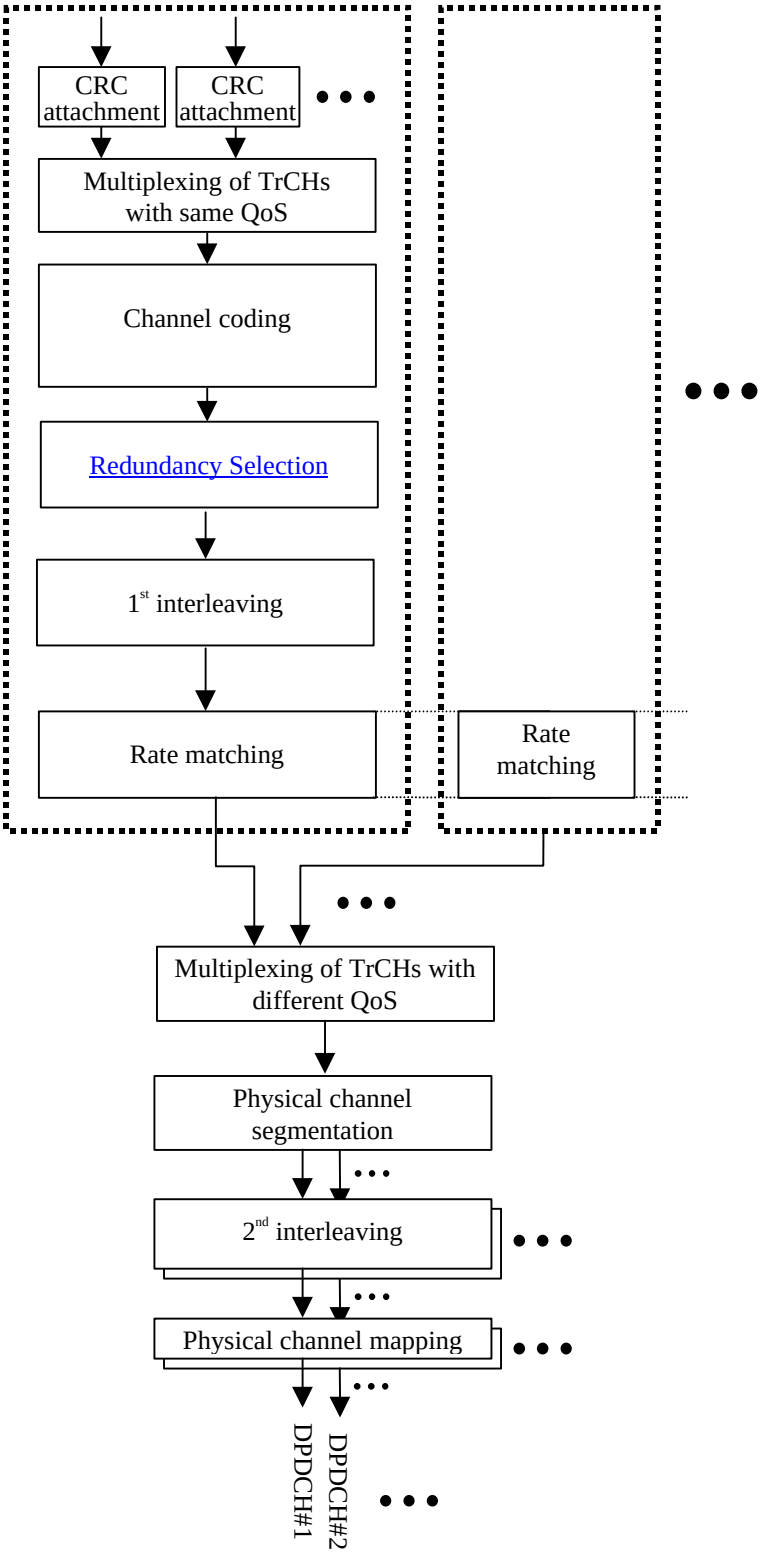

Figure 4-1. Transport channel multiplexing structure for uplink. (updated)

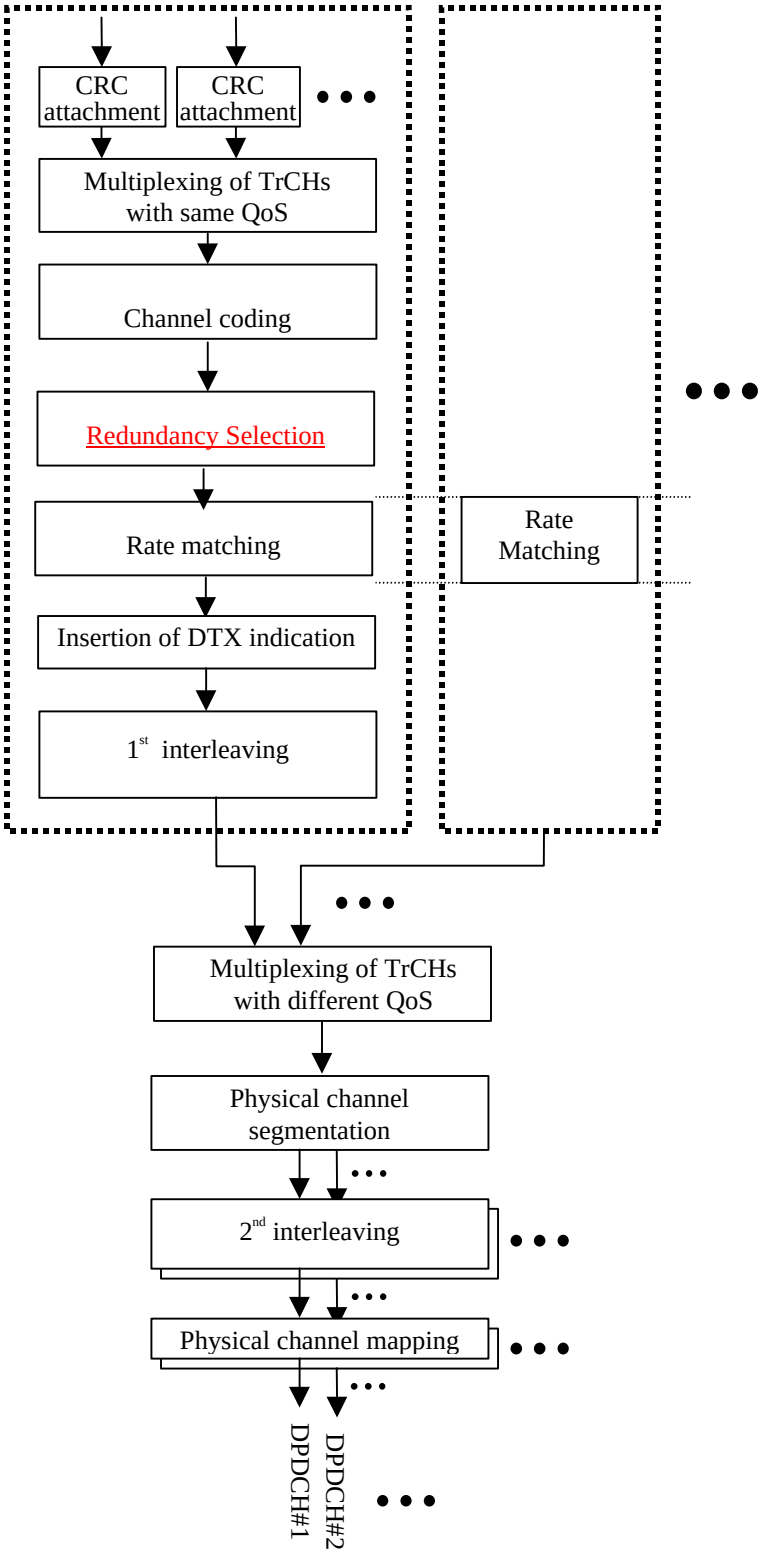

Figure 4-2. Transport channel multiplexing structure for downlink. (updated)

This box has also to be included into the document S1.22, in the Figure 6–1. “Transport channel multiplexing structure for uplink and downlink”. The update figure is shown below.

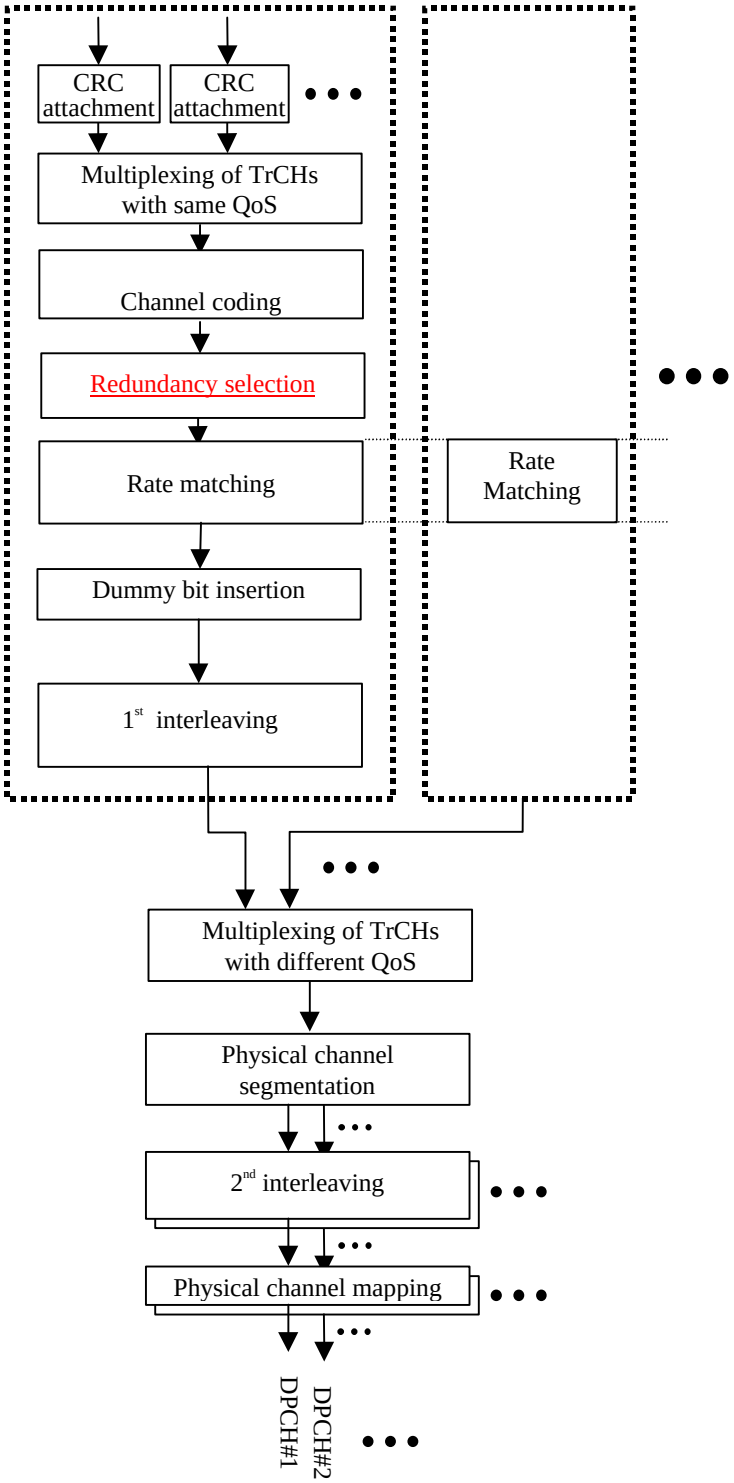

Figure 6–1. Transport channel multiplexing structure for uplink and downlink (updated)

3 Additional chapter about "Redundancy Selection"

Into the document S1.12, "Multiplexing and Channel coding(FDD)" a new chapter describing the functionality of the "Redundancy Selection" has to be inserted.

4.2.3 Redundancy Selection

The Redundancy Selection function can remove some of the redundancy information which was added by the channel coder. Which redundancy is removed can be controlled by the higher layers for each channel coded block.
Currently, the Redundancy Selection is only performed for Hybrid ARQ Type II/III operation, for all other operation modes, the Redundancy Selection passes the channel coded data unchanged.

The same text should be inserted into the document S1.22, "TDD multiplexing, channel coding and interleaving description", in a new Chapter "6.2.3 Redundancy Selection".

References

[1] 3GPP TSG RAN WG1 Tdoc R1-99178: 'ARQ error control techniques', source: SIEMENS AG
[2] 3GPP TSG RAN WG1 Tdoc R1-99296: 'Support of Hybrid ARQ Type II/III in the physical Layer', source: SIEMENS AG
[3] 3GPP TSG RAN WG1 Tdoc R1-99195: 'Liaison statement to TSG RAN WG 1 on Random Access and Hybrid ARQ Type II/III', source: TSG RAN WG2
[4] 3GPP TSG RAN WG1 Tdoc R1-99313: 'Liaison Statement on Hybrid ARQ Type II/III', source: TSG RAN WG1
[5] 3GPP TSG RAN WG1 TS S1.12 V1.1.0: 'Multiplexing and channel coding (FDD)', Source: editor
[6] 3GPP TSG RAN WG1 TS S1.22 V1.1.0: 'Multiplexing and channel coding (TDD)', Source: editor
[7] 3GPP TSG RAN WG1 Tdoc R1-99355: 'Support of Hybrid ARQ Type II/III in the Physical Layer', Source: Siemens