TSGR1#7 (99)b06

TR R1.03 V0.0.1 (1999-08)

Technical Report

3rd Generation Partnership Project (3GPP);
Technical Specification Group (TSG);
Radio Access Network (RAN);
Working Group 1 (WG1);
Physical Layer Items For Inclusion Later Than Release '99

Reference

<Workitem> (<Shortfilename>.PDF)

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Contents

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Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project, Technical Specification Group Radio Access Network, Working Group 1 (3GPP TSG RAN WG1).

The contents of this TR may be subject to continuing work within the 3GPP and may change following formal TSG approval. Should the TSG modify the contents of this TR, it will be re-released with an identifying change of release date and an increase in version number as follows:

Version m.x.y

where:

m indicates [major version number]

x the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

y the third digit is incremented when editorial only changes have been incorporated into the report.

1 Scope

This technical report collects material on UTRA Physical Layer Items to be included in the specification documents after release '99. Only items accepted by the 3GPP TSG RAN WG1 group for later releases are included.

<Editors note: Acceptance of items in V0.0.1 has not been discussed by the group. These items have been collected by the editor for discussion.>

The items are described by accepted specification text if it exists. In cases without existing specification text, text proposals or new texts are used.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

<Editor's Note: Relevant references should be discussed>

[1] TS 25.201 (V2.1.1): "Physical layer – general description"

[2] TS 25.211 (V2.1.1): "Transport channels and physical channels (FDD)"

[3] TS 25.212 (V2.0.0): "Multiplexing and channel coding (FDD)"

[4] TS 25.213 (V2.1.2): "Spreading and modulation (FDD)"

[5] TS 25.214 (V1.1.1): "Physical layer procedures (FDD)"

[6] TS 25.221 (V1.1.1): "Transport channels and physical channels (TDD)"

[7] TS 25.222 (V2.0.1): "Multiplexing and channel coding (TDD)"

[8] TS 25.223 (V2.1.1): "Spreading and modulation (TDD)"

[9] TS 25.224 (V1.0.1): "Physical layer procedures (TDD)"

[10] TS 25.231 (V0.3.0): "Measurements"

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the [following] terms and definitions [given in ... and the following] apply.

<defined term>: <definition>.

example: text used to clarify abstract rules by applying them literally.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

<symbol> <Explanation>

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

<ACRONYM> <Explanation>

ARQ	Automatic Repeat Request
BCCH	Broadcast Control Channel
BER	Bit Error Rate
BLER	Block Error Rate
BS	Base Station
CCPCH	Common Control Physical Channel
DCH	Dedicated Channel
DL	Downlink (Forward link)
DPCH	Dedicated Physical Channel
DPCCH	Dedicated Physical Control Channel
DPDCH	Dedicated Physical Data Channel
DS-CDMA	Direct-Sequence Code Division Multiple Access
FACH	Forward Access Channel
FDD	Frequency Division Duplex
FER	Frame Error Rate
Mcps	Mega Chip Per Second
ODMA	Opportunity Driven Multiple Access
OVSF	Orthogonal Variable Spreading Factor (codes)
PCH	Paging Channel
PG	Processing Gain
PRACH	Physical Random Access Channel
PUF	Power Up Function
RACH	Random Access Channel
RX	Receive
SCH	Synchronisation Channel
SF	Spreading Factor
SIR	Signal-to-Interference Ratio
TDD	Time Division Duplex
TFCI	Transport Format Combination Indicator
TFI	Transport-Format Indicator
TPC	Transmit Power Control
TX	Transmit
UE	User Equipment
UL	Uplink (Reverse link)
VA	Voice Activity

4 Items for inclusion later than release '99

This section lists text describing the items for later inclusion.

When specification texts or text proposals are used, the respective references are given first, followed by a colon and the text in framed format:

<reference>: <text>

When no text exists, new text is introduced by the words 'new text' and given in framed format also:

New text: <text>

Specifications to be treated in the respective sections are referenced by their version numbers only.

4.1 Transport channels and physical channels (FDD) (TS 25.211)

4.1.1 DSCH Control Channel

Sec. 4.2 of V2.1.1:

4.2 Common transport channels

There are six types of common transport channels: BCH, FACH, PCH, RACH, DSCH, and DSCH control channel.

Sec. 4.2.6, last par. of V2.1.1:

Two possibilities exist for the DSCH:

- the DSCH is associated with a DCH,
- the DSCH is associated with a DSCH control channel.

It is for further study whether both possibilities are needed.

Sec. 4.2.7 of V2.1.1:

4.2.7 DSCH Control Channel

<Note: WG1 concluded that DSCH control channel will not be included in release 99.>

The DSCH control channel is a downlink transport channel carrying control information to the UE for operating the DSCH when not associated with a DCH. Such control information corresponds among other things to resource allocation messages and L1 control information such as TPC, that are not available on the DSCH.

Sec. 5.3.3.4 of V2.1.1:

5.3.3.4 Physical Shared Channel Control Channel (PSCCCH)

<Note: WG1 concluded that PSCCCH will not be included in release 99.>

The frame structure for the PSCCCH is shown in Figure 1.

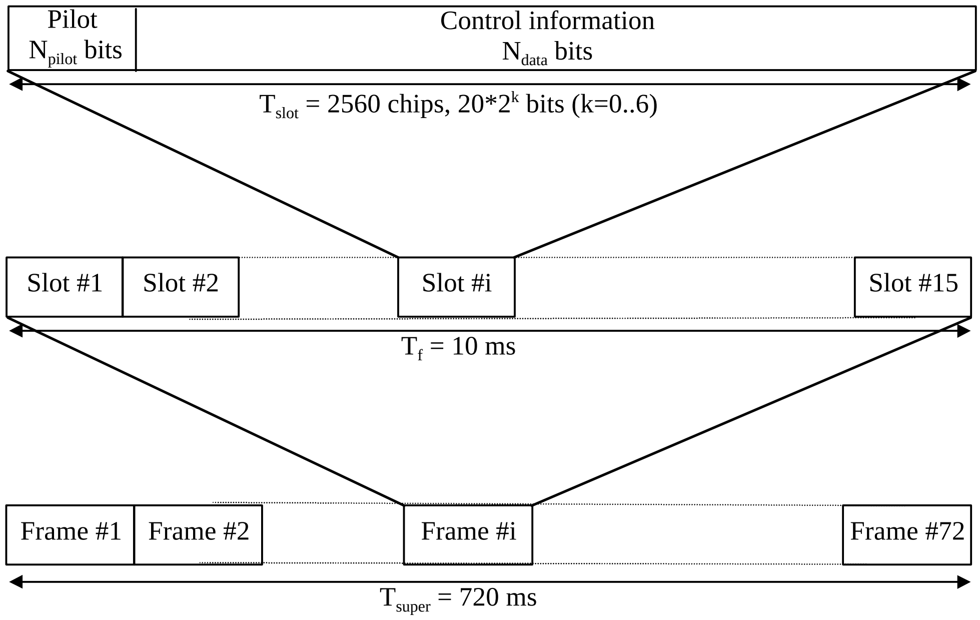

Figure 1: Frame structure of the Physical Shared Channel Control Channel (PSCCCH).

The PSCCCH contains pilot symbols, and a control information field. The control information field can include TPC commands concerning several users. Other control information includes code assignment for the DSCH, but could also comprise other type of information if needed. The TPC commands would come in support of fast closed loop power control of the PDSCH, and thus, would have to be decoded on a slot-by-slot basis. The exact structure of the control information field is for further study.

Sec. 5.3.3.5.2 of V2.1.1:

5.3.3.5.2 DSCH associated with a DSCH control channel

<Note: WG1 concluded that DSCH control channel will not be included in release 99.>

The frame structure of the DSCH when associated with a DSCH control channel is shown in Figure 2.

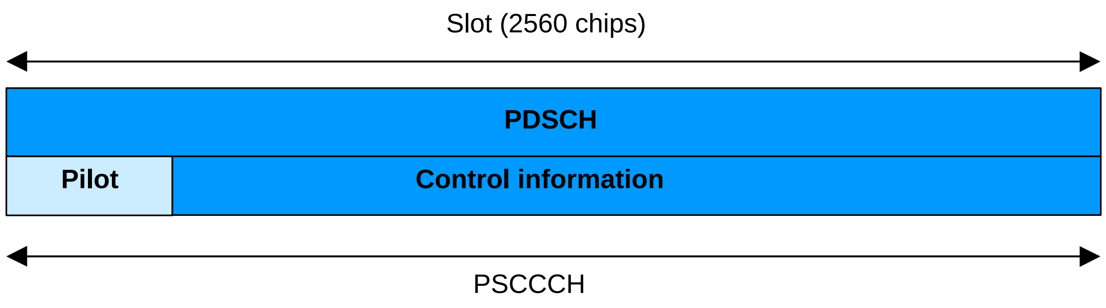

Figure 2: Frame structure for the DSCH when associated to a DSCH control channel.

Sec. 6, fig.25 of V2.1.1:

Transport Channels	**Physical Channels**
BCH	Primary Common Control Physical Channel (Primary CCPCH)
FACH	Secondary Common Control Physical Channel (Secondary CCPCH)
PCH	
RACH	Physical Random Access Channel (PRACH)
FAUSCH	
CPCH	Physical Common Packet Channel (PCPCH)
DCH	Dedicated Physical Data Channel (DPDCH)
	Dedicated Physical Control Channel (DPCCH)
	Synchronisation Channel (SCH)
DSCH	Physical Downlink Shared Channel (PDSCH)
DSCH control channel	Physical Shared Channel Control Channel (PSCCCH)
	Acquisition Indication Channel (AICH)
	Page Indication Channel (PICH)

4.1.2 FAUSCH

Sec. 4.1, last par. of V2.1.1:

[There are two types of dedicated transport channel, the Dedicated Channel (DCH) and the Fast Uplink Signalling Channel (FAUSCH).]

Sec 4.1.2 of V2.1.1:

4.1.2 FAUSCH – Fast Uplink Signalling Channel

<Note: WG1 concluded that FAUSCH will not be included in release 99.>

The Fast Uplink Signalling Channel (FAUSCH) is an optional uplink transport channel that is used to carry control information from a UE. The FAUSCH is always received from the entire cell.

Sec. 5.2.2.1 of V2.1.1:

[The Physical Random Access Channel (PRACH) is used to carry the RACH and the FAUSCH.]

Sec. 5.2.2.1.4 of V2.1.1:

5.2.2.1.4 FAUSCH transmission

<Note: WG1 concluded that FAUSCH will not be included in release 99.>

<Editors note: FAUSCH sections need to be updated for 15 slots/frame.>

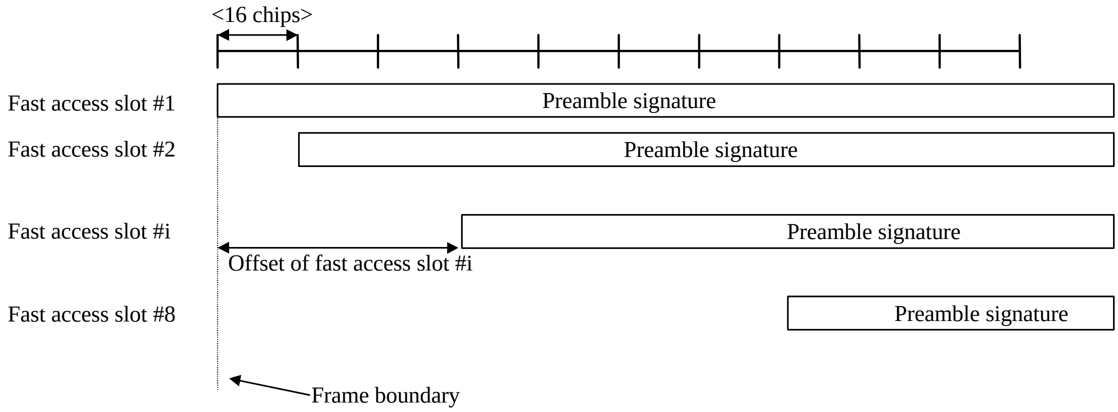

Figure 3: PRACH used for FAUSCH fast access slots.

The Fast Uplink Physical Channel (FAUSCH) is based on the transmission of a signature of length 16 complex symbols ±(1+j). The signature is one of the set of signatures used for the RACH preamble. Signature no.[8] is selected because it has the best correlation properties. Each symbol is spread with a 256 chip real Orthogonal Gold code. A time slot is allocated to the UE by the network when entering Connected Mode but the allocation may be updated with appropriate signalling. To avoid the possibility of collisions only one UE is allowed to transmit with a given signature in a particular time slot. Thus the UE can start the transmission of the FAUSCH at an assigned time offset relative to the frame boundary of the received BCH of the current cell. The different time offsets are denoted *fast access slots* and are spaced [16] chips apart as illustrated in Figure 5. To avoid possible confusion of transmissions from different UEs the separation between allocations of fast access slots to different UEs must be sufficient to allow for any round-trip delay resulting from the physical distance between network and UE. Therefore the allocation of fast access slots may be limited by the network to a subset of those available, depending on the deployment scenario.

Sec. 5.2.2.1.5 of V2.1.1:

5.2.2.1.5 Sharing of PRACH by RACH and FAUSCH

<Note: WG1 concluded that FAUSCH will not be included in release 99.>

FAUSCH uses only the preamble part of PRACH. The RACH and FAUSCH transmissions could use different Gold Codes for spreading the signatures, but the complexity of the uplink receiver is significantly reduced if the same Gold Code is used. Low interference between RACH and FAUSCH can then be achieved by restricting the allocation of RACH access slots and FAUSCH fast access slots so that the respective transmissions occur in different parts of the 10 ms frame. The partitioning of the frame is flexible. For example, if RACH access slots are spaced 2.5 ms apart, then FAUSCH fast access slots could be allocated in the gaps. The UE can determine the available RACH access slots my monitoring the BCH. The FAUSCH fast access slots are individually allocated to a specific UE.

4.2 Multiplexing and channel coding (FDD) (TS 25.212)

4.2.1 Hybrid ARQ

Sec. 6.3 of S1.22 (V1.1.0) and text proposal in Tdoc TSGR1#4(99)356:

6.3 Automatic Repeat Request (ARQ)

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.

Fig. 4-1 of text proposal in Tdoc TSGR1#4(99)356 to replace fig. 4-2 of S1.12 (V1.1.0):

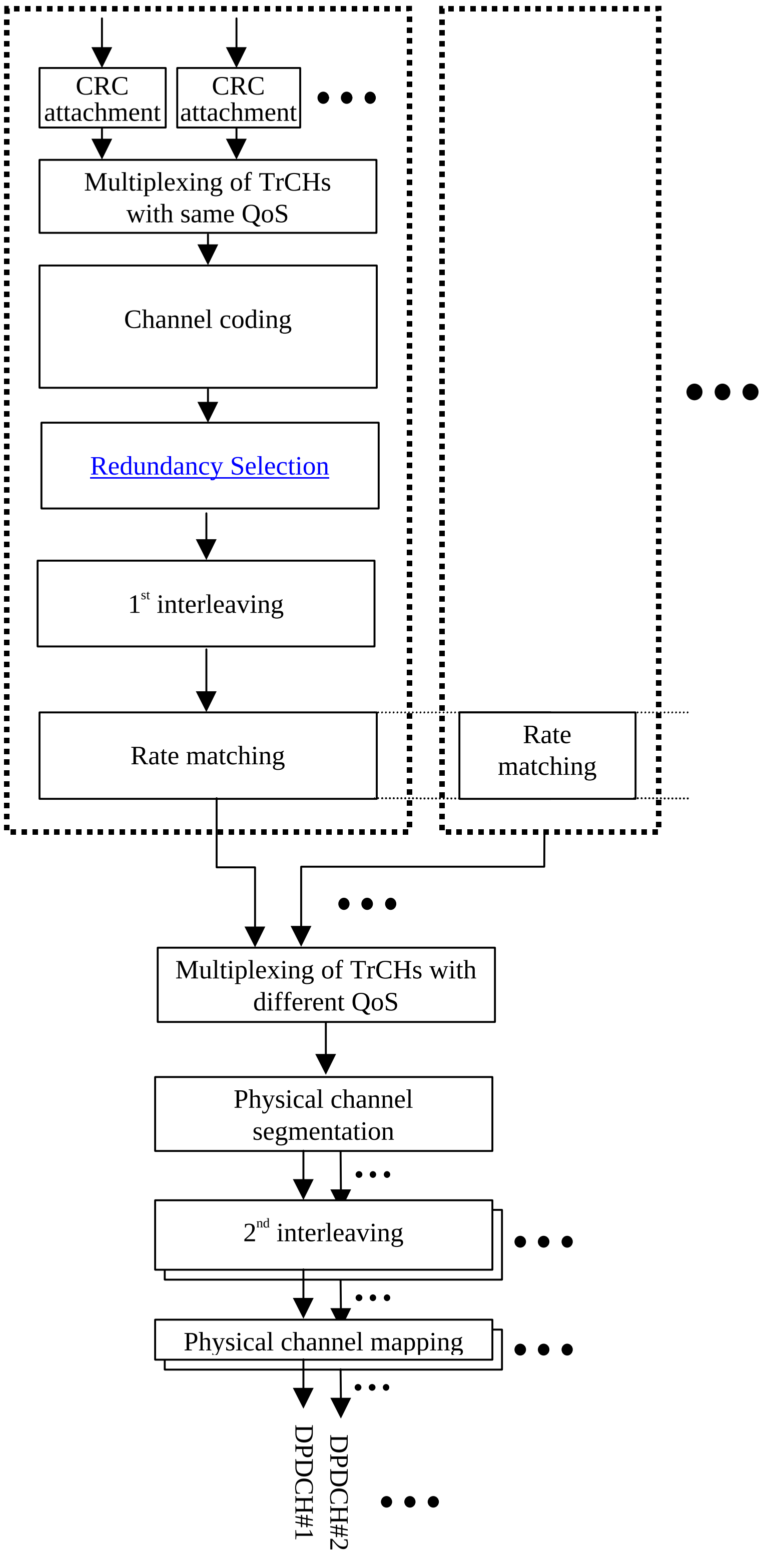

Figure 4-1. Transport channel multiplexing structure for uplink. (updated)

Fig. 4-2 of text proposal in Tdoc TSGR1#4(99)356 to replace fig. 4-2 of S1.12 (V1.1.0):

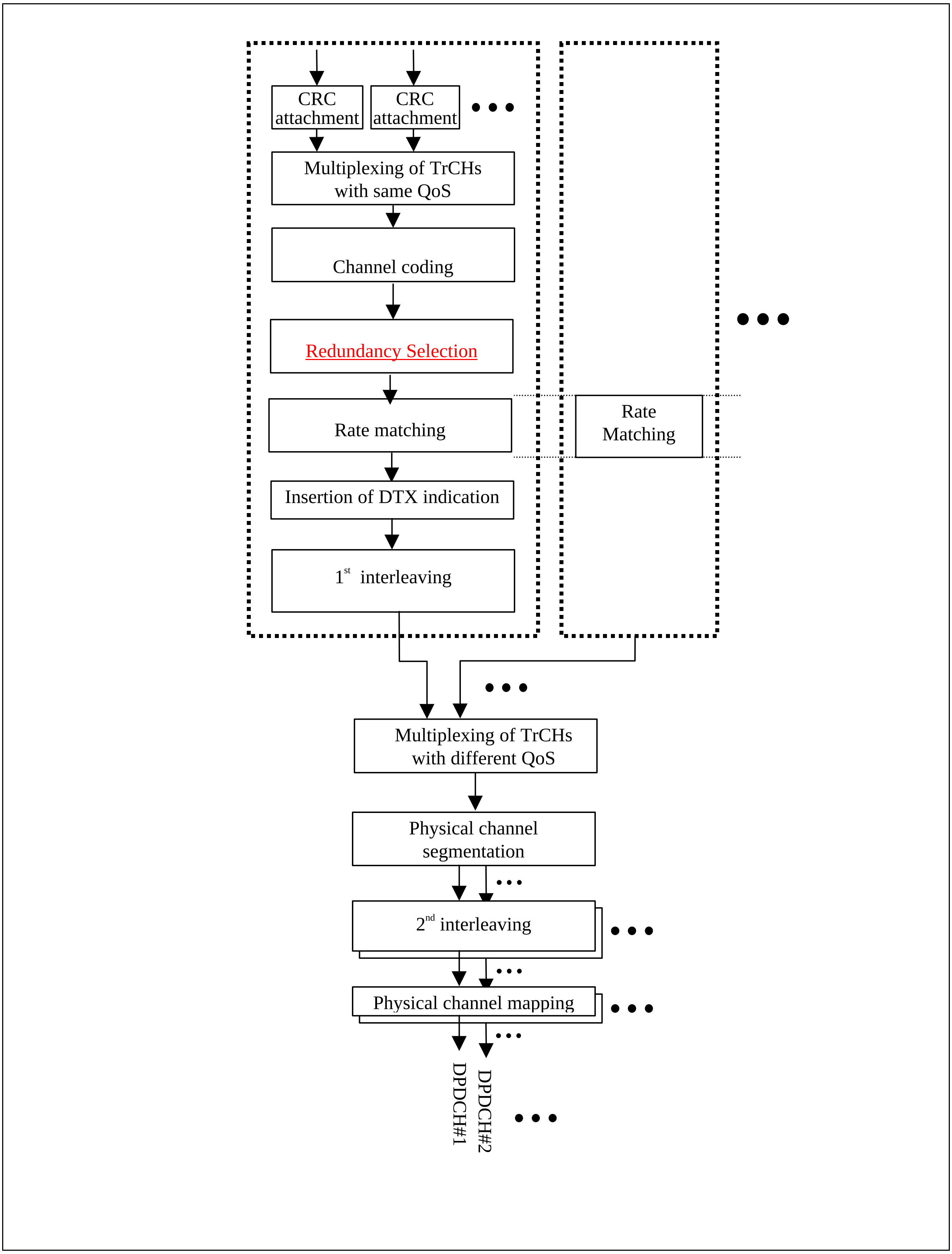

Figure 4-2. Transport channel multiplexing structure for downlink. (updated)

Additional text in Tdoc TSGR1#4(99)356 to be inserted in S1.12 (V1.1.0):

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.

4.3 Spreading and modulation (FDD) (TS 25.213)

4.4 Physical layer procedures (FDD) (TS 25.214)

4.5 Transport channels and physical channels (TDD) (TS 25.221)

4.5.1 DSCH control channel, PSCCH

<Editors note: new text is required>

4.5.2 FAUSCH

<Editors note: new text is required>

4.5.3 RACH half burst

Sec. 5.3.2 of V1.1.1:

5.3.2 The physical random access channel (PRACH)

The RACH or in case of ODMA networks the ORACH as described in section **Error! Reference source not found.** are mapped onto one or more uplink physical random access channels (PRACH). In such a way the capacity of RACH and ORACH can be flexibly scaled depending on the operators need.

This description of the physical properties of the PRACH also applies to bursts carrying other signaling or user traffic if they are scheduled on a time slot which is (partly) allocated to the RACH or ORACH.

5.3.2.1 Spreading codes

The uplink PRACH uses fixed spreading with a spreading factors SF=16 or SF=8 as described in section **Error! Reference source not found.**. The set of admissible spreading codes for use on the PRACH and the associated spreading factors are broadcasted on the BCH (within the RACH configuration parameters on the BCH, see Ref.[3])

5.3.2.2 Burst Types

The mobile stations send the uplink access bursts randomly in the PRACH. Two distinct access bursts are defined which effectively devide a 625µs ("full") time-slot into two 312.5µs ("half") slots. The access bursts 1 and 2 occupy the first and the second half slot, respectively. The access bursts of type 1 and 2 coexist in a full time slot: they never collide with each other.Depending on the RACH configuration broadcasted on the BCH, up to 8 different mobile stations can access on the same half slot simultaneously without colliding. The precise number of collision groups depends on the set of admissible midambles and spreading codes (i.e. the selected RACH configuration. The access bursts are depicted in **Error! Reference source not found.** and **Error! Reference source not found.** and the contents of the access burst fields are listed in **Error! Reference source not found.** and **Error! Reference source not found.**.

Table 1 The contents of the access burst 1 fields

Chip Number (CN)	Length of field in chips	Length of field in symbols	Length of field in µs	Contents of field
0-335	336	21	82.0	Data symbols
336-847	512	-	125.0	Midamble
848-1183	336	21	82.0	Data symbols
1184-1279	96	-	23.4	Guard period
1279-2559	1280	-	312.5	Extended guard period

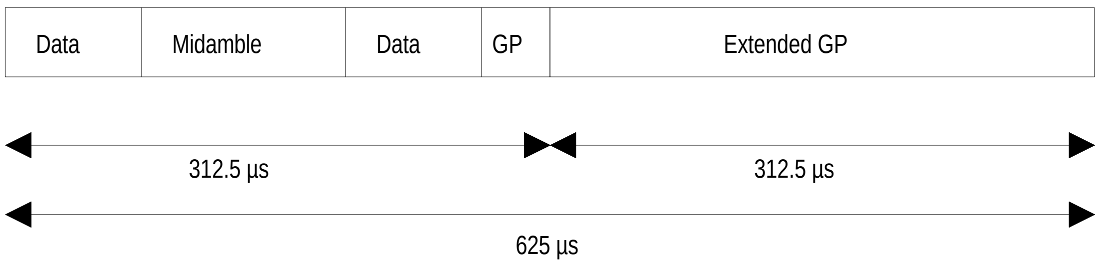

Figure 4 Access burst 1, GP denotes the guard period

Table 2 The contents of the access burst 2 fields

Chip Number (CN)	Length of field in chips	Length of field in symbols	Length of field in µs	Contents of field
0-1279	1280	-	312.5	Extended guard period
1280-1615	336	21	82.0	Data symbols
1616-2127	512	-	125.0	Midamble
2128-2463	336	21	82.0	Data symbols
2464-2559	96	-	23.4	Guard period

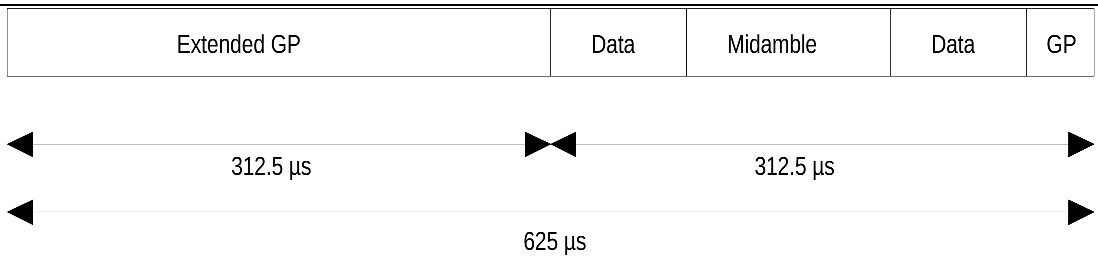

Figure 5 Access burst 2, GP denotes the guard period

5.3.2.3 Training sequences for access bursts

The training sequences, i.e. midambles, of different users active in the same half time slot are time shifted versions of a small set of periodic basic codes (in cells with small radius, a single periodic code can be used). The necessary time shifts are obtained by choosing either *all* k=1,2,3...,K (for cells with small radius) or *uneven* k=1,3,5,...≤K (for cells with large radius, as explained in Sect. 6.2.3.1). Different cells use different periodic basic codes, i.e. different midamble sets. In this way, a joint channel estimation for the channel impulse responses of all active users within one half time slot can be performed by a small number of cyclic correlations (in cells with small radius, a single cyclic correlator suffices). The different user specific channel impulse response estimates are obtained sequentially in time at the output of the cyclic correlators.

4.6 Multiplexing and channel coding (TDD) (TS 25.222)

4.6.1 Hybrid ARQ

Sec. 6.3 of S1.22 (V1.1.0) and text proposal in Tdoc TSGR1#4(99)356:

6.4 Automatic Repeat Request (ARQ)

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.

Fig. 6-1 of Tdoc TSGR1#4(99)356 to replace fig. 6-1 in S1.22 (V1.1.0):

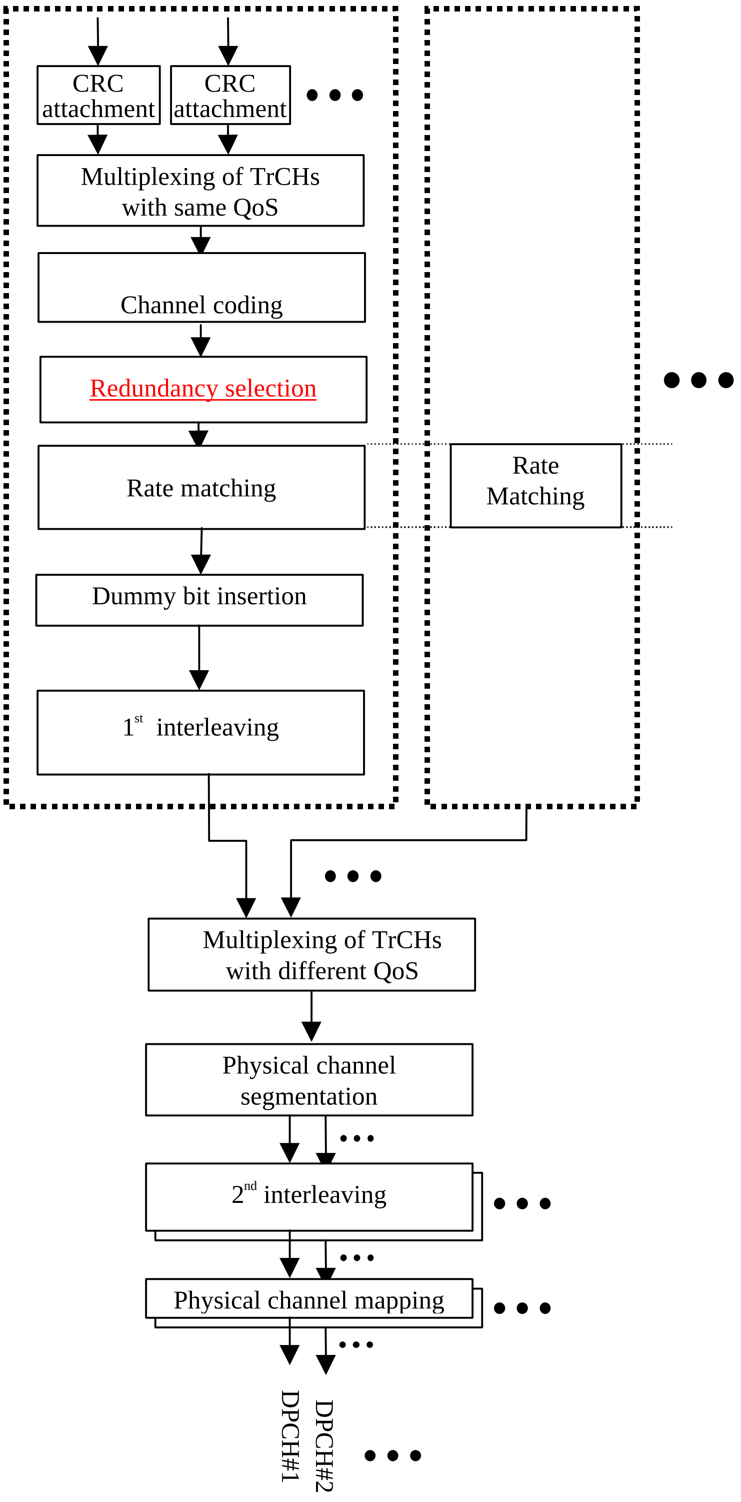

Figure 6–1. Transport channel multiplexing structure for uplink and downlink (updated)

Additional text in Tdoc TSGR1#4(99)356 to be inserted in S1.22 (V1.1.0):

6.2.3 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.

4.6.2 RACH Channel Coding

Tab. 6.2.3-1 of V2.0.1:

Table 4.6.2-1 Error Correction Coding Parameters

<table>
<tr><th>Transport channel type</th><th>Coding scheme</th><th>Coding rate</th></tr>
<tr><td>BCH</td><td rowspan="5">Convolutional code</td><td rowspan="3">1/2</td></tr>
<tr><td>PCH</td></tr>
<tr><td>FACH</td></tr>
<tr><td>RACH</td><td>1/2, [2/3, 7/8] <Editor's note: the values in square brackets have not yet been approved.></td></tr>
<tr><td>DCH</td><td rowspan="2">1/2, 1/3 or no coding</td></tr>
<tr><td>DCH</td><td>Turbo code</td></tr>
</table>

First bullet point of Sec. 6.2.3.1 of V2.0.1:

- Constraint length K=9. Coding rates 1/2, 1/3 and [2/3, 7/8].

4.7 Spreading and modulation (TDD) (TS 25.223)

4.8 Physical layer procedures (TDD) (TS 25.224)

4.9 Physical Layer Measurements (TS 25.231)

5 History

Document history

Editor of R1.03, Physical Layer Items For Inclusion Later Than '99, is:

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V0.0.1	1999-08-16	First version created by the editor on the basis of WG1 minutes, specifications and text proposals.
This document is written in Microsoft Word 97.		