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TR R1.03 V0.1.2 (1999-10)

Technical Report

3rd Generation Partnership Project (3GPP); Technical Specification Group (TSG); Radio Access Network (RAN); Working Group 1 (WG1); Physical Layer Items Not For Inclusion In Release '99

Reference
<Workitem> (<Shortfilename>.PDF)

Keywords
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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 which have already been in the specifications, but were decided not to be included in release ’99.

The items are described by text from the specifications or by text proposals which have been accepted by WG1.

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 not for inclusion in release '99

This section lists text describing the items not for inclusion in R'99.

The text is copied from the specification documents or from text proposals accepted by WG1. Texts are introduced by references, followed by a colon and the text in framed format:

<reference>: <text>

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. 4.2.7 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.

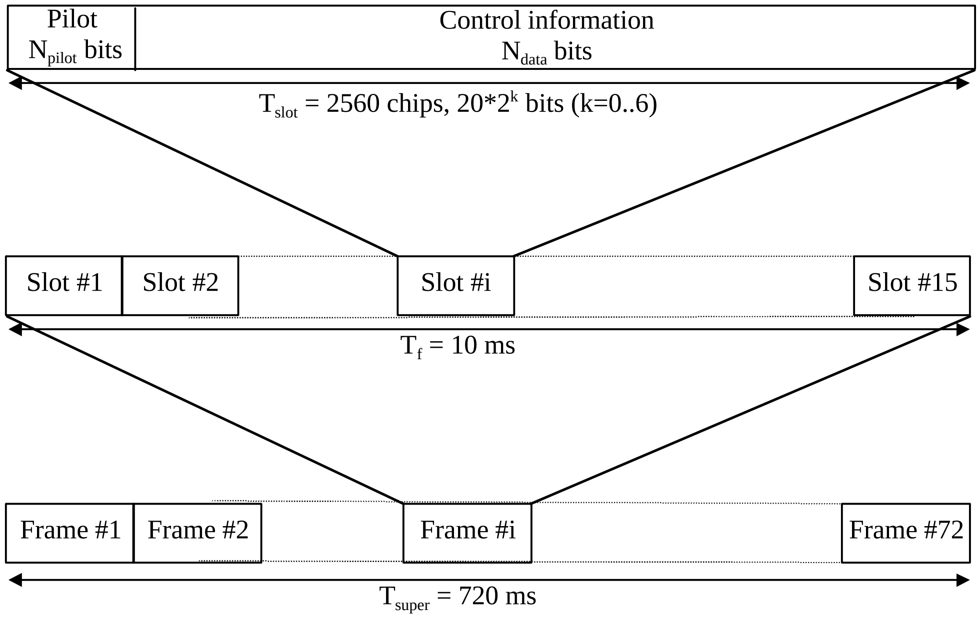

Figure 1: Frame structure of the Physical Shared Channel Control Channel (PSCCCH).

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.

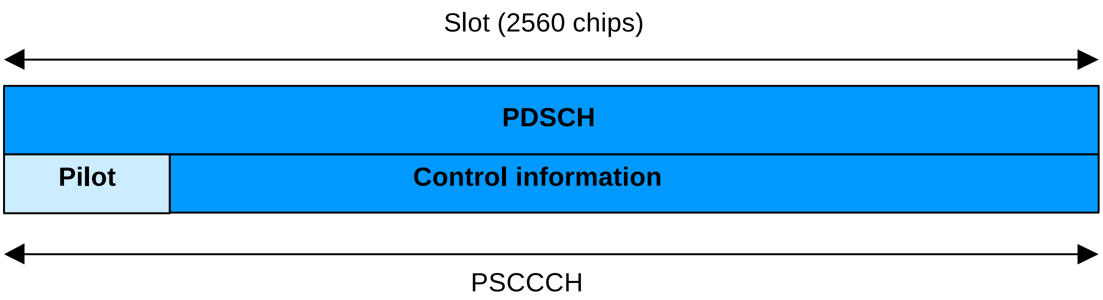

Figure 2: Frame structure for the DSCH when associated to a DSCH control channel.

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.

Text proposal of Tdoc TSGR1#4(99)b34 for inclusion in V2.1.1:

5.2.2.3 Physical Fast Uplink Signalling Channel

The Physical Fast Uplink Signalling Channel (PFAUSCH) is used to carry the FAUSCH.

5.2.2.3.1 FAUSCH transmission

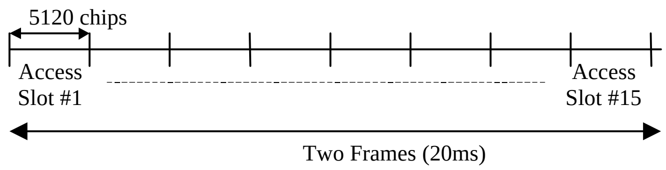

Figure 5: PFAUSCH access slots

The PFAUSCH consists of 15 access slots, offset in time, by multiples of 5120 chips, from the boundary of every second frame of the received BCH of the current cell. Information on what access slots are available within the current cell is broadcast on the BCH.

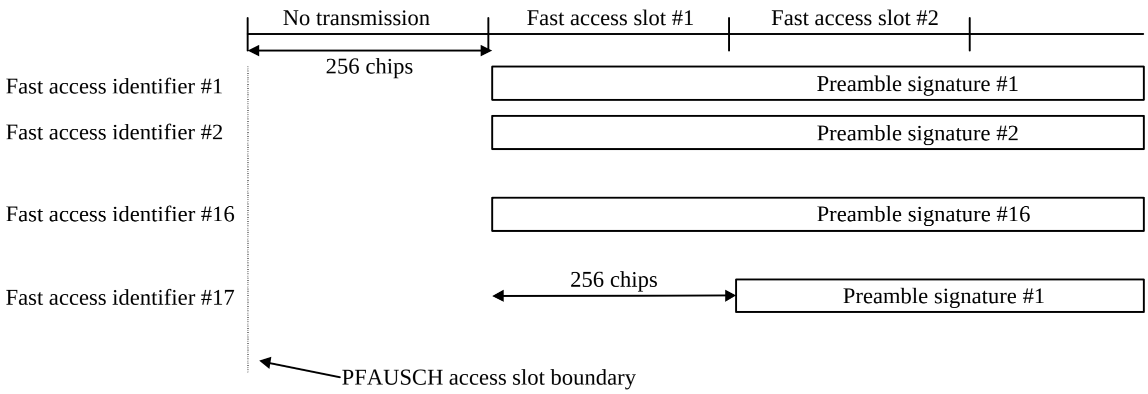

Figure 5: PFAUSCH used for FAUSCH fast access identifiers.

The Fast Uplink Physical Channel (FAUSCH) is based on the transmission of signatures of length 16 complex symbols ±(1+j). The signatures are the same set of signatures used for the RACH preamble. The signatures are spread with a 4096 Long Code, as per the RACH. A *fast access identifier*, comprising a unique combination of signature and time slot, together with a PFAUSCH access slot number, may be allocated to the UE by the network when entering Connected Mode, but the allocation may be updated with appropriate signalling.

For fast access identifier #i, within a particular PFAUSCH access slot, the assigned fast access slot is given by int(((i-1)/16)+1), and the preamble is (i-1)mod16 + 1.

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 boundary of the PFAUSCH access slot. The different time offsets are denoted *fast access slots* and are spaced 256 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 with the same signature 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.

Fig. of Tdoc TSGR1#4(99)b34 to replace fig.25 in 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	Physical Fast Access Signalling Channel (PFAUSCH)
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)

4.1.3 Slow Power Control

New par. in sec. 5.2.1 of V2.2.1 according to Tdoc TSGR1#7(99)c00:

In slow transmit power control, the relationship presented in Table 5 is not valid, and TPC bits are used to carry power control ratio (PCR) as described in 4.3.4 of TS 25.212 and in 5.2.3.3 of TS 25.214.

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

4.2.1 Hybrid ARQ

Sec. 6.3 of S1.22 (V1.1.0):

6.3 Automatic Repeat Request (ARQ)

<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.

4.2.2 Slow Power Control

New sec. in V2.0.1 according to Tdoc TSGR1#7(99)c00:

4.3.4 Coding and Interleaving of power control ratio (PCR) for slow transmit power control

When slow transmit power control is used, there are two (encoded) TPC bits in every slot of the radio frame. One PCR is sent in a radio frame, i.e. 30 TPC bits are used. The PCR is firstly encoded using biorthogonal (32, 6) code. The mapping of PCR to the biorthogonal code words, $C_{32,m}$ and $\overline{C_{32,m}}$, is defined in TS 25.214. The biorthogonal code words are generated in the same way as OVSF codes of level 32 defined in document TS 25.213. The biorthogonal code words are secondly encoded into PCR code words of 30 bits by puncturing the two least significant bits. Channel interleaving is not applied for the encoded bits, and the bits of the PCR code words are directly mapped to the slots of radio frames so that more significant bit is transmitted before the less significant bit within a radio frame.

4.3 Spreading and modulation (FDD) (TS 25.213)

4.3.1 FAUSCH

Text proposal of Tdoc TSGR1#4(99)b34 for inclusion in V2.1.0:

4.3.4 Fast uplink signalling codes

4.3.4.1 Preamble spreading code

Spreading of the FAUSCH preamble is carried out in the same way as for the RACH (4.3.3.1 RACH preamble spreading code).

4.3.4.2 Preamble signature

FAUSCH preamble signatures are the same as those specified for the RACH (4.3.3.2 RACH preamble signature).

<Note: 4.3.4.1 and 4.3.4.2 may need to be rewritten depending on the exact text produced for the relevant RACH sections>

4.3.2 Chip rates different from 3.840 Mcps

Table 2 of V2.2.0:

Symbol rate (ksps)				spreading code cycle(chip) SF	No. of Spreading codes
Chip rate= [0.96 Mcps]	3.84 Mcps	[7.68 Mcps]	[15.36 Mcps]		
[240]	960	[1920]	[3840]	4	4
[120]	480	[960]	[1920]	8	8

[60]	240	[480]	[960]	16	16
[30]	120	[240]	[480]	32	32
[15]	60	[120]	[240]	64	64
[7.5]	30	[60]	[120]	128	128
-	15	[30]	[60]	256	256
-	[7.5]	[15]	[30]	512	512
-	-	[7.5]	[15]	1024	1024
			[7.5]	2048	2048

Table 1. Correspondence between Symbol Rate and Spreading Code Types

Sec. 4.4.1 of V2.2.0:

4.4.1 Modulating chip rate

The modulating chip rate is 3.84 Mcps. This basic chip rate can be extended to [0.96,] 7.68 or 15.36 Mcps.

Sec. 5.3.1 of V2.2.0:

5.3.1 Modulating chip rate

The modulating chip rate is 3.84 Mcps. This basic chip rate can be extended to [0.96,] 7.68 or 15.36 Mcps.

4.4 Physical layer procedures (FDD) (TS 25.214)

4.4.1 FAUSCH

Text proposal of Tdoc TSGR1#4(99)b34 for inclusion in V1.1.0:

4.x PFAUSCH synchronisation

<section to follow 4.4 PRACH synchronisation. No text prepared at this time>

5.1.x PFAUSCH

<section to follow 5.1.1 PRACH on PFAUSCH Power control. No text prepared at this time>

x FAUSCH procedure

<New section "FAUSCH procedure" to be added between sections 6 Random access procedure, and 7 Transmission stop and resumption control. No text prepared at this time.>

4.4.2 Slow Power Control

Sec. 5.2.3.3 of V1.1.1 with changes according to Tdoc TSGR1#7(99)c00:

5.2.3.3 Slow transmit power control

Following an order from the network and acknowledgement by the UE, ordinary fast closed-loop transmit power control can be stopped and a slow transmit power control mode can be entered when the UE is not in soft handover. In this mode, downlink DPCCH/DPDCH transmit power is determined utilising power control ratio (PCR) reported from the UE. Uplink transmission is suspended when the UE does not have any information to send, and the transmission is resumed to send PCR at least once in every T_{RINT} second. The UE calculates PCR in the following steps:

1. The UE measures the Ec/Io of the CPICH received from the cell in which the UE is located, and sets the value to Q_1.
2. The UE measures the Ec/Io of the CPICH received from the cells belonging to the handover monitoring set, and sets the values greater than Q_1/R_{SEARCH} to Q_i, where i = 2, 3, …, n.
3. The UE sets the PCR to $(Q_1 + Q_2 + \dots + Q_n)/Q_1$.

All TPC bits in the uplink DPCCH are used to sendPCR. DPCCH that includes two TPC bits per slot is used. One PCR is sent per frame, i.e. 30 TPC bits are used. Biorthogonal code words, $C_{32,m}$ and $\overline{C_{32,m}}$, are used as defined in 4.3.4 of TS 25.212. Code word $C_{32,m}$ corresponds to 0.5(m-1) dB and code word $\overline{C_{32,m}}$ corresponds to {0.5(m-1)+0.25} dB where m = 1, 2, …, 32. Following an order from the network, the slow transmit power control is stopped and ordinary fast closed-loop transmit power control is started. The parameters T_{RINT} and R_{SEARCH} are set using higher layer signaling.

While uplink transmission is suspended, the TPC commands in downlink DPCCH are all dummy, and are "1". When uplink transmission is resumed, the UE transmits dummy slots composed of only DPCCH prior to a radio frame composed of DPCCH and DPDCH. The number of the dummy slots is N_{DS}. The TPC commands in the dummy slots are dummy, and are all "1". When the UE transmits dummy slots, ordinary transmit power control described in 5.1.2.2 is started in uplink transmission.

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

4.5.1 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 2 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 3 Access burst 1, GP denotes the guard period

Table 3 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

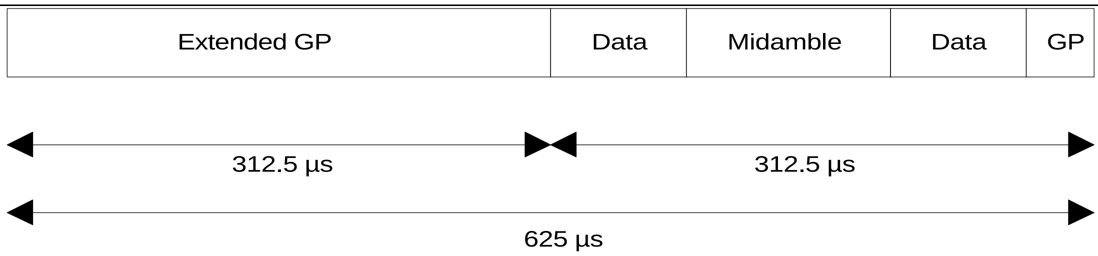

Figure 4 Access burst 2, GP denotes the guard period

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):

6.3 Automatic Repeat Request (ARQ)

<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.

4.6.2 RACH Channel Coding

Tab. 6.2.3-1 of V2.0.1:

Table 4.6.2-1 Error Correction Coding Parameters

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

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].

4.6.3 SCCC Turbo Coder

Note in sec. 6.2.3.2.1 of V2.1.1:

<Note: It needs to be clarified from TSG SA what are the service specifications with respect to different qualities of service. The performance below BER of 10^{-6} needs to be studied if there is a requirement for this quality of services over the physical layer.>

4.7 Spreading and modulation (TDD) (TS 25.223)

4.7.1 Chip rates different from 3.840 Mcps

Table 1 of V2.2.0:

Table 1: Basic modulation parameters.

Chip rate	same as FDD basic chiprate, 3.84 Mchip/s [(7.68,15.360 Mcps)]	Low chiprate: Value is FFS
Data modulation	QPSK	QPSK
Spreading characteristics	Orthogonal Q chips/symbol, where $Q = 2^p$, 0 <= p <= 4	Orthogonal Q chips/symbol, where $Q = 2^p$, 0 <= p <= 4

4.8 Physical layer procedures (TDD) (TS 25.224)

4.8.1 Synchronisation of Cells and ODMA Relays

Sec. 4.2 of V1.1.1:

4.2 Synchronisation of Cells and ODMA Relays

4.2.1 Synchronisation of TDD Cells

In several scenarios, there is a need to synchronise Node Bs in order to optimise system capacity. One example is a scenario for coordinated operation with overlapping coverage areas of the cells, i.e. there is contiguous coverage for a certain area.

Several alternatives can be used to synchronise Cells . The 3GPP TS25.2xx specification shall provide the means for Cell synchronisation by an air interface protocol.

< Editors note: The specification of this Cell synchronisation protocol is for further study and depends on required synchronisation accuracy. The protocol shall fulfil the following requirements:

- *Reliability and stability*
- *Low implementation effort*
- *Minimum impact on air interface traffic capacity.*

For example the two schemes below are considered in WG1:

1. *For Cell synchronisation via the air interface a special burst, the network synchronisation burst, is used. This burst is sent on a predetermined TS at regular intervals. During the reception of the network synchronisation burst in a cell the transmission in this cell has to be switched off. The UTRAN receives this burst and adjusts the frame timing in the cells accordingly.*
2. *Cells are synchronised by means of receiving other cells Physical Synchronisation Channel (PSCH). >*

4.2.1.1 Inter-system-synchronisation

<Editors Note: to be determined>

4.2.2 Synchronisation of ODMA Relays

Due to the relatively short range of transmissions, the inclusion of ODMA does not impose any additional guard period or frame synchronisation requirements over those discussed above for standard TDD.

Any potential overlap caused by relay transmissions will be localised to a node and its neighbours by the ODMA protocol.

The inclusion of ODMA could relax the guard period requirements when relaying between nodes (not involving the BS) since neighbouring UEs are regarded as relay opportunities and any communications between neighbours (on an ODCH) could be synchronised further

4.8.2 ODMA Power Control

Sec. 4.3.2 of V1.1.1:

4.3.2 ODMA Power Control
<for further study>

4.9 Physical Layer Measurements (TS 25.231)

5 History

Document history		
Editor of R1.03, Physical Layer Items Not For Inclusion In Release'99, is: Frank Kowalewski Bosch Telecom GmbH Tel.: +49 5341 28 5850 Fax: +49 5341 28 5140 Email: Frank.Kowalewski @ fr.bosch.de		
V0.0.1	1999-09-02	First version based on WG1 minutes, specifications, text proposals and WG1 discussion on the document's scope.
V0.1.0	1999-09-07	Version agreed with the following modifications at 7th WG1 meeting at Hanover: Note on SCCC Turbo Coder included, chip rates different from 3.84 Mcps included.
V0.1.1	1999-10-07	Sections 4.8.1 and 4.8.2 on ODMA included.
V0.1.2	1999-10-15	Sections 4.1.3, 4.2.2 and 4.2 on slow power control included.
This document is written in Microsoft Word 97.		