TSG RAN Working Group 1 Meeting #9 **TSGR1#9(99)i22**
Dresden, Germany, November 30 - December 3

TSG-RAN Working Group 2 (Radio L2 and Radio L3) TSGR2#8(99)g61
Cheju, Korea, 2 - 5 November 1999

Source: TSG RAN WG2

Title: Reply to liaison on Physical Layer Service Implementation Capabilities

To: TSG RAN WG1

Cc: TSG T WG2, TSG SA WG4

TSG RAN WG2 gratefully acknowledges the input from RAN WG1 on the Physical Layer capabilities for AMR and CS data. The structure of the new TR 25.926 on UE Radio Access Capabilities may be a bit different from the tables attached to the liaison from RAN WG1, but most of the information contained therein is understood to be included. It is observed that the place to describe capabilities related to blind rate detection may require further consideration. The first WG2-approved draft of the new report is attached to this liaison for information, checking and possible commenting by RAN WG1.

Regarding the following question from RAN WG1 related to the number of transport channels for the support of AMR:

> Number of transport channels higher than 4 in uplink, or higher than 5 in downlink ?: There has been a proposal in WG1 that the number of transport channels in the transport format combination set could be higher than the maximum number of transport channels in one frame. In that way the coding could be optimised for different AMR modes, by having different transport channels carrying the same bit class in different modes. (e.g. TrCH1 would carry class A at 12.2 k mode and TrCh5 would carry class A at 7.95 k mode). In this way the coding could be changed when changing the mode. There is not yet a consensus on this issue whether this can be acceptable. Thus TSG RAN WG1 would like to hear what is the opinion of TSG RAN WG2, whether they see this as an acceptable feature.

The view of RAN WG2 is encapsulated in the informative annex B of TS 25.302 "Services Provided by The Physical Layer" (v. 3.1.0)[1], which is attached as an annex to this LS. There the following is said:

> "On the radio interface, one Transport Channel is established per class of bits i.e. DCH A for class A, DCH B for class B and DCH C for class C."

Therefore four transport channels in uplink and five in downlink are considered sufficient for supporting all AMR modes. This view is based on the following assumptions:

- The rate matching and power control capabilities of the physical layer should be able to produce the requested quality with good efficiency on the radio interface. Thus no mode-specific encoding should be necessary.
- The mode-specific coding is used in GSM-based systems where one reason is to optimise a given slot size. Such restrictions don't appear in the same way in a CDMA-system such as the FDD-mode.

If the advantages of mode-specific coding are considered by SA WG4 to justify extra complexity in the radio interface protocols and UTRAN interfaces, the subject can be reconsidered by RAN WG2.

---

[1] This annex needs to be updated according to the information in the liaison from RAN WG1.

Annex: Example of Transport format attributes for AMR speech codec

The support for the AMR speech codec is exemplified below. On the radio interface, one Transport Channel is established per class of bits i.e. DCH A for class A, DCH B for class B and DCH C for class C. Each DCH has a different transport format combination set which corresponds to the necessary protection for the corresponding class of bits as well as the size of these class of bits for the various AMR codec modes.

With this principle, the AMR codec mode which is used during a given TTI can be deduced from the format of the transport channels DCH A, DCH B and DCH C for that particular TTI.

Note that a similar principle can also be applied for other source codecs e.g. other speech codecs or video codecs.
An example of transport channel description for each class of bits is given below:

	Attribute	Value		
		Class A	Class B	Class C
Dynamic part	Transport Block Size	81 65 75 61 55 55 49 39	103 99 84 87 79 63 54 56	60 40 0 0 0 0 0 0
	Transport Block Set Size	Same as the transport block sizes		
	Transmission Time Interval (option for TDD only)			
Semi-static part	Transmission Time Interval (FDD)	20 ms		
	Type of channel coding	Convolutional coding		
	code rates	1/2, 1/3 + class-specific rate matching	None, 1/2, 1/3 + class-specific rate matching	None, 1/2 , 1/3 + class-specific rate matching
	CRC size	8	0	0
	Resulting ratio after static rate matching	0.5 to 4(with no coding the rate matching ratio needs to be >1)		

TSG-RAN Working Group 2 (Radio L2 and Radio L3) *TSGR2#8(99)d43*
Cheju, Korea, 2 - 5 November 1999

Agenda Item: 4

Source: **Secretary**

Title: 3GPP TS 25.302: Services provided by the Physical Layer

Document for: Information

TS 25.302 v3.1.0 including CRs approved during 3GPP TSG RAN plenary #5.

TS 25.302 V3.1.0 (1999-10)

Technical Specification

3rd Generation Partnership Project (3GPP); Technical Specification Group (TSG) RAN; Working Group 2 (WG2);

Services provided by the Physical Layer

Reference

<Workitem> (<Shortfilename>.PDF)

Keywords

Digital cellular telecommunications system, Universal Mobile Telecommunication System (UMTS), UTRA, IMT-2000

3GPP

Postal address

Office address

Individual copies of this deliverable can be downloaded from
http://www.3gpp.org

Internet

secretariat@3gpp.org

Contents

Foreword

This Technical Specification has been produced by the 3GPP.

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

Version 3.y.z

where:

x the first digit:

2. presented to TSG for information;

2. presented to TSG for approval;

2. Indicates TSG approved document under change control.

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

z the third digit is incremented when editorial only changes have been incorporated in the specification.

1 Scope

The present document is a technical specification of the services provided by the physical layer of UTRA to upper layers.

2 References

References may be made to:

2. specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply;

2. all versions up to and including the identified version (identified by “up to and including” before the version identity);

2. all versions subsequent to and including the identified version (identified by “onwards” following the version identity); or

2. publications without mention of a specific version, in which case the latest version applies.

A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] ETSI UMTS 23.10 : UMTS Access Stratum Services and Functions

[2] 3GPP TS 25.301 : Radio Interface Protocol Architecture

[3] 3GPP TS 25.212 : UTRA FDD multiplexing, channel coding and interleaving description

[4] 3GPP TS 25.222 : UTRA TDD multiplexing, channel coding and interleaving description

[5] 3GPP TS 25.224 : Physical Layer Procedures (TDD)

3 Definitions and Abbreviations

3.1 Definitions

See [3] for a definition of fundamental concepts and vocabulary.

3.2 Abbreviations

ARQ	Automatic Repeat Request
BCCH	Broadcast Control Channel
BCH	Broadcast Channel
C-	Control-
CC	Call Control
CCCH	Common Control Channel
CCH	Control Channel
CCTrCH	Coded Composite Transport Channel
CN	Core Network
CRC	Cyclic Redundancy Check
DC	Dedicated Control (SAP)
DCA	Dynamic Channel Allocation
DCCH	Dedicated Control Channel
DCH	Dedicated Channel
DL	Downlink
DRNC	Drift Radio Network Controller
DSCH	Downlink Shared Channel
DTCH	Dedicated Traffic Channel
FACH	Forward Link Access Channel
FAUSCH	Fast Uplink Signaling Channel
FCS	Fame Check Sequence
FDD	Frequency Division Duplex
GC	General Control (SAP)
HO	Handover
ITU	International Telecommunication Union
kbps	kilo-bits per second
L1	Layer 1 (physical layer)
L2	Layer 2 (data link layer)
L3	Layer 3 (network layer)

LAC	Link Access Control
LAI	Location Area Identity
MAC	Medium Access Control
MM	Mobility Management
Nt	Notification (SAP)
OCCCH	ODMA Common Control Channel
ODCCH	ODMA Dedicated Control Channel
ODCH	ODMA Dedicated Channel
ODMA	Opportunity Driven Multiple Access
ORACH	ODMA Random Access Channel
ODTCH	ODMA Dedicated Traffic Channel
PCCH	Paging Control Channel
PCH	Paging Channel
PDU	Protocol Data Unit
PHY	Physical layer
PhyCH	Physical Channels
RACH	Random Access Channel
RLC	Radio Link Control
RNC	Radio Network Controller
RNS	Radio Network Subsystem
RNTI	Radio Network Temporary Identity
RRC	Radio Resource Control
SAP	Service Access Point
SCCH	Synchronization Control Channel
SCH	Synchronization Channel
SDU	Service Data Unit
SRNC	Serving Radio Network Controller
SRNS	Serving Radio Network Subsystem
TCH	Traffic Channel
TDD	Time Division Duplex
TFCI	Transport Format Combination Indicator
TFI	Transport Format Indicator
TMSI	Temporary Mobile Subscriber Identity
TPC	Transmit Power Control
U-	User-

UE	User Equipment
UE_R	User Equipment with ODMA relay operation enabled
UL	Uplink
UMTS	Universal Mobile Telecommunications System
URA	UTRAN Registration Area
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

4 Interfaces to the physical layer

The physical layer (layer 1) is the lowest layer in the OSI Reference Model and it supports all functions required for the transmission of bit streams on the physical medium.

The physical layer interfaces the Medium Access Control (MAC) Layer and the Radio Resource Control (RRC) Layer as depicted in figure 2.1.

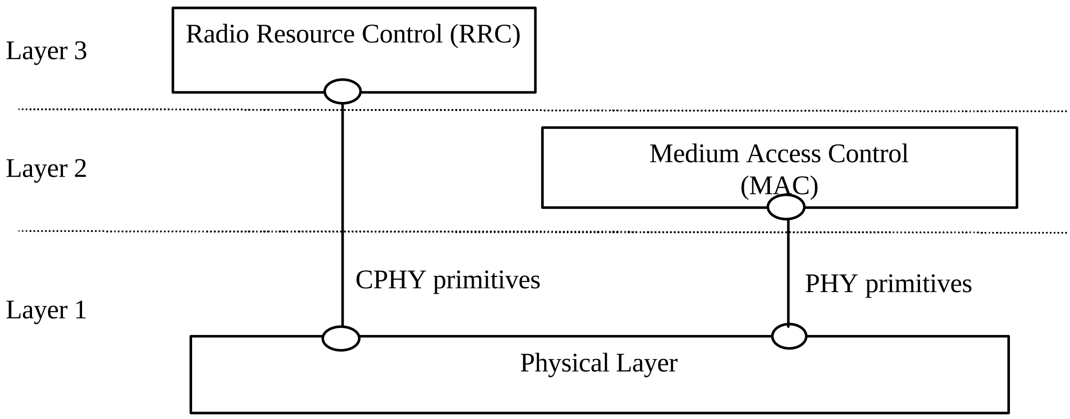


Figure 1 : Interfaces with the Physical Layer

4.1 Interface to MAC

The physical layer interfaces the MAC entity of layer 2.. Communication between the Physical Layer and MAC is in an abstract way performed by means of PHY-primitives defined which do not constrain implementations.

NOTE: The terms physical layer and layer 1, will be used synonymously in this description.

The PHY-primitives exchanged between the physical layer and the data link layer provide the following functions:

- transfer of transport blocks over the radio interface
- indicate the status of the layer 1 to layer 2

4.2 Interface to RRC

The physical layer interfaces the RRC entity of layer 3 in the UE and in the network.

Communication is performed in an abstract way by means of CPHY-primitives. They do not constrain implementations.

The CPHY-primitives exchanged between the physical layer and the Network layer provide the following function:

- control of the configuration of the physical layer

The currently identified exchange of information across that interface have only a local significance to the UE or Network.

5 Services and functions of the physical layer

5.1 General

The physical layer offers data transport services to higher layers. The access to these services is through the use of transport channels via the MAC sub-layer. The characteristics of a transport channel are defined by its transport format (or format set), specifying the physical layer processing to be applied to the transport channel in question, such as convolutional channel coding and interleaving, and any service-specific rate matching as needed.

The physical layer operates exactly according to the L1 radio frame timing. A transport block is defined as the data accepted by the physical layer to be jointly encoded. The transmission block timing is then tied exactly to this L1 frame timing, e.g. every transmission block is generated precisely every 10ms, or a multiple of 10 ms.

A UE can set up multiple transport channels simultaneously, each having own transport characteristics (e.g. offering different error correction capability). Each transport channel can be used for information stream transfer of one radio bearer or for layer 2 and higher layer signalling messages.

The multiplexing of these transport channels onto the same or different physical channels is carried out by L1. In addition, the Transport Format Combination Indication field (TFCI) shall uniquely identify the transport format used by each transport channel of the Coded Composite Transport Channel within the current radio frame.

5.2 Overview of L1 functions

The physical layer performs the following main functions:

- FEC encoding/decoding of transport channels
- Measurements and indication to higher layers (e.g. FER, SIR, interference power, transmission power, etc…)
- Macrodiversity distribution/combining and soft handover execution
- Error detection on transport channels
- Multiplexing of transport channels and demultiplexing of coded composite transport channels
- Rate matching
- Mapping of coded composite transport channels on physical channels
- Modulation and spreading/demodulation and despreading of physical channels
- Frequency and time (chip, bit, slot, frame) synchronization
- Closed-loop power control
- Power weighting and combining of physical channels
- RF processing
- Support of Uplink Synchronization as defined in [5] (TDD only)
- Timing advance on uplink channels (TDD only)

5.3 L1 interactions with L2 retransmission functionality

Provided that the RLC PDUs are mapped one-to-one onto the Transport Blocks, Error indication may be provided by L1 to L2. For that purpose, the L1 CRC can be used for individual error indication of each RLC PDU. The L1 CRC will then serve multiple purposes:

- Error indication for uplink macro diversity selection combining (L1)
- Frame error indication for speech services
- Quality indication

- Error indication for L2 retransmissions

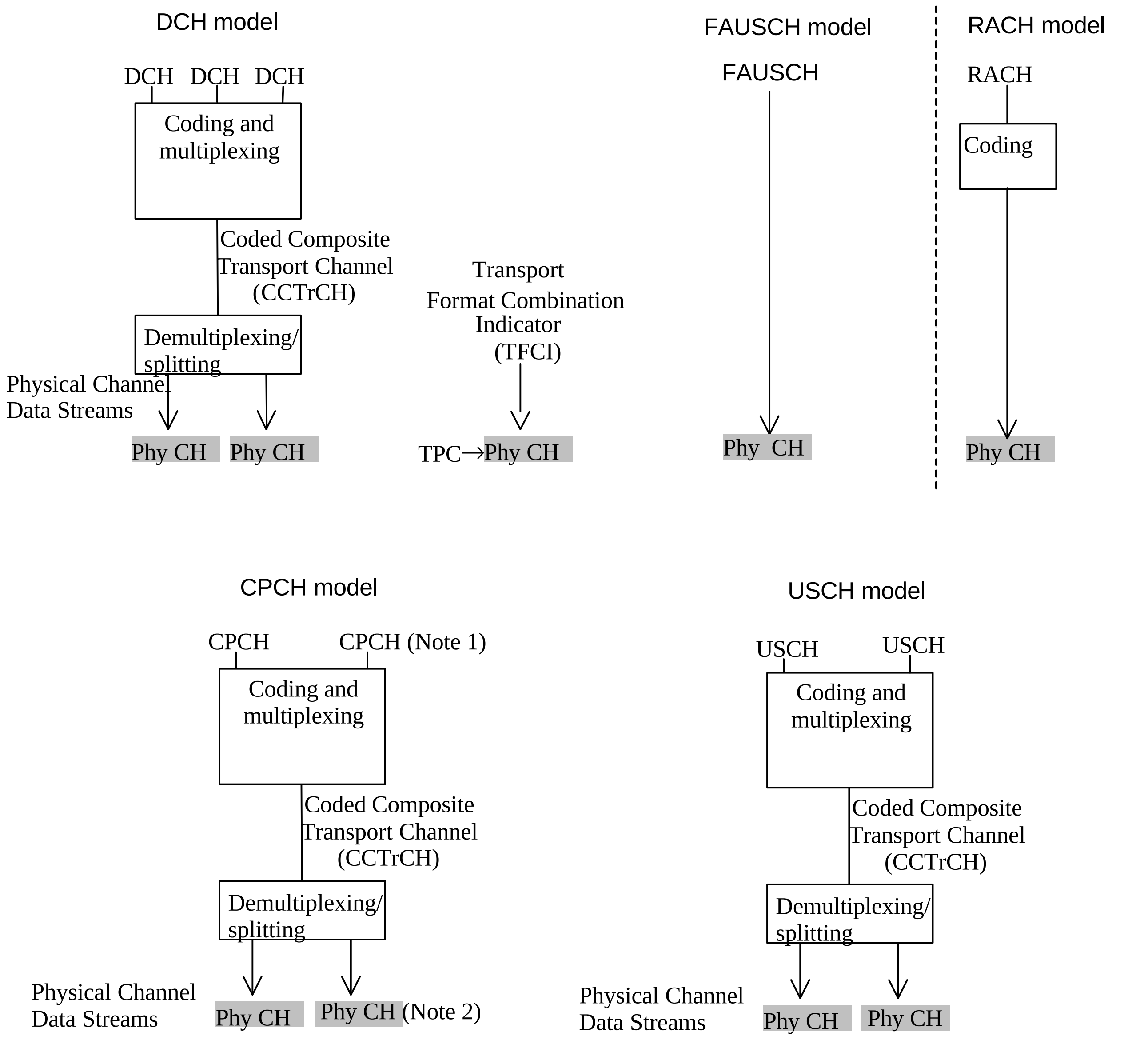
As a conclusion, L1 needs to give an error indication to L2 for each erroneous Transport Block delivered.

6 Model of physical layer of the UE

6.1 Uplink models

Figure 2 shows models of the UE’s physical layer in the uplink for both FDD and TDD mode. It shows two models: DCH model and RACH model. Some restriction exist for the use of different types of transport channel at the same time, these restrictions are described in the chapter “UE Simultaneous Physical Channel combinations”. More details can be found in [3] and [4].

Note: Models for uplink transport channels currently marked ffs will be necessary if these channels are included in the description.



Note 1: The need to multiplex several CPCH transport channels is FFS
Note 2: Only the data part of the CPCH can be mapped on multiple physical channels
Note 3: FAUSCH and CPCH are for FDD only.
Note 4: USCH is for TDD only.

Figure 2: Model of the UE's physical layer – uplink

The DCH model shows that one or several DCHs can be processed and multiplexed together by the same coding and multiplexing unit. The detailed functions of the coding and multiplexing unit are not defined in this document but in [3] and [4]. The single output data stream from the coding and multiplexing unit is denoted *Coded Composite Transport Channel (CCTrCH).*

The bits on a CCTrCH Data Stream can be mapped on the same Physical Channel and should have the same C/I requirement.

On the downlink, multiple CCTrCH can be used simultaneously with one UE. In the case of FDD, only one fast power control loop is necessary for these different CCtrCH, but the different CCtrCH can have different C/I requirements to provide different QoS on the mapped Transport Channels. In the case of TDD, different power control loops can be applied for different CCTrCH. One physical channel can only have bits coming from the same CCTrCH.

On the uplink and in the case of FDD, only one CCTrCH can be used simultaneously. On the uplink and in the case of TDD, multiple CCTrCH can be used simultaneously.

When multiple CCTrCH are used by one UE, one or several TFCI can be used, but each CCTrCH has only zero or one corresponding TFCI. In the case of FDD, these different words are mapped on the same DPCCH. In the case of TDD, these different TFCI can be mapped on different DPCH.

The data stream of the CCTrCH is fed to a data demultiplexing/splitting unit that demultiplexes/splits the CCTrCH's data stream onto one or several *Physical Channel Data Streams*.

Note: The term "splitting" used for above function in FDD mode has been replaced by "demultiplexing/splitting". The intention of using the term splitting is to express that this function is performed on bit level not on some block level. The term demultiplexing/splitting shall cover both cases, block or bit level demultiplexing, where block lengths larger than 1 bit may be applied in the TDD mode. This needs to be confirmed by the L1 group

The current configuration of the coding and multiplexing unit is either signalled to, or optionally blindly detected by, the network for each 10 ms frame. If the configuration is signalled, it is represented by the *Transport Format Combination Indicator (TFCI)* bits. Note that the TFCI signalling only consists of pointing out the current transport format combination within the already configured transport format combination set. In the uplink there is only one TFCI representing the current transport formats on all DCHs of one CCTrCH simultaneously. In FDD mode, the physical channel data stream carrying the TFCI is mapped onto the physical channel carrying the power control bits and the pilot.

The DCH and USCH have the possibility to perform Timing Advance in TDD mode.

For the FAUSCH, there is no coding, since the FAUSCH is only used for the transmission of a reservation request by sending an up-link signalling code (USC) at the time-offset allocated for the specific UE during the 10 ms frame. Due to the fixed time-offset allotted to a specific UE, the FAUSCH is a dedicated control channel.

The model for the RACH case shows that RACH is a common type transport channel in the uplink. RACHs are always mapped one-to-one onto physical channels, i.e. there is no physical layer multiplexing of RACH. Service multiplexing is handled by the MAC layer. The CPCH which is another common type transport channel has a physical layer model as shown in the above figure.

6.2 Downlink models

Figure 3 and Figure 4 show the model of the UE's physical layer for the downlink in FDD and TDD mode, respectively. Note that there is a different model for each transport channel type.

Note: Models for downlink transport channels currently marked ffs will be necessary if these channels are included in the description.

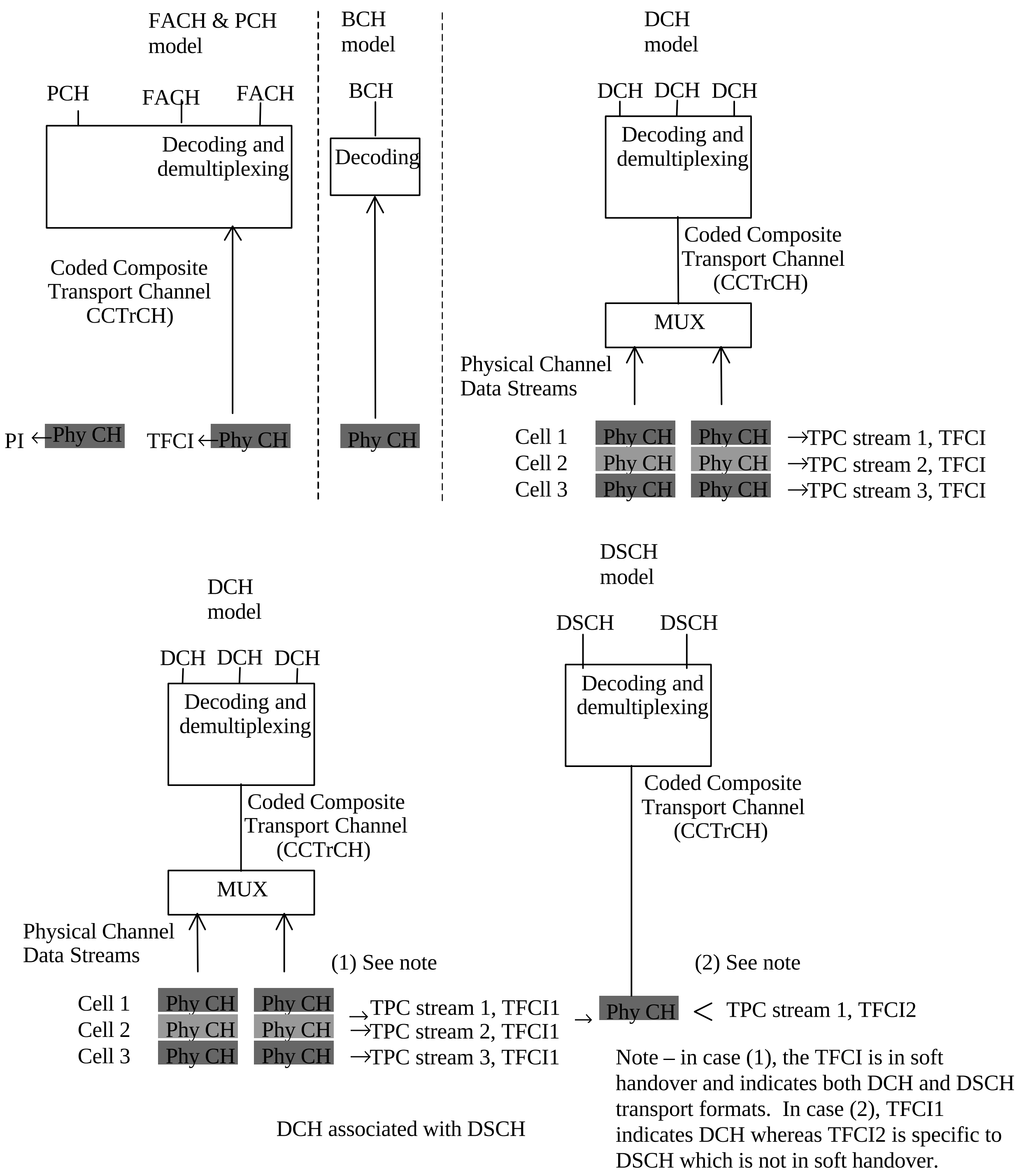


Figure 3: Model of the UE's physical layer – downlink FDD mode

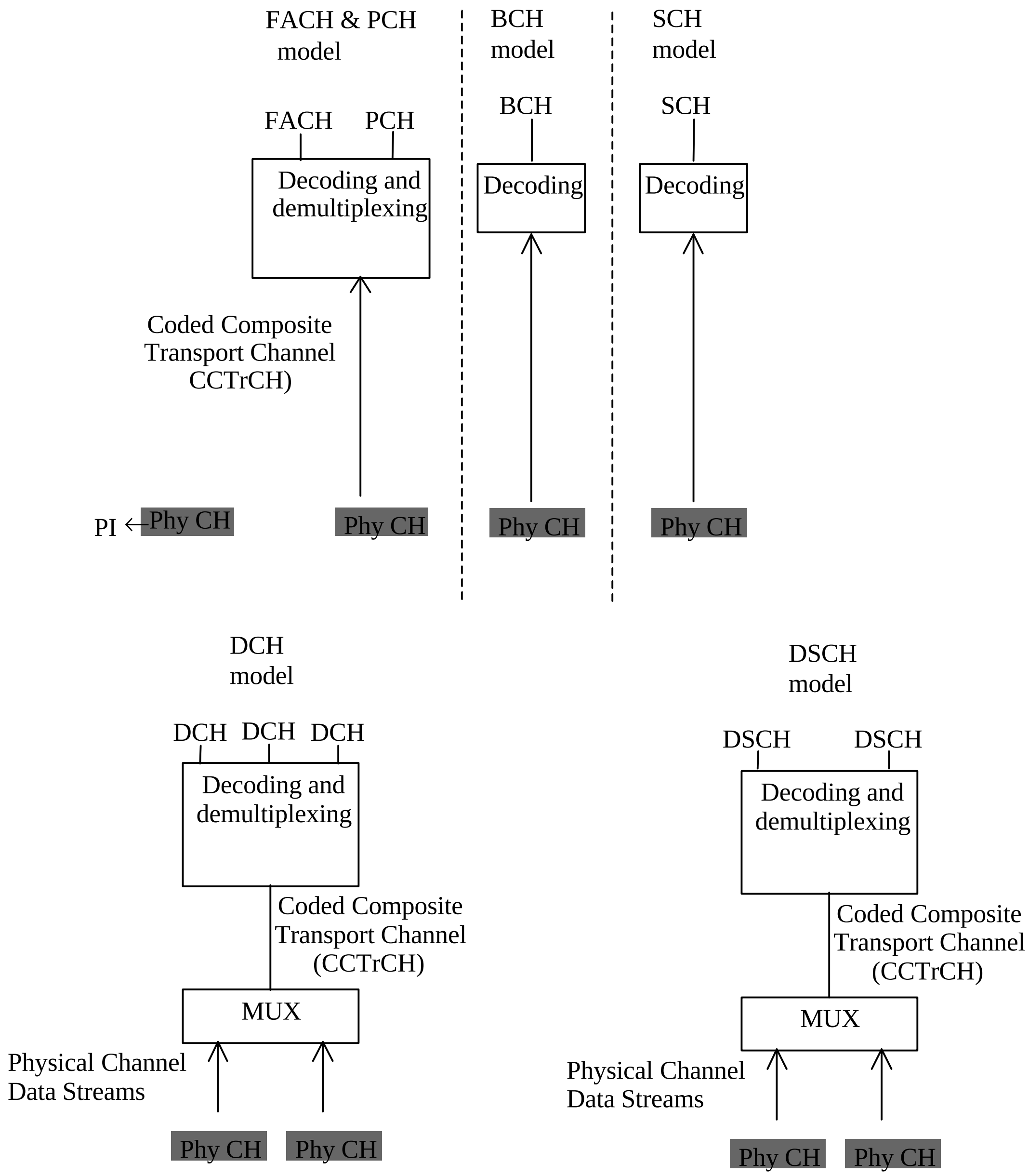


Figure 4: Model of the UE's physical layer – downlink TDD mode

For the DCH case, the mapping between DCHs and physical channel data streams works in the same way as for the uplink. Note however, that the number of DCHs, the coding and multiplexing etc. may be different in uplink and downlink.

In the FDD mode, the differences are mainly due to the soft and softer handover. Further, the pilot, TPC bits and TFCI are time multiplexed onto the same physical channel(s) as the DCHs. Further, the definition of physical channel data stream is somewhat different from the uplink.

Note that it is logically one and the same physical data stream in the active set of cells, even though physically there is one stream for each cell. The same processing and multiplexing is done in each cell. The only difference between the cells is the actual codes, and these codes correspond to the same spreading factor.

The physical channels carrying the same physical channel data stream are combined in the UE receiver, excluding the pilot, and in some cases the TPC bits. TPC bits received on certain physical channels may be combined provided that UTRAN has informed the UE that the TPC information on these channels is identical.

In the TDD mode, a PCH and a FACH can be encoded and multiplexed together forming a CCTrCH. The PCH is associated with a separate physical channel carrying page indicators (PIs) which are used to trigger UE reception of the physical channel that carries PCH. A FACH or a PCH can also be individually mapped onto separate physical channels. The BCH is always mapped onto one physical channel without any multiplexing with other transport channels.

Note, in the TDD mode there is the SCH in addition (not shown in Figure 4).

In the FDD mode, a PCH and one or several FACH can be encoded and multiplexed together forming a CCTrCH. Similarly as in the DCH model there is one TFCI for each CCTrCH for indication of the transport formats used on each PCH and FACH. The PCH is associated with a separate physical channel carrying page indicators (PIs) which are used to trigger UE reception of the physical channel that carries PCH. A FACH or a PCH can also be individually mapped onto a separate physical channel. The BCH is, as for TDD, always mapped onto one physical channel without any multiplexing with other transport channels.

6.3 Relay link Model

The Relay link applies to the TDD mode only. The applicability to the FDD mode is FFS.

Figure 4 illustrates the model of the UE's physical layer for the TDD mode.

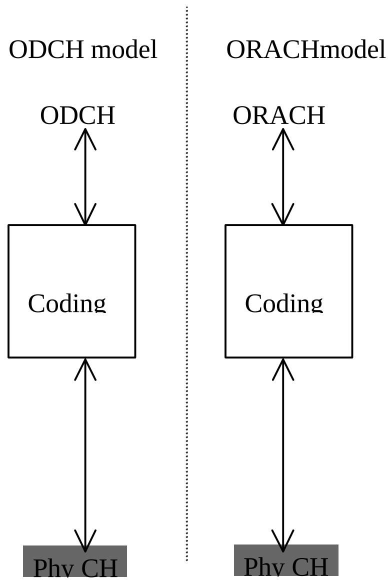


Figure 5 : Model of the UE's physical lay–r - relay link TDD mode.

The ORACH is a channel used within UE's to transmit and receive probing messages, and also to transmit and receive small packets of information. The ODCH is used to transmit larger amounts of data over a number of hops between UE's.

7 Formats and configurations for L1 data transfer

7.1 General concepts about Transport Channels

Layer 2 is responsible for the mapping of data onto L1 via the L1/L2 interface that is formed by the transport channels. In order to describe how the mapping is performed and how it is controlled, some definitions and terms are required. The required definitions are given in the following sections. Note that the definitions are generic for all transport channel types, i.e. not only for DCHs.

All Transport Channels are defined as unidirectional (i.e. uplink, downlink, or relay-link). This means that a UE can have simultaneously (depending on the services and the state of the UE) one or several transport channels in the downlink, and one or more Transport Channel in the uplink.

7.1.1 Transport Block

This is the basic unit exchanged between L1 and MAC, for L1 processing.

A Transport Block typically corresponds to an RLC PDU or corresponding unit. In the TDD mode it may possibly also be formed by a MAC peer-to-peer message. Layer 1 adds a CRC for each Transport Block.

7.1.2 Transport Block Set

This is defined as a set of Transport Blocks which are exchanged between L1 and MAC at the same time instance using the same transport channel.

7.1.3 Transport Block Size

This is defined as the number of bits in a Transport Block. The Transport Block Size is always fixed within a given Transport Block Set, i.e. all Transport Blocks within a Transport Block Set are equally sized.

7.1.4 Transport Block Set Size

This is defined as the number of bits in a Transport Block Set.

7.1.5 Transmission Time Interval

This is defined as the inter-arrival time of Transport Block Sets, and is equal to the periodicity at which a Transport Block Set is transferred by the physical layer on the radio interface. It is always a multiple of the minimum interleaving period (e.g. 10ms, the length of one Radio Frame). The MAC delivers one Transport Block Set to the physical layer every TTI.

Figure 6 shows an example where Transport Block Sets, at certain time instances, are exchanged between MAC and L1 via three parallel transport channels. Each Transport Block Set consists of a number of Transport Blocks. The Transmission Time Interval, i.e. the time between consecutive deliveries of data between MAC and L1, is also illustrated.

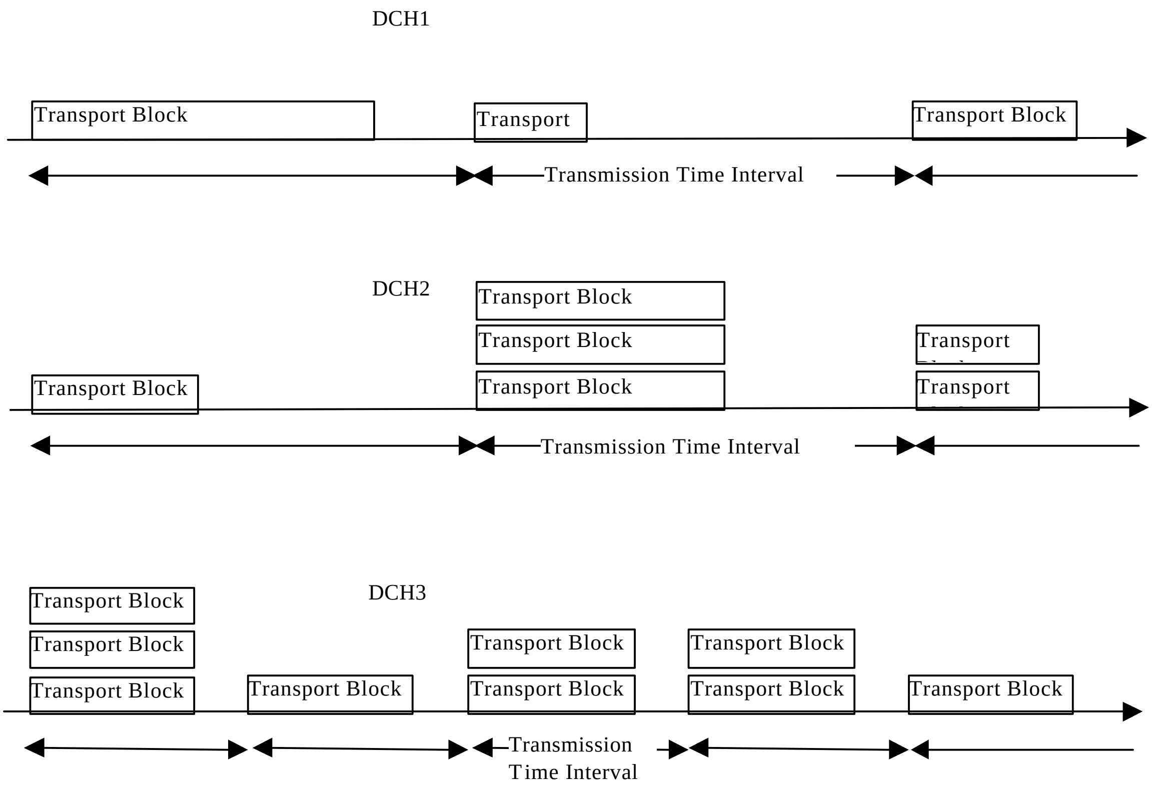


Figure 6. Exchange of data between MAC and L1

7.1.6 Transport Format

This is defined as a format offered by L1 to MAC (and vice versa) for the delivery of a Transport Block Set during a Transmission Time Interval on a Transport Channel. The Transport Format constitutes of two parts – one *dynamic* part and one *semi-static* part.

Attributes of the dynamic part are:

- Transport Block Size
- Transport Block Set Size
- Transmission Time Interval (optional dynamic attribute for TDD only)

Attributes of the semi-static part are:

- Transmission Time Interval (mandatory for FDD, optional for the dynamic part of TDD NRT bearers)
- Error protection scheme to apply
    - Type of error protection, turbo code, convolutionnal code or no channel coding
    - coding rate
    - Static rate matching parameter
    - Puncturing limit for uplink
- Size of CRC

In the following example, the Transmission time Interval is seen as a semi-static part

Example:

- Dynamic part: {320 bits, 640 bits}, Semi-static part: {10ms, convolutional coding only, static rate matching parameter = 1}

7.1.7 Transport Format Set

This is defined as the set of Transport Formats associated to a Transport Channel.

The semi-static parts of all Transport Formats are the same within a Transport Format Set.

Effectively the first two attributes of the dynamic part form the instantaneous bit rate on the Transport Channel. Variable bit rate on a Transport Channel may, depending on the type of service which is mapped onto the transport channel, be achieved by changing between each Transmission Time Interval one of the following:

1. the Transport Block Set Size only
2. both the Transport Block Size and the Transport Block Set Size

Example 1:

- Dynamic part: {20 bits, 20 bits}; {40 bits, 40 bits}; {80 bits, 80 bits}; {160 bits, 160 bits}
- Semi-static part: {10ms, Convolutional coding only, static rate matching parameter = 1}

Example 2:

- Dynamic part: {320 bits, 320 bits}; {320 bits, 640 bits}; {320 bits, 1280 bits}
- Semi-static part: {10ms, Convolutional coding only, static rate matching parameter = 2}

The first example may correspond to a Transport Channel carrying a speech service, requiring blocks delivered on a constant time basis. In the second example, which illustrates the situation where a non-real time service is carried by the Transport Channel, the number of blocks delivered per Transmission Time Interval varies between the different Transport Formats within the Transport Format Set. Referring to Figure 6, the Transport Block Size is varied on DCH1 and DCH2. That is, a Transport Format Set where the dynamic part has a variable Transport Block Size has been assigned for DCH1. On DCH3 it is instead only the Transport Block Set Size that is varied. That is, the dynamic parts of the corresponding Transport Format Sets only include variable Transport Block Set Sizes.

7.1.8 Transport Format Combination

The layer 1 multiplexes one or several Transport Channels, and for each Transport Channel, there exists a list of transport formats (Transport Format Set) which are applicable. Nevertheless, at a given point of time, not all combinations may be submitted to layer 1 but only a subset, the Transport Format Combination. This is defined as an authorised combination of the combination of currently valid Transport Formats that can be submitted simultaneously to the layer 1 for transmission on a Coded Composite Transport Channel of a UE, i.e. containing one Transport Format from each Transport Channel.

Example:

DCH1: Dynamic part: {20 bits, 20 bits}, Semi-static part: {10ms, Convolutional coding only, static rate matching parameter = 2}

DCH2: Dynamic part: {320 bits, 1280 bits}, Semi-static part: {10ms, Convolutional coding only, static rate matching parameter = 3}

DCH3: Dynamic part: {320 bits, 320 bits}, Semi-static part: {40ms, Turbo coding, static rate matching parameter = 2}

7.1.9 Transport Format Combination Set

This is defined as a set of Transport Format Combinations on a Coded Composite Transport Channel.

Example:

Dynamic part:

Combination 1: DCH1: {20 bits, 20 bits}, DCH2: {320 bits, 1280 bits}, DCH3: {320 bits, 320 bits}

Combination 2: DCH1: {40 bits, 40 bits}, DCH2: {320 bits, 1280 bits}, DCH3: {320 bits, 320 bits}

Combination 3: DCH1: {160 bits, 160 bits}, DCH2: {320 bits, 320 bits}, DCH3: {320 bits, 320 bits}

Semi-static part:

DCH1: {10ms, Convolutional coding only, static rate matching parameter = 1}

DCH2: {10ms, Convolutional coding only, static rate matching parameter = 1}

DCH3: {40ms, Turbo coding, static rate matching parameter = 2}

The Transport Format Combination Set is what is given to MAC for control. However, the assignment of the Transport Format Combination Set is done by L3. When mapping data onto L1, MAC chooses between the different Transport Format Combinations given in the Transport Format Combination Set. Since it is only the dynamic part that differ between the Transport format Combinations, it is in fact only the dynamic part that MAC has any control over.

The semi-static part, together with the target value for the L1 closed loop power control, correspond to the service attributes:

- Quality (e.g. BER)
- Transfer delay

These service attributes are then offered by L1. However, it is L3 that guarantees that the L1 services are fulfilled since it is in charge of controlling the L1 configuration, i.e. the setting of the semi-static part of the Transport Formats. Furthermore, L3 controls the target for the L1 closed loop power control through the outer loop power control (which actually is a quality control rather than a power control).

Note that a Transport Format Combination Set need not contain all possible Transport Format Combinations that can be formed by Transport Format Sets of the corresponding Transport Channels. It is only the allowed combinations that are included. Thereby a maximum total bit rate of all transport channels of a Code Composite Transport Channel can be set appropriately. That can be achieved by only allowing Transport Format Combinations for which the included Transport Formats (one for each Transport Channel) do not correspond to high bit rates simultaneously.

The selection of Transport Format Combinations can be seen as a fast part of the radio resource control. The dedication of these fast parts of the radio resource control to MAC, close to L1, means that the flexible variable rate scheme provided by L1 can be fully utilised. These parts of the radio resource control should be distinguished from the slower parts, which are handled by L3. Thereby the bit rate can be changed very fast, without any need for L3 signalling.

7.1.10 Transport Format Indicator (TFI)

The TFI is a label for a specific transport format within a transport format set. It is used in the inter-layer communication between MAC and L1 each time a transport block set is exchanged between the two layers on a transport channel.

When the DSCH is associated with a DCH, the TFI of the DSCH also indicates the physical channel (i.e. the channelization code) of the DSCH that has to be listened to by the UE.

7.1.11 Transport Format Combination Indicator (TFCI)

This is a representation of the current Transport Format Combination.

There is a one-to-one correspondence between a certain value of the TFCI and a certain Transport Format Combination. The TFCI is used in order to inform the receiving side of the currently valid Transport Format Combination, and hence how to decode, de-multiplex and deliver the received data on the appropriate Transport Channels.

MAC indicates the TFI to Layer 1 at each delivery of Transport Block Sets on each Transport Channel. Layer 1 then builds the TFCI from the TFIs of all parallel transport channels of the UE , processes the Transport Blocks appropriately and appends the TFCI to the physical control signalling . Through the detection of the TFCI the receiving side is able to identify the Transport Format Combination. For FDD, in case of limited Transport Format Combination Sets the TFCI signalling may be omitted, instead relying on blind detection. Nevertheless, from the assigned Transport

Format Combinations, the receiving side has all information it needs in order to decode the information and transfer it to MAC on the appropriate Transport Channels.

The multiplexing and exact rate matching patterns follow predefined rules and may therefore be derived (given the Transport Format Combinations) by transmitter and receiver without signalling over the radio interface.

When the meaning of the TFCI field needs to be reconfigured, two procedures can be used depending on the level of reconfiguration:

- **Complete reconfiguration of TFCI:** In this procedure all TFCI values are reinitialized and new values are defined instead. The complete reconfiguration requires an explicit synchronization between the UE and UTRAN regarding when the reconfiguration becomes valid.

- **Incremental reconfiguration of TFCI:** In this procedures, a part of the TFCI values before and after the reconfiguration remain identical (note that this must be true for at least a TFCI that carry the signaling connection). This procedure supports addition, removal or redefinition of TFCI values. This procedure does not require an explicit execution time. This procedure may imply the loss of some user-plane data.

7.1.12 Rate matching

Two levels of rate matching are defined on the radio interface:

- A static rate matching per Transport Channel. The static rate matching is part of the semi-static attributes of the Transport Channel

- A dynamic rate matching per CCTrCH. The dynamic rate matching adjusts the size of the physical layer data payload to the physical channel as requested by RRC.

The static rate matching and the dynamic rate matching to be applied by the physical layer are indicated by RRC to the physical layer.

RRC is responsible for configurating the physical layer on whether:

- Blind Rate Detection or TFCI is used

- Dynamic rate matching is applied or not on the downlink

7.2 Types of Transport Channels

A general classification of transport channels is into two groups:

- common channels and
- dedicated channels (where the UEs can be unambiguously identified by the physical channel, i.e. code and frequency)

Common transport channel types are:

1. Random Access Channel(s) (RACH) characterized by:
    - existence in uplink only,
    - limited data field. The exact number of allowed bits is FFS.
    - collision risk,
    - open loop power control,
2. ODMA Random Access Channel(s) (ORACH) characterized by:
    - used in TDD mode only (FDD is for FFS)
    - existence in relay-link
    - collision risk,
    - open loop power control,

- no timing advance control

3. Forward Access Channel(s) (FACH) characterized by:
    - existence in downlink only,
    - possibility to use beam forming,
    - possibility to use slow power control,
    - possibility to change rate fast (each 10ms),
    - lack of fast power control and
4. Broadcast Channel (BCH) characterized by:
    - existence in downlink only,
    - low fixed bit rate and
    - requirement to be broadcast in the entire coverage area of the cell.
5. Paging Channel (PCH) characterized by:
    - existence in downlink only,
    - association with a physical layer signal, the Page Indicator, to support efficient sleep mode procedures and
    - requirement to be broadcast in the entire coverage area of the cell.
6. Synchronisation channel (SCH) characterised by :
    - existence in TDD and downlink only
    - low fixed bit rate
    - requirement to be broadcast in the entire coverage area of the cell
7. Downlink Shared Channel(s) (DSCH) characterised by:
    - existence in downlink only,
    - possibility to use beamforming,
    - possibility to use slow power control,
    - possibility to use fast power control, when associated with dedicated channel(s)
    - possibility to be broadcast in the entire cell
    - always associated with another channel (DCH or DSCH Control Channel).
8. DSCH Control Channel characterised by:
    - existence in downlink only,
    - possibility to use beam forming,
    - possibility to use slow power control,
    - lack of fast power control

    Note: It is for further study whether or not the DSCH Control Channel needs to be regarded as separate transport channel type from FACH. Seen from the upper layers, the current requirements are identical to a FACH, but some extra L1 information (e.g.TPC bits) may lead to a different physical channel.
9. CPCH Channel characterised by:
    - existence in FDD only,
    - existence in uplink only,
    - fast power control on the message part,
    - possibility to use beam forming,
    - possibility to change rate fast,

- collision detection,
- open loop power estimate for pre-amble power ramp-up
- possibility to use timing advance

9. Uplink Shared channel (USCH) characterised by:
    - used in TDD only
    - existence in uplink only,
    - possibility to use beam forming,
    - possibility to use power control,
    - possibility to change rate fast
    - possibility to use Uplink Synchronization

Dedicated transport channel types are:

1. Dedicated Channel (DCH) characterized by:
    - existing in uplink or downlink
    - possibility to use beam forming,
    - possibility to change rate fast (each 10ms),
    - fast power control
    - possibility to use timing advance (TDD only)
    - possibility to use Uplink Synchronization

2. Fast Uplink Signaling Channel (FAUSCH) to allocate, in conjunction with FACH, dedicated channels; the FAUSCH is characterized by:
    - existing in uplink only,
    - inherent addressing of a UE by a unique time-offset (indicating to a UE when to send an uplink signalling code, USC) related to the beginning of the 10 ms frame,
    - allowing for a UE to notify (by sending an USC) a request for a DCH, the allocation of which is messaged via the FACH. No further information is conveyed via the FAUSCH,

applicability for TDD mode is FFS3. ODMA Dedicated Channel (ODCH) characterized by:

- used in TDD mode only (FDD is for FFS),
- possibility to use beam forming,
- possibility to change rate fast (each 10ms),
- closed loop power control,
- closed loop timing advance control

To each transport channel (except for the FAUSCH, since it only conveys a reservation request),, there is an associated Transport Format (for transport channels with a fixed or slow changing rate) or an associated Transport Format Set (for transport channels with fast changing rate).

7.3 Compressed Mode

Compressed Mode is defined as the mechanism whereby certain idle periods are created in radio frames so that the UE can perform measurements during these periods (more details can be found in [3]).

Compressed Mode is obtained by layer 2 using transport channels provided by the layer 1 as follows :

- Compressed Mode is controlled by the RRC layer which configures the layer 2 and the physical layer
- The number of occurrences of compressed frames is controlled by RRC, and can be modified by RRC signalling
- Layer 2 instructs every Transmission Time Interval the Layer 1 on whether compressed mode should be applied for a given Transport Format Combination Set. The instruction may indicate also the type of compressed mode.
- The compression of frames can be either cyclic (typically for circuit services) in a compressed mode pattern (defined below) or a-periodic (typically for NRT services)
- It is under the responsibility of the layer 2 if necessary and if possible to either buffer some layer 2 PDUs (typically at the RLC layer for NRT services) or to rate adapt the data flow (similarly to GSM) so that there is no loss of data because of compressed mode. This will be service dependent and controlled by the RRC layer.

The following parameters characterize a transmission gap :

- TGL : Transmission Gap Length is the duration of no transmission, expressed in number of slots.
- CFN : The connection frame number when the transmission gap starts
- SN : The slot number when the transmission gap starts

With this definition, it is possible to have a flexible position of the transmission gap in the frame.

The following parameters characterize a compressed mode pattern (illustrated in Figure 1) :

- TGP : Transmission Gap Period is the period of repetition of a set of consecutive frames containing up to 2 transmission gaps (*).
- TGL : As defined above
- TGD : Transmission Gap Distance is the duration of transmission between two consecutive transmission gaps within a transmission gap period, expressed in number of frames. In case there is only one transmission gap in the transmission gap period, this parameter shall be set to zero.
- PD: Pattern duration is the total time of all TGPs expressed in number of frames.
- CFN : The connection frame number when the first transmission gap starts
- PCM: Power Control Mode specifies the uplink power control algorithm applied during recovery period after each transmission gap in compressed mode. PCM can take 2 values (0 or 1). The different power control modes are described in TS 25.214.

In a compressed mode pattern, the first transmission gap starts in the first frame of the pattern. The gaps have a fixed position in the frames, and start in the slot position defined in [3].

(*) : Optionally, the set of parameters may contain 2 values TGP1 and TGP2, where TGP1 is used for the 1st and the consecutive odd gap periods and TGP2 is used for the even ones. Note if TGP1=TGP2 this is equivalent to using only one TGP value.

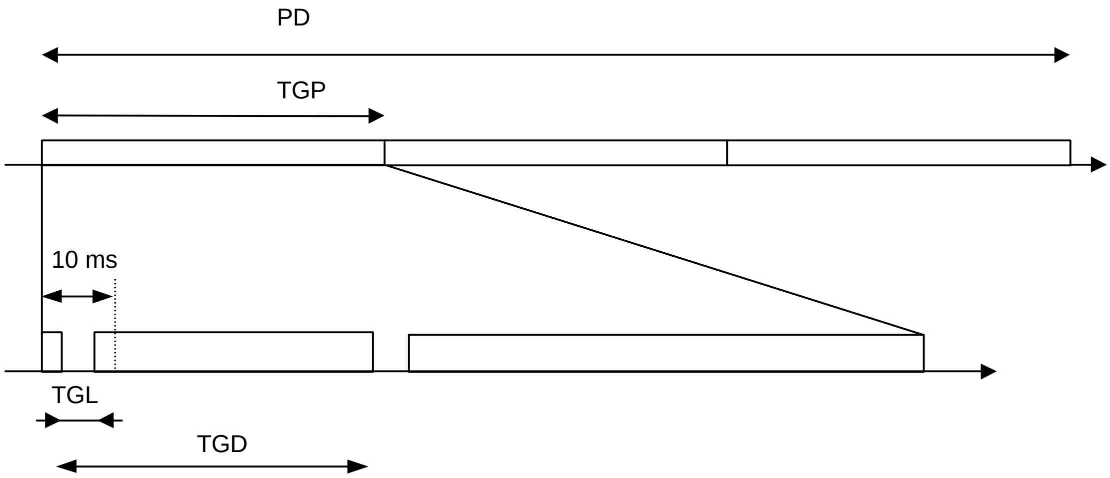


Figure 7. Illustration of compressed mode pattern parameters.

8 UE Simultaneous Physical Channels combinations

This sections describes the requirements from the UE to send and receive on multiple Transport Channels which are mapped on different physical channels simultaneously depending on the service capabilities and requirements. The section will describe the impacts on the support for multiple services (e.g. speech call and SMS-CB) depending on the UE capabilities.

8.1 FDD Uplink

The table describes the possible combinations of FDD physical channels that can be supported in the uplink by one UE at any one time.

	Physical Channel Combination	Transport Channel Combination	**Baseline Capability or Service dependent**	**Comment**
1	PRACH	RACH	Baseline	The PRACH physical channel includes the preambles and the message.
2	PRACH	FAUSCH	Service dependent	
3	PCPCH consisting of one control and one data part during the message portion	CPCH	Service dependent	The PCPCH physical channel includes the preambles and the message. The maximum channel bit rate is dependant on UE Service Capability
4	PCPCH consisting of one control and more than one data part during the message portion	CPCH	Service dependent	The PCPCH physical channel includes the preambles and the message. The maximum channel bit rate is dependant on UE Service Capability
5	DPCCH+DPDCH	One or more DCH coded into a single CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependant on UE Service Capability
6	DPCCH+ more than one DPDCH	One or more DCH coded into a single CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependant on UE Service Capability

8.2 FDD Downlink

The table describes the possible combinations of FDD physical channels that can be supported in the downlink by one UE at any one time.

	Physical Channel Combination	**Transport Channel Combination**	**Baseline Capability or Service dependent**	**Comment**
1	PCCPCH	BCH	Baseline	
2	SCCPCH	FACH + PCH	Baseline	The maximum channel bit rate that can be supported is dependent on the UE Service Capability
3	SCCPCH + AICH	FACH + PCH + RACH in uplink Or FACH + PCH + CPCH in uplink	Baseline	The maximum channel bit rate that can be supported is dependent on the UE Service Capability. This physical channel combination facilitates the preamble portion of the CPCH in the uplink
4	SCCPCH + DPCCH	FACH + PCH + CPCH in uplink	Service dependent	This physical channel combination facilitates the message portion of the CPCH in the uplink
5	More than one SCCPCH	More than one FACH + PCH	Service dependent	
6	PICH	N/A	Baseline	
7	DPCCH + DPDCH	One or more DCH coded into a single CCTrCH	Service dependant	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability
8	DPCCH + more than one DPDCH	One or more DCH coded into a single CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability
9	PDSCH + DPCCH + one or more DPDCH	DSCH + one or more DCH coded into a single CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability
10	SCCPCH + DPCCH + one or more DPDCH	FACH + one or more DCH coded into a single CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability This combination of physical channels is used for DRAC control of an uplink DCH and for receiving services such as cell broadcast or multicast whilst in connected mode.
11	SCCPCH + PDSCH + DPCCH + one or more DPDCH	FACH + DSCH + one or more DCH coded into a single CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability This combination of physical channels is used for simultaneous DSCH and DRAC control of an uplink DCH.

12	More than one DPCCH + more than one DPDCH	More than one DCH coded into one or more CCTrCH	Service dependent	*See note 1*

Notes:

1 The use of more than one DPCCH and/or more than one CCTrCH are currently for FFS within TSG RAN WG1.

8.3 TDD Uplink

The table describes the possible combinations of TDD physical channels that can be supported in the uplink by one UE in any one 10ms frame, where a TDD physical channel corresponds to one code, one timeslot, one frequency and is mapped to one resource unit (RU). This table addresses combinations of uplink physical channels in the same 10ms frame.

	Physical Channel Combination	**Transport Channel Combination**	**Baseline Capability or Service Dependent**	**Comment**
1	PRACH	RACH	Baseline	One RACH transport channel maps to one PRACH physical channel.
2	One or more DPCH	One or more DCH coded into one or more CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability.
3	PRACH + one or more DPCH	RACH + one or more DCH coded into one or more CCTrCH	Service dependent	One RACH transport channel maps to one PRACH physical channel The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability.
4	One or more PUSCH	One or more USCH coded onto one or more CCTrCH	Service dependent	It is assumed here that a USCH transport channel may map to one or more PUSCH physical channels based on system configuration. USCH requires a control channel (RACH or DCH); however, it is not required to be in the same 10ms frame as the USCH.
5	PRACH + one or more PUSCH	RACH + One or more USCH coded on to one or more CCTrCH	Service dependent	One RACH transport channel maps to one PRACH physical channel. It is assumed here that a USCH transport channel may map to one or more PUSCH physical channels based on system configuration.

6	One or more PUSCH + one or more DPCH	One or more USCH coded onto one or more CCTrCH + one or more DCH coded into one or more CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability. It is assumed here that a USCH transport channel may map to one or more PUSCH physical channels based on system configuration.
7	PRACH + one or more PUSCH + one or more DPCH	RACH + one or more USCH coded onto one or more CCTrCH + one or more DCH coded into one or more CCTrCH	Service dependent	One RACH transport channel maps to one PRACH physical channel. The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability. It is assumed here that a USCH transport channel may map to one or more PUSCH physical channels based on system configuration.

8.4 TDD Downlink

The table describes the possible combinations of TDD physical channels that can be supported in the downlink by one UE in any one 10ms frame, where a TDD physical channel corresponds to one code, one timeslot, one frequency and is mapped to one resource unit (RU). This table addresses combinations of downlink physical channels in the same 10ms frame.

	Physical Channel Combination	**Transport Channel Combination**	**Baseline Capability or Service dependent**	**Comment**
1	One or two PSCH	SCH	Baseline	SCH can map to one or two PSCH in a frame depending on the synchronization case as defined in 25.221 (see note 1)
2	One or more CCPCH	BCH and/or PCH and/or one or more FACH	Baseline	BCH can map to multiple CCPCH in a frame. FACH can map to multiple CCPCH in a frame. PCH can map to multiple CCPCH in a frame. See note 2.

3	One or more DPCH	One or more DCH coded into one or more CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability
4	One or more CCPCH + one or more DPCH	BCH and/or PCH and/or one or more FACH + one or more DCH coded into one or more CCTrCH	Service dependent	The number of DCHs and the maximum channel bit rate are dependent on the UE Service Capability. BCH can map to multiple CCPCH in a frame. FACH can map to multiple CCPCH in a frame. See note 2.

5	One or more PDSCH	One or more DSCH coded onto one or more CCTrCH	Service dependent	It is assumed here that a DSCH transport channel may map to one or more PDSCH physical channels based on system configuration. DSCH requires a control channel (FACH or DCH); however, it is not required to be in the same 10ms frame as the DSCH.
6	One or more PDSCH + one or more CCPCH	BCH and/or PCH and/or one or more FACH + one or more DSCH coded onto one or more CCTrCH	Service dependent	BCH can map to multiple CCPCH in a frame. Each FACH can map to multiple CCPCH in a frame. It is assumed here that a DSCH transport channel may map to one or more PDSCH physical channels based on system configuration. For the case of DSCH + BCH, DSCH requires a control channel (FACH or DCH); however, it is not required to be in the same 10ms frame as the DSCH. See note 2.
7	One or more PDSCH + one or more DPCH	One or more DSCH coded onto one or more CCTrCH + one or more DCH coded into one or more CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability It is assumed here that a DSCH transport channel may map to one or more PDSCH physical channels based on system configuration.
8	One or more PDSCH + one or more CCPCH + one or more DPCH	BCH and/or PCH and/or one or more FACH + one or more DSCH coded onto one or more CCTrCH + one or more DCH coded into one or more CCTrCH	Service dependent	BCH can map to multiple CCPCH in a frame. Each FACH can map to multiple CCPCH in a frame. The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability It is assumed here that a DSCH transport channel may map to one or more PDSCH physical channels based on system configuration. See note 2.

Notes:

1. Reference: TS25.221: Physical Channels and Mapping of Transport Channels Onto Physical Channels (TDD).
2. The possibility to multiplex PCH and one or more FACH on one or more CCTrCHs is FFS
3. The PSCH synchronization channel can co-exist with all listed combinations

8.5 TDD UE Uplink and Downlink Combinations (within 10 ms air frames)

This table describes the possible uplink and downlink physical channel combinations that can be supported by a UE in TDD mode.

	DL Physical Channel Combination	DL Transport Channel Combination	UL Physical Channel Combination	UL Transport Channel Combination	Baseline Capability or Service Dependent	Comment
1			PRACH	RACH	Baseline	One RACH transport channel maps to one PRACH physical channel
2	One or more CCPCH	BCH and/or PCH and/or one or more FACH			Baseline	BCH or FACH, or PCH can map to multiple CCPCH in a frame.
3	One or more CCPCH	BCH and/or PCH and/or one or more FACH	PRACH	RACH	Baseline	One RACH transport channel maps to one PRACH physical channel BCH or FACH, or PCH can map to multiple CCPCH in a frame.
4	One or more CCPCH	BCH and/or PCH and/or one or more FACH	PRACH and one or more DPCH	RACH and one or more DCH coded into one or more CCTrCH	Service Dependent	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability. BCH or FACH, or PCH can map to multiple CCPCH in a frame.
5	One or more CCPCH and one or more DPCH	BCH and/or PCH and/or one or more FACH and one or more DCH coded onto one or more CCTrCH	PRACH and one or more DPCH	RACH and one or more DCH coded into one or more CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability. See Note 1. BCH or FACH, or PCH can map to multiple CCPCH in a frame.

6			One or more DPCH	One or more DCH coded into one or more CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability.

7	One or more DPCH	One or more DCH coded onto one or more CCTrCH	One or more DPCH	One or more DCH coded into one or more CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability. See Note 1.

Notes:

1. The requirement for an UL DCH to exist in every 10 ms frame for DL Power Control, Transmit Diversity, and Joint Pre-distortion is FFS.

2. The PSCH synchronization channel can co-exist with all listed combinations

3. USCH and DSCH combinations are FFS

8.6 TDD UE Uplink Timeslot Combinations

This table describes possible uplink physical channels that can be supported by a UE within a specific time slot.

	Physical Channel Combination	Transport Channel Combination	Baseline Capability or Service Dependent	Comment
1	PRACH	RACH	Baseline	Time slots supporting RACH do not support other channel types. One RACH transport channel maps to one PRACH physical channel.
2	One or more DPCH	One or more DCH coded into one or more CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability.
3	One or more PUSCH	One or more USCH coded onto one or more CCTrCH	Service dependent	It is assumed here that a USCH transport channel may map to one or more PUSCH physical channels based on system configuration. USCH requires a control channel (RACH/FACH or DCH); however, it is not required to be in the same 10ms frame as the USCH.
4	One or more PUSCH + one or more DPCH	One or more USCH coded onto one or more CCTrCH + one or more DCH coded into one or more CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability. It is assumed here that a USCH transport channel may map to one or more PUSCH physical channels based on system configuration.

8.7 TDD UE Downlink Timeslot Combinations

This table describes possible downlink physical channels that can be supported by a UE within a specific time slot.

	Physical Channel Combination	Transport Channel Combination	Baseline Capability or Service dependent	Comment
1	One PSCH	SCH	Baseline	SCH can map to one or two PSCH in a frame depending on the synchronization case as defined in 25.221 (see note 1)
2	One or more CCPCH	BCH and/or PCH and/or one or more FACH	Baseline	BCH can map to multiple CCPCH in a frame. FACH can map to multiple CCPCH in a frame. PCH can map to multiple CCPCH in a frame. See note 2.

3	One or more DPCH	One or more DCH coded into one or more CCTrCH	Service dependant	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability
4	One or more CCPCH + one or more DPCH	BCH and/or PCH and/or one or more FACH and one or more DCH coded into one or more CCTrCH	Service dependent	The number of DCHs and the maximum channel bit rate are dependent on the UE Service Capability. BCH can map to multiple CCPCH in a frame. FACH can map to multiple CCPCH in a frame. See note 2.
5	One or more PDSCH	One or more DSCH coded onto one or more CCTrCH	Service dependent	It is assumed here that a DSCH transport channel may map to one or more PDSCH physical channels based on system configuration. DSCH requires a control channel (FACH or DCH); however, it is not required to be in the same 10ms frame as the DSCH.
6	One or more PDSCH + one or more CCPCH	BCH and/or PCH and/or one or more FACH and one or more DSCH coded onto one or more CCTrCH	Service dependant	BCH can map to multiple CCPCH in a frame. Each FACH can map to multiple CCPCH in a frame. It is assumed here that a DSCH transport channel may map to one or more PDSCH physical channels based on system configuration. For the case of DSCH + BCH, DSCH requires a control channel (FACH or DCH); however, it is not required to be in the same 10ms frame as the DSCH. See note 2.

7	One or more PDSCH + one or more DPCH	One or more DSCH coded onto one or more CCTrCH + one or more DCH coded into one or more CCTrCH	Service dependent	The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability It is assumed here that a DSCH transport channel may map to one or more PDSCH physical channels based on system configuration.

8	One or more PDSCH + one or more CCPCH + one or more DPCH	BCH and/or PCH and/or one or more FACH and one or more DSCH coded onto one or more CCTrCH and one or more DCH coded into one or more CCTrCH	Service dependent	BCH can map to multiple CCPCH in a frame. Each FACH can map to multiple CCPCH in a frame. The maximum number of DCHs and the maximum channel bit rate are dependent on UE Service Capability It is assumed here that a DSCH transport channel may map to one or more PDSCH physical channels based on system configuration. See note 2.

Notes:

1. Reference: TS25.221: Physical Channels and Mapping of Transport Channels Onto Physical Channels (TDD).

2. The possibility to multiplex PCH and one or more FACH on one or more CCTrCHs is FFS

3. The PSCH synchronization channel can co-exist with all listed combinations

9 Measurements provided by the physical layer

One of the key services provided by the physical layer is the measurement of various quantities which are used to trigger or perform a multitude of functions. Both the UE and the UTRAN are required to perform a variety of measurements. The standard will not specify the method to perform these measurements or stipulate that the list of measurements provided in this section must all be performed. While some of the measurements are critical to the functioning of the network and are mandatory for delivering the basic functionality (e.g., handover measurements, power control measurements), others may be used by the network operators in optimising the network (e.g., radio environment).

Measurements may be made periodically and reported to the upper layers or may be event-triggered (e.g., primary CCPCH becomes better than the previous best primary CCPCH). Another reporting strategy may combine the event triggered and the periodical approach (e.g. falling of link quality below a certain threshold initiates periodical reporting). The measurements are tightly coupled with the service primitives in that the primitives' parameters may constitute some of the measurements.

The list and frequency of measurements which the physical layer reports to higher layers is described in this section. The precision requirements of the measurements are specified in TS25.103.

The measurement quantities measured by the physical layer shall be such that the following principles are applied:

For handover measurements, the decoding of parameters on the BCCH logical channel of monitored neighbouring cells, should not, in general, be needed for calculating the measurement result. If there is a need to adjust the measurement result with parameters broadcast on the PCCPCH, these parameters shall be provided by the UTRAN in inband measurement control messages. There may be some exceptions to this rule. *For example, it may be necessary to decode the SFN of the measured neighbouring cell for time difference measurements. [Note: It should be decided whether the SFN is a L3 or L1 parameter. WG1 has approved that SFN is a L1 parameter.In a LS sent to WG2, they also indicate that the SFN is encoded together with the BCH transport blocks, with a joint CRC. However WG2 had questions regarding the advantage of this method, compared to having the SFN as a L3 parameter, and have sent back a LS to WG1.]*

In idle mode or in RRC connected mode using common Transport Channels, the UE shall be able to monitor cells for cell reselection, without being required to frequently decode parameters on the BCCH logical channel of the monitored neighbouring cells. The decoding frequency of these parameters, set by the cell reselection algorithm, should be such that UE standby times are not significantly decreased.

9.1 Measurements of downlink channels

9.1.1 Observed time difference to UTRA cell

This measure is mandatory for the UE.

Measurement	Measured time difference to UTRA cell
Source	L1 (UE)
Destination	RRC (RNC) for handover
Reporting Trigger	On-demand, Event-triggered
Definition	***For FDD: The 'Observed time difference to UTRA cell' indicates the time difference which is measured by UE between CFN in the UE and the SFN of the target neighbouring cell. It is notified to SRNC by Measurement Report message or Measurement Information Element in other RRC messages.*** ***For TDD: This is the relative time difference in the frame timing between the serving and the target cell measured at the UE.***

9.1.2 Observed time difference to GSM cell

This measure is mandatory for the UE if the handover to GSM service is to be supported.

Measurement	Measured time difference to GSM cell
Source	L1 (UE)
Destination	RRC (RNC) for maintenance and handover to GSM
Reporting Trigger	On-demand, Event-triggered
Definition	***Time difference between the Primary CCPCH of the current cell and the timing of the GSMcell.***

9.1.3 CPICH RX E_c/I_0

This measure is mandatory for the UE.

Measurement	CPICHRx Ec/Io
Source	L1(UE)
Destination	RRC (UE, RNC),
Reporting Trigger	Periodic, on demand and event triggered
Definition	$-20\log_{10}(E_c/I_o)$ where E_c is the energy per chip of the CPICH (for FDD: measured in the searcher) and I_o is the received spectral density.

9.1.4 CPICH Rx SIR

Note : WG1 has not yet come to any agreement on the impact on terminal complexity if L1 should support measurement of RX CPICH SIR. Therefore, this measurement is currently not supported by L1. However, it is too early to rule out the possibility that it will eventually be included also in the WG1 specifications.

This measure is mandatory for the UE.

Measurement	CPICH Rx SIR
Source	L1 (UE)
Destination	RRC (UE, RNC)
Reporting Trigger	periodic or event triggered
Definition	***This quantity is a ratio of the CPICH Received Signal Code Power (RSCP) to the Interference Signal Code Power (ISCP). The RSCP is the measured symbol power of the CPICH at the demodulator output and the ISCP is the measured interference symbol power.***

9.1.5 CPICH Rx RSCP

This measure is mandatory for the UE.

Measurement	CPICH Rx RSCP
Source	L1(UE)
Destination	RRC (UE, RNC)
Reporting Trigger	periodic or event triggered
Definition	***Received Signal Code Power, is received power on one code, defined on the pilot symbols after despreading for FDD and on the midamble for TDD.***

9.1.6 CPICH Rx ISCP

Note : WG1 has not yet come to any agreement on the impact on terminal complexity if L1 should support measurement of RX CPICH ISCP. Therefore, this measurement is currently not supported by L1. However, it is too early to rule out the possibility that it will eventually be included also in the WG1 specifications.

This measure is mandatory for the UE.

Measurement	CPICH Rx ISCP
Source	L1(UE)
Destination	RRC (UE, RNC)
Reporting Trigger	periodic or event triggered
Definition	***Interference on Signal Code Power, is the interference after despreading. Thereby only the non-orthogonal part of the interference is included. For FDD this is measured on the Primary CCPCH. For TDD this is measured in specified timeslots.***

9.1.7 DPCH SIR

This measure is mandatory for the UE.

Measurement	DPCH SIR
Source	L1(UE)
Destination	RRC(UE,RNC)
Reporting Trigger	Periodic, once every power control cycle , event triggered
Definition	The ratio of the measured symbol power at the demodulator output to the measured interference power at the demodulator output. For FDD this is measured on the DPCCH.

9.1.8 UTRA Cell Signal strength (RSSI)

This measure is mandatory for the UE.

Measurement	signal strength
Source	L1(UE)
Destination	RRC (RNC),
Reporting Trigger	Periodic, event triggered, on demand
Definition	Received Signal Strength Indicator, the wideband received power within the channel bandwidth averaged over [1 s] interval. For TDD this is measured in specified timeslots.

9.1.9 Alternate mode Signal strength

9.1.9.1 GSM Signal Strength

This measure is mandatory for the UE if the service handover to GSM is to be supported.

Measurement	GSM signal strength
Source	L1(UE)
Destination	RRC (RNC)
Reporting Trigger	Periodic, event triggered, on demand
Definition	reference GSM document 05.08

9.1.10 Transport CH BLER

This measure is mandatory for the UE.

Measurement	transport channel BLER (BLock Error Rate)
Source	L1(UE)
Destination	**RRC(RNC,UE)**
Reporting Trigger	Periodic, on demand
Definition	The error detection mechanism will determine whether or not a block error occurred.

9.1.11 Physical CH BER

This measure is mandatory for the UE.

Measurement	physical channel BER
Source	L1(UE)
Destination	**RRC(UE,RNC)**
Reporting Trigger	**On-demand, Event-triggered**
Definition	The estimate of the raw BER of the physical channel calculated only on the data part.

9.1.12 Total Tx Power

Measurement	total Tx power
Source	L1(Node-B)
Destination	**RRC(RNC)**
Reporting Trigger	**On-demand, periodic, Event-triggered**
Definition	The total power emitted by the Node-B within the channel bandwidth averaged over an interval of [1 s]. For TDD this is measured in specified timeslots.

9.1.13 Code Tx Power

Measurement	Code Tx power
Source	L1(Node-B)
Destination	**RRC (RNC)**
Reporting Trigger	**On-demand, periodic, Event-triggered**
Definition	The total power emitted by the Node-B on one channelisation code for one UE averaged over [100 ms] . For TDD this is measured in specified timeslots.

9.2 Measurements on uplink channels

9.2.1 UL load

Measurement	UL load
Source	**L1 (Node B)**
Destination	**RRC(RNC)**
Reporting Trigger	**On-demand, Event-triggered, Periodic**
Definition	**the total received signal power for a carrier within the cell. For TDD this is measured in specified timeslots.**

9.2.2 UE Tx Power

This measure is mandatory for the UE.

Measurement	UE Tx power
Source	L1(UE)
Destination	**RRC (UE,RNC)**
Reporting Trigger	**On-demand, periodic, Event-triggered**
Definition	RRC (UE) – the total Tx power, measured at the antenna connector, averaged over [100 ms] . For TDD this is measured in specified timeslots.RRC (RNC) – indication of Tx power reaching threshold (for example, upper or lower power limits)

9.2.3 Transport CH BLER

Measurement	transport channel BLER (BLock Error Rate)
Source	L1(Node-B)
Destination	**RRC(RNC)**
Reporting Trigger	periodic, event triggered, on demand
Definition	The error detection mechanism will determine whether or not a block error occurred.

9.2.4 Physical CH BER

Measurement	physical channel BER
Source	L1(Node-B)
Destination	**RRC(RNC)**
Reporting Trigger	**On-demand, Event-triggered, periodic**
Definition	The estimate of the raw BER of the physical channel calculated only on the data part.

9.2.5 RX Timing deviation (TDD only)

Measurement	RX timing deviation (TDD only)
Source	L1 (Node B)
Destination	RRC (RNC)
Reporting Trigger	Periodic, event triggered
Definition	The difference of the time of arrival of the UL transmissions in relation to the arrival time of a signal with zero propagation delay.

9.2.6 Rx ISCP (TDD only)

Measurement	Rx ISCP
Source	L1(Node B)
Destination	RRC (RNC)
Reporting Trigger	periodic or event triggered
Definition	Interference on Signal Code Power, is the interference after despreading in specified timeslots. Thereby only the non-orthogonal part of the interference is included.

9.2.7 Rx RSCP (TDD only)

Measurement	Rx RSCP
Source	L1(Node B)
Destination	RRC (RNC)
Reporting Trigger	periodic or event triggered
Definition	Received Signal Code Power, is received power on DPCH or PUSCH

9.3 Miscellaneous measurements

9.3.1 Time of Arrival (TOA)

The Time of Arrival (TOA) measurement at a single node-B may provide an estimate of the round trip time of signals between the Node-B and the UE and this may be used to calculate a radial distance to the UE within the sector. A group of simultaneous TOA measurements made from a number of Node-B or LMU may be used to estimate the location of the UE. This support for this measurement is LCS positioning method dependant..

Measurement	Time of arrival (TOA)
Source	L1(Node-B or LMU)
Destination	RRC (RNC-LCS)
Reporting Trigger	on demand, event triggered
Definition	the time of arrival of the uplink transmissions in relation to the CCPCH timing reference..

9.3.2 SFN-SFN Observed time difference

The SFN-SFN observed time difference at the UE of a group of Node-B may be used for location calculation. . The applicability of this measure is LCS method dependent This support for this measurement is LCS positioning method dependant.

Measurement	SFN-SFN observed time difference
Source	L1 (UE)
Destination	RRC (RNC) for handover, maintenance and LCS
Reporting Trigger	On-demand, Event-triggered
Definition	***Time difference between the Primary CCPCH of the current cell and the Primary CCPCH of a neighboring cell.***

9.3.3 Frequency Offset (FO)

The Frequency Offset (FO) measures the rate of change (drift) of the Relative Time Difference and may be used to estimate the RTD at the time the UE location measurements are made. . This support for this measurement is LCS positioning method dependant.

Measurement	Frequency Offset (FO)
Source	L1(LMU)
Destination	RRC (RNC-LCS)
Reporting Trigger	On demand, event triggered, periodic
Definition	The Frequency Offset (FO) measures the rate of change (drift) of the Relative Time Difference of the CCPCH transmissions of two Node-B.

10 Primitives of the physical layer

The Physical layer interacts with other entities as illustrated in figure 2.1. The interactions with the MAC layer and the RRC layer are shown in terms of primitives where the primitives represent the logical exchange of information and control between the physical layer and higher layers. They do not specify or constrain implementations. The (adjacent) layers connect to each other through Service Access Points (SAPs). Primitives, therefore, are the conveyer of the information exchange and control through SAPs.

Three types of primitives are used for this document, as follows.

- **REQUEST**

  This type is used when a higher layer is requesting a service from a lower layer

- **INDICATION:**

  This type is used by a lower layer providing a service to notify its higher layer of activities concerning that higher layer

- **CONFIRM:**

  This type is used by a lower layer providing the requested service to confirm to the higher layer that the activity has been completed.

The primitives defined below are for local communications between MAC and L1, as well as RRC and L1 in the same protocol stack.

For the physical layer two sets of primitives are defined

* **Primitives between layer 1 and 2:**

PHY - Generic name - Type: Parameters

* **Primitives between layer 1 and the RRC entity:**

CPHY - Generic name - Type: Parameters.

NOTE : This is a logical description of the primitives and does not cover addressing aspects (e.g. Transport Channel ID, Physical Channel ID, start frame number or disconnect frame number).

10.1 Generic names of primitives between layers 1 and 2

The primitives between layer 1 and layer 2 are shown in the Table 1.

Table 1. Primitives between layer 1 and 2

Generic Name	Parameters
PHY-DATA-REQ	TFI, compressed mode type, TBS
PHY-DATA-IND	TFI, TBS, CRC result, TD[(1)]
PHY-STATUS-IND	Event value

[(1)]: TDD only

10.1.1 PHY-Data-REQ

The PHY-DATA primitives are used to request SDUs used for communications passed to and from the physical layer. One PHY-DATA primitive is submitted every Transmission Time Interval for each Transport Channel.

Primitive Type: request.

Parameters:

- TFI
- Type of compressed mode (e.g. uncompressed, compressed)
- Transport Block Set
- FN_{CELL}
- Page indicators (PIs) (PCH only)

10.1.2 PHY- Data-IND

The PHY-DATA primitives are used to indicate SDUs used for Layer 2 passed to and from the physical layer. One PHY-DATA primitive is submitted every Transmission Time Interval for each Transport Channel.

Primitive Type: indicate

Parameters:

- TFI
- Transport Block Set
- CRC check result
- TD (RX Timing Deviation measurement) (optional, TDD only)

10.1.3 10.1.3 PHY-Status-IND

The PHY-STATUS primitive can be used by the layer 1 to notify higher layers of an event which has occurred.

Primitive Type: indication

Parameters

- Event value

10.2 Generic names of primitives between layers 1 and 3

The status primitives between layer 1 and 3 are shown in the Table 2.

Table 2: Status primitives between layer 1 and 3

Generic Name	Parameters
CPHY-Sync-IND	none
CPHY-Out-of-Sync-IND	none
CPHY-Measurement-REQ	Measurement parameters
CPHY-Measurement-IND	Measurement parameters
CPHY-ERROR-IND	Error Code

10.2.1 STATUS PRIMITIVES

10.2.1.1 CPHY-Sync-IND

This primitive is used for L1 to indicate to RRC that synchronisation of a certain physical channel has been done in the receiver. In FDD synchronization is based on reception of the DPCCH, and in TDD synchronization is based on midamble reception.

Primitive Type: indication

Parameters:

- none

10.2.1.2 CPHY-Out-of-Sync-IND

Primitive sent from L1 to RRC indicating that synchronisation of a previously configured connection has been lost in the receiver. In FDD synchronization is based on reception of the DPCCH, and in TDD synchronization is based on midamble reception.

Primitive Type: indication

Parameters:

- none

10.2.1.3 CPHY-Measurement-REQ

The Request primitive is used for RRC to configure L1 measurements.

Primitive Type: request

Parameters:

- transmission power threshold
- Refer to section 9 for measurement parameters

10.2.1.4 CPHY-Measurement-IND

The Indication primitive is used to report the measurement results

Primitive Type: indication

Parameters:

- **Refer to Section 9 for measurement parameters**

10.2.1.5 CPHY-ERROR-IND

The CPHY-ERROR primitive is used to indicate to the management entity that an error has occurred as a result of a physical layer fault.

Primitive Type: indication

Parameters

- Error Code

10.2.2 CONTROL PRIMITIVES

The control primitives between layer 1 and 3 are shown in the Table 3

Table 3. Control primitives between layer 1 and 3

Generic Name	Parameters
CPHY-TrCH-Config-REQ	Transport channel description,
CPHY-TrCH-Config-CNF	
CPHY-TrCH_Release-REQ	
CPHY-TrCH_Release-CNF	
CPHY-RL-Setup-REQ	Physical channel description
CPHY-RL-Setup-CNF	none
CPHY-RL-Release-REQ	none
CPHY-RL-Release-CNF	none
CPHY-RL-Modify-REQ	Physical channel description
CPHY-RL-Modify-CNF	none
CPHY-Commit-REQ	Activation Time

10.2.2.1 CPHY-TrCH-Config-REQ

This primitive is used for setting up and configuring a transport channel, and also to modify an existing transport channel.

Primitive Type: request

Parameters:

- Transport channel description

10.2.2.2 CPHY-TrCH-Config-CNF

This primitive is used for confirming the setting up and configuring a transport channel, and also modifying an existing transport channel.

Primitive Type: confirm

Parameters:

- none

10.2.2.3 CPHY-TrCH-Release-REQ

This primitive is used for releasing a transport channel.

Primitive Type: request

Parameters:

- none

10.2.2.4 CPHY-TrCH-Release-CNF

This primitive is used for confirming the releasing a transport channel.

Primitive Type: confirm

Parameters:

- none

10.2.2.5 CPHY-RL-Setup-REQ

The Request primitive is sent from RRC to L1 for establishment of a Radio link to a certain UE.

Primitive Type: request

Parameters:

- Physical channel description

10.2.2.6 CPHY-RL-Setup-CNF

The Confirm primitive is returned from L1 to RRC when the Radio link is established. In case L1 is unable to execute the request, this is indicated in the confirm primitive.

Primitive Type: confirm

Parameters:

- none

10.2.2.7 10.2.7 CPHY-RL-Release-REQ

The Request primitive is sent from RRC to L1 for release of a Radio link to a certain UE.

Primitive Type: request

Parameters:

- none

10.2.2.8 CPHY-RL-Release-CNF

The Confirm primitive is returned from L1 to RRC when the radio link is released.

Primitive Type: confirm

Parameters:

- none

10.2.2.9 CPHY-Modify-REQ

The Request primitive is sent from RRC to L1 for modification of a Radio link to a certain UE.

Primitive Type: request

Parameters:

- Physical channel description

10.2.2.10 CPHY-RL-Modify-CNF

The Confirm primitive is returned from L1 to RRC when the radio link is modified. In case L1 is unable to execute the request, this is indicated in the confirm primitive.

Primitive Type: confirm

Parameters:

- none

10.2. 11 CPHY-Commit-R This primitive is sent from RRC to L1 to synchronise UE and NW for the physical channel modification.

Primitive Type: **request**

Parameters:

- Activation time

10.3 Parameter definition

10.3.1 Error code

- Hardware failure

10.3.2 Event value

- Maximum transmission power has been reached
- Allowable transmission power has been reached
- Average transmission power is below allowable transmission power

10.3.3 Physical channel description

10.3.3.1 Primary SCH

- Tx diversity mode

10.3.3.2 Secondary SCH

- Tx diversity mode

10.3.3.3 Primary CCPCH

- Frequency info
- DL scrambling code
- Tx diversity mode

- Timeslot (TDD only)
- Midamble type (TDD only)
- Superframe offset (TDD only)
- Repetition period (TDD only)
- Repetition length (TDD only)

10.3.3.4 Secondary CCPCH

- DL scrambling code
- Channelisation code
- Tx diversity mode
- Timeslot (TDD only)
- Midamble type (TDD only)
- Midamble shift (TDD only)
- Superframe offset (TDD only)
- Repetition period (TDD only)
- Repetition length (TDD only)

10.3.3.5 PRACH

Note: The PRACH can also be used to map the FAUSCH Transport Channel

- Access Slot
- Preamble spreading code
- Preamble signature
- Spreading factor for data part
- Power control info
    - UL target SIR
    - Primary CCPCH DL TX Power
    - UL interference
    - Power offset (Power ramping)
- Access Service Class Selection
    - Preamble signature classification information
- AICH transmission timing parameter
- Persistence value
- Timeslots (TDD only)
- Spreading codes (TDD only)

- Midamble codes (TDD only)

10.3.3.6 Uplink DPDCH+DPCCH

- UL scrambling code
- DPCCH Gate rate
- DPCCH slot structure (N_{pilot}, N_{TPC}, N_{TFCI}, N_{FBI})
- Transmission Time offset value
- Timing Advance (TDD only)
- DPCH channelization code (TDD only)
- Midamble Type (TDD only)
- DPCH midamble shift (TDD only)
- Timeslot (TDD only)
- Superframe offset (TDD only)
- Repetition Period (TDD only)
- Repetition length (TDD only)
- TFCI presence (TDD only)

10.3.3.7 Downlink DPCH

- Transmission Time offset value
- DPCCH Gate rate
- DL scrambling code
  - DL Channelisation code
- Tx diversity mode
  - FB mode
- Slot structure ($N_{pilo,}$ N_{TPC}, N_{TFCI}, $N_{FBI,}$, N_{data1}, N_{data2})
- Midamble Type (TDD only)
- DPCH midamble shift (TDD only)
- Timeslot (TDD only)
- Superframe offset (TDD only)
- Repetition period (TDD only)
- Repetition length (TDD only)
- TFCI presence (TDD only)

10.3.3.8 PCPCH (Physical Common Packet Channel)

- CPCH Set ID to which this CPCH belongs.
- UE Access Preamble (AP) code
- DL AP-AICH Channelisation code
- UL CD preamble code
- DL CD-AICH Channelisation code
- CPCH UL scrambling code
- CPCH UL Channelisation code
- DPCCH DL Channelisation code
- Data rate (spreading factor)
- N_frames_max: Maximum packet length in frames
- Persistency value (PV_{cpch})
- Signature set: set of preamble signatures for AP to access this CPCH

10.3.3.9 PICH

- Scrambling code
- Channelisation code
- Timeslot (TDD only)
- Midamble Type (TDD only)
- Midamble shift (TDD only)
- Superframe offset (TDD only)
- Repetition period (TDD only)
- Repetition length (TDD only)

10.3.3.10 AICH

- Scrambling code
- Channelisation code
- Tx diversity mode

[Note: the value for the parameters need to be consistent with the corresponding PRACH. This needs to be confirmed by WG1].

10.3.3.11 PDSCH

- Scrambling code
- Chnnelisation code
- Tx diversity mode
  - FB mode
- DL channelisation code (TDD only)
- Midamble Type (TDD only)
- PDSCH Midamble shift (TDD only)
- Timeslot (TDD only)

- Superframe offset (TDD only)
- Repetition period (TDD only)
- Repetition length (TDD only)
- TFCI presence (TDD only)

10.3.3.12 PUSCH

- PUSCH channelisation code (TDD only)
- Midamble Type (TDD only)
- PUSCH midamble shift (TDD only)
- Timeslot (TDD only)
- Superframe offset (TDD only)
- Repetition period (TDD only)
- Repetition length (TDD only)
- TFCI presence (TDD only)
- Timing Advance (TDD only)

10.3.4 Transport channel description

11 Radio Frame transmission

11.1 Downlink Frame format

11.2 Uplink Frame format

11.3 Order of bit transmission

12 Annex A: Description of Transport Formats

The following table describes the characterisation of a Transport Format. The possible values for the attributes will be defined by the L1 experts group based on the requirements identified by the L23 experts group. Note that the allowed Transport Format Combinations are not described here, and will need to be covered also.

		Attribute values
Dynamic part	Transport Block Size	1 to 5000 1 bit granularity
	Transport Block Set Size	1 to 200000 1 bit granularity
	Transmission Time Interval (option for TDD only)	10, 20 ms, 40 and 80 ms
Semi-static part	Transmission Time Interval (FDD, option for TDD NRT bearers)	10, 20 ms, 40 and 80 ms
	Type of channel coding	Turbo Convolutional coding
	code rates	1/2, 1/3
	CRC size	0, 8, 16, 24
	Resulting ratio after static rate matching	0.5 to 4

Note: The maximum size of the Transport Block has been chosen so as to avoid any need for segmentation in the physical layer into sub-blocks (segmentation should be avoided in the physical layer).

13 Annex B (Informative): Example of Transport format attributes for AMR speech codec

The support for the AMR speech codec is exemplified below. On the radio interface, one Transport Channel is established per class of bits i.e. DCH A for class A, DCH B for class B and DCH C for class C. Each DCH has a different transport format combination set which corresponds to the necessary protection for the corresponding class of bits as well as the size of these class of bits for the various AMR codec modes.

With this principle, the AMR codec mode which is used during a given TTI can be deduced from the format of the transport channels DCH A, DCH B and DCH C for that particular TTI.

Note that a similar principle can also be applied for other source codecs e.g. other speech codecs or video codecs.

An example of transport channel description for each class of bits is given below:

	Attribute	Value		
		Class A	Class B	Class C
Dynamic part	Transport Block Size	81 65 75 61 55 55 49 39	103 99 84 87 79 63 54 56	60 40 0 0 0 0 0 0
	Transport Block Set Size	Same as the transport block sizes		
	Transmission Time Interval (option for TDD only)			
Semi-static part	Transmission Time Interval (FDD)	20 ms		
	Type of channel coding	Convolutional coding		
	code rates	1/2, 1/3 + class-specific rate matching	None, 1/2, 1/3 + class-specific rate matching	None, 1/2 , 1/3 + class-specific rate matching
	CRC size	8	0	0
	Resulting ratio after static rate matching	0.5 to 4(with no coding the rate matching ratio needs to be >1)		

14 History

Document history		
Date	**Version**	**Comment**
August 1999	3.0.0	Approved by TSG-RAN
October 1999	3.1.0	CRs approved by TSG-RAN
Rapporteur for TS 25.302 is :		
Pierre Lescuyer Nortel Networks Tel: +33 1 39 44 44 86 Fax: +33 1 39 44 50 02 email: lescuyer@nortelnetwoks.com		
This document is written in Microsoft Word version 7.0.		

TSG-RAN Working Group 2 (Radio layer 2 and Radio layer 3) *TSGR2#8(99)g51*
Cheju, Korea, 2nd to 5th November 1999

Source: TSG-RAN WG2

Title: **TR 25.926 UE Radio Access Capabilities**

Document for:

TR 25.926 V0.1.0 (1999-11)

Technical Report

3rd Generation Partnership Project (3GPP);
Technical Specification Group (TSG) RAN;
Working Group 2 (WG2);

UE Radio Access Capabilities

Reference

<Workitem> (<Shortfilename>.PDF)

Keywords

Digital cellular telecommunications system, Universal Mobile Telecommunication System (UMTS), UTRA, IMT-2000

3GPP

Postal address

Office address

Internet

secretariat@3gpp.org

Individual copies of this deliverable can be downloaded from http://www.3gpp.org

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present deliverable may have been declared to 3GPP and/or its organizational partners. The information pertaining to these essential IPRs, if any, is publicly available for **3GPP members and non-members, free of charge**. This can be found in the latest version of the 3GPP Technical Report:

[reference tbd.]

Pursuant to the 3GPP Interim IPR Policy, no investigation, including IPR searches, has been carried out by 3GPP. No guarantee can be given as to the existence of other IPRs not referenced in the [tbd.], which are, or may be, or may become, essential to the present document.

Foreword

This Technical Report has been produced by the 3GPP.

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

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 Indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the specification.

1 Scope

The scope of this technical report is to identify the parameters of the access stratum part of the UE radio access capabilities. Furthermore, the possible combinations of these values are defined.

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.
- A non-specific reference to a TS shall also be taken to refer to later versions published as an EN with the same number.

3 Definitions and Abbreviations

3.1 Definitions

3.2 Abbreviations

UE User Equipment

UMTS Universal Mobile Telecommunication System

UTRAN UMTS Terrestrial Radio Access Network

4 UE radio access capability parameters

< In this chapter all UE radio access capability parameters will be defined. The selection of parameters will be based on UE implementation constraints and not on RAB constraints. For each parameter the relation to configuration parameters (from the RRC specification) will be shown.>

In the following the UE radio capability parameters are defined. In addition the relevant RRC configuration parameters are shown when applicable. When using the RRC configuration parameters, UTRAN needs to respect the UE capabilities. Only parameters for which there is a need to set different values for different UEs are considered as UE capability parameters. Therefore, the capabilities that are the same for all UEs, including baseline capabilities, are not listed here.

4.1 PDCP parameters

Header compression algorithm supported

Defines which header compression algorithms that are supported by the UE.

No explicit configuration parameter has been defined yet.

4.2 BMC parameters

No UE radio access capability parameters identified

4.3 RLC parameters

Editors note: It is FFS whether some of the RLC functions should be considered as UE capabilities.

Total RLC AM buffer size

The total buffer size across all RLC AM entities puts requirements on memory.

UTRAN controls that the UE capability can be fulfilled through the following parameters:

1. The number of RLC AM entities configured (no explicit RRC parameter)
2. UL PU size
3. Transmission window size (#PUs)
4. Receiving window size (FFS whether this is configurable)

The following criterion must be fulfilled in the configuration:

$$\sum_{i=1}^{\#RLC\_AM\_entities} Transmission\_window\_size_i \bullet UL\_PU\_size_i + \sum_{i=1}^{\#RLC\_AM\_entities} Receiving\_window\_size_i \bullet DL\_PU\_size_i \leq Total\_RLC\_buffer\_size$$

where *i* is the RLC “entity number”

Maximum number of radio bearers

The number of radio bearers affects how the total processing and memory capacity can be shared between different RLC machines.

UTRAN shall not establish more RBs than the UE capability allows for.

4.4 MAC parameters

No capability parameters identified.

4.5 PHY parameters

Editors note: It is FFS whether some of the parameters need to be separate for different physical channel types. Furthermore, some of the parameters that are currently separted between uplink and downlink will be merged if it shows that the appropriate values are the same in uplink and downlink.

4.5.1 Transport channel parameters in downlink

Maximum total number of bits of all transport blocks received in TTIs that end at the same time

This parameter is related to memory and processing capacity requirements for received downlink data before it is delivered to MAC. To ensure sufficient flexibility, one must assume that the delay requirements of all transport channels are such that a transport block must be processed within 10ms. As shown in Figure 1 the worst case occurs for the maximum TTI.

UTRAN must ensure that there is no TFC within the TFCS for which the sum of *Number of Transport Blocks * Transport Block size* over all simultaneous transport channels is larger than what the UE capability allows for.

Editors note: It has been noted that the current definition does not cover the case where TTIs on simultaneous DCH and DSCH are not aligned.

Maximum number of simultaneous transport channels

The number of simultaneous transport channels affects how the total memory space and processing capacity can be shared among the transport channels.

UTRAN shall not set up more simultaneous transport channels than the UE capability allows for.

Editors note: It is FFS whether the maximum number of TrChs per CCTrCH should be included.

Maximum number of simultaneous CCTrCH

Needed for TDD. FFS for FDD.

Maximum total number of transport blocks received within TTIs that end at the same time

Relates to processing requirements for CRC in downlink.

UTRAN must ensure that there is no TFC within the TFCS for which the sum of *Number of Transport Blocks* is larger than what the UE capability allows for.

Maximum number of TFC in the TFCS

The maximum number of TFC in a TFCS sets the size of the TFCI to TFCS mapping table to be handled by the UE.

Support for turbo decoding

Defines whether turbo decoding is supported or not

The UTRAN configuration parameter is *Type of channel coding* which is part of the Transport format set (TFS) of each transport channel.

Support of 24 bits CRC

Defines whether 24 bits CRC is supported or not. CRC lengths of 0, 8, 12 and 16 bits shall be mandatory for all UEs.

UTRAN configures the CRC size through the parameter *CRC size*, which is part of the *Transport format set*.

Editors note: It is unclear whether 24 bits CRC is needed for PCH. In that case it will be mandatory for all UEs, and the capability parameter will be removed.

Support of blind rate transport format detection (FFS)

Defines whether the UE supports blind rate transport format detection or not.

Editors note:.. The criteria for blind rate detection (combined with 12.2k data rate) is recommended to be defined (in WG1 specification or TR 25.926 report) that well that no extra signalling (additional parameters) is needed, thereby enabling efficient and reliable RAB allocation from the UTRAN.

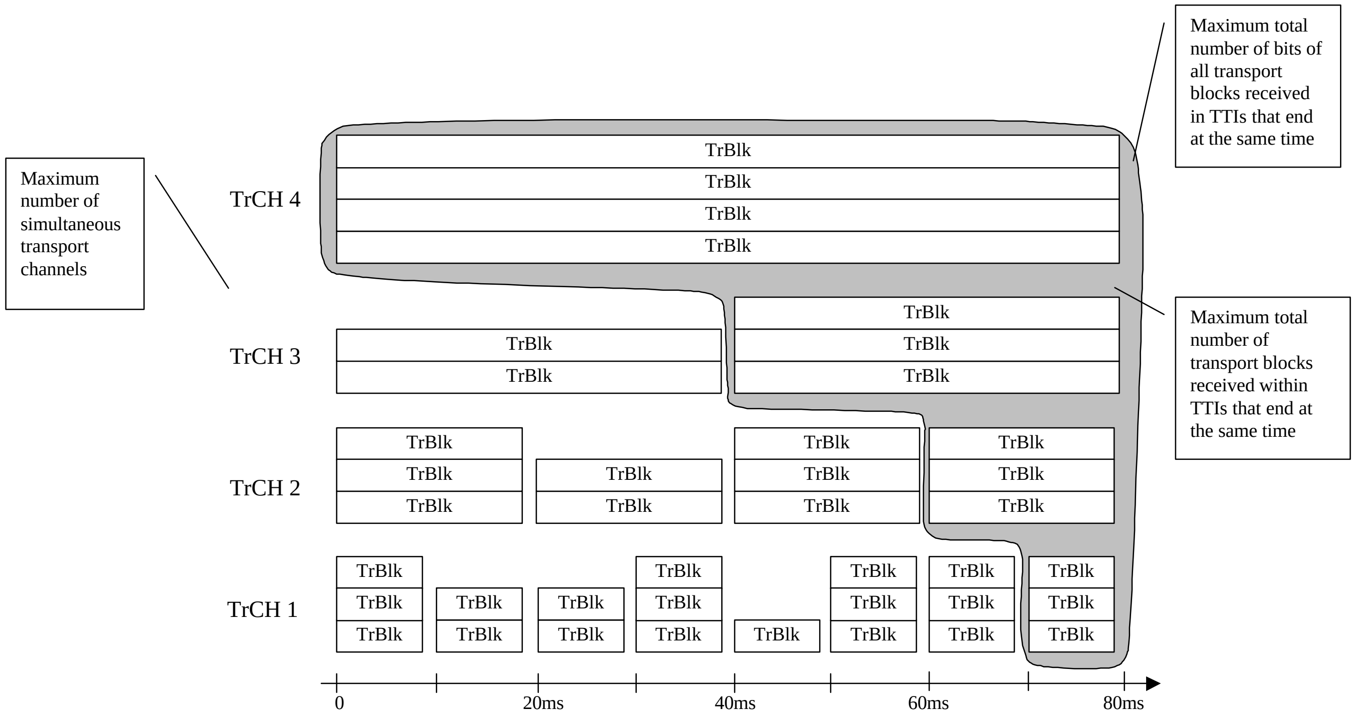


Figure 1. UE transport channel processing limitations in downlink

4.5.2 Transport channel parameters in uplink

Maximum total number of bits of all transport blocks transmitted in TTIs that start at the same time

This parameter is related to memory and processing capacity requirements for uplink data received from MAC before it can be transmitted over the radio interface. To ensure sufficient flexibility, one must assume that the delay requirements of all transport channels are such that a transport block must be processed within 10ms. As shown in Figure 2 the worst case occurs for the maximum TTI.

UTRAN must ensure that there is no TFC within the TFCS for which the sum of *Number of Transport Blocks * Transport Block size* over all simultaneous transport channels is larger than what the UE capability allows for.

Maximum number of simultaneous transport channels

The number of simultaneous transport channels affects how the total memory space and processing capacity can be shared among the transport channels.

UTRAN shall not set up more simultaneous transport channels than the UE capability allows for.

Maximum number of simultaneous CCTrCH

TDD only. For FDD there is always only one CCTrCH at a time.

Maximum total number of transport blocks transmitted within TTIs that start at the same time

Relates to processing requirements for CRC in uplink.

UTRAN must ensure that there is no TFC within the TFCS for which the sum of *Number of Transport Blocks* is larger than what the UE capability allows for.

Maximum number of TFC in the TFCS

The maximum number of TFC in a TFCS sets the size of the TFCI to TFCS mapping table to be handled by the UE.

Support for turbo encoding

Defines whether turbo encoding is supported or not

The UTRAN configuration parameter is *Type of channel coding* which is part of the Transport format set (TFS) of each transport channel.

Support of 24 bits CRC

Defines whether 24 bits CRC is supported or not. CRC lengths of 0, 8, 12 and 16 bits shall be mandatory for all UEs.

UTRAN configures the CRC size through the parameter *CRC size*, which is part of the *Transport format set*.

Editors note: It is unclear whether 24 bits CRC is needed for PCH. In that case it will be mandatory for all UEs, and the capability parameter will be removed.

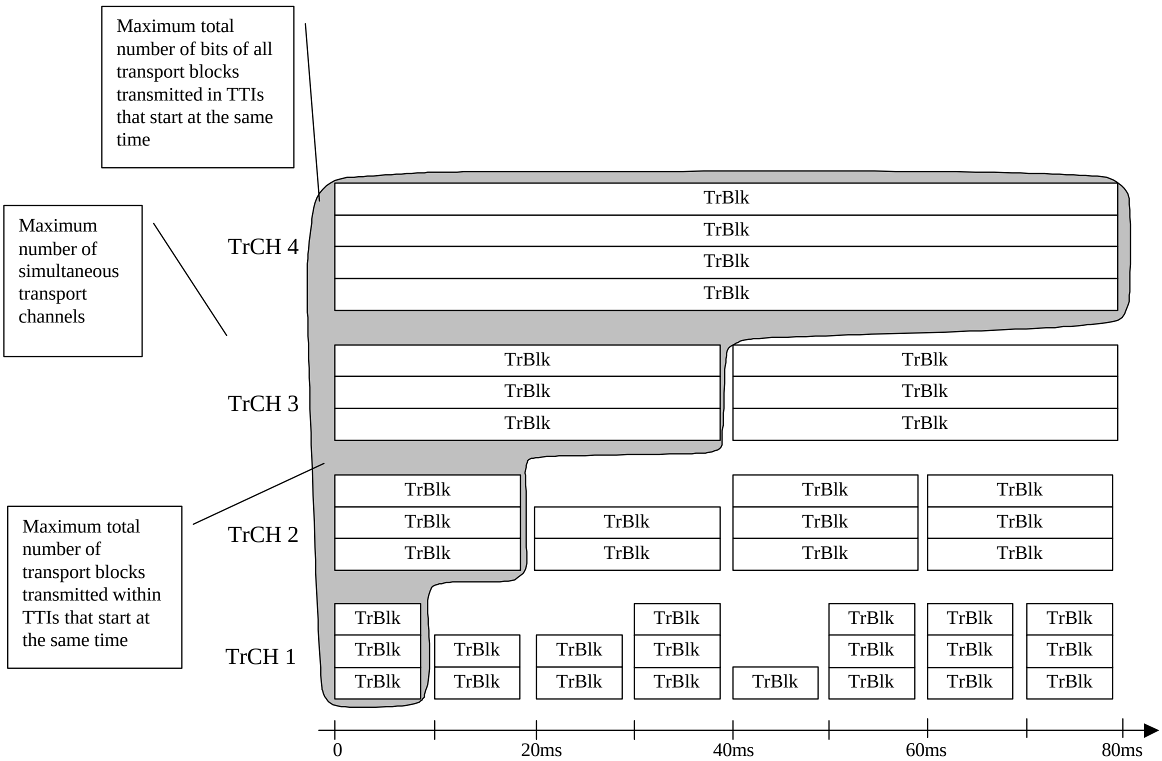


Figure 2. UE transport channel processing limitations in uplink

4.5.3 FDD Physical channel parameters in downlink

Maximum number of DPCH per RL

Defines the multi-code (within one RL) reception capability of the UE.

The corresponding configuration parameter is the range bound *MaxChancount* for the parameter *DL channelization code* which is part of *Downlink DPCH info*.

Maximum number of simultaneous S-CCPCH

Defines the S-CCPCH multi-code reception capability o the UE.

Minimum SF

The corresponding configuration parameter is *Spreading factor* which is part of *Downlink DPCH info*.

Support for SF 512

Spreading factor 512 should not be mandatory for all UEs.

The corresponding configuration parameter is *Spreading factor* which is part of *Downlink DPCH info*.

Support of PDSCH

Support of PDSCH is only required for some RAB realisations, and is therefore a UE capability.

The corresponding configuration parameter is *Downlink transport channel type* which is part of *RB mapping info*.

Maximum number of PDSCH

Simultaneous reception of SCCPCH and DPCH

Simultaneous reception of SCCPCH and DPCH, i.e. simultaneous reception of FACH and DCH is required for e.g. DRAC procedure, but it should not be mandatory for all UEs (e.g. speech only UEs).

Editors note: It is FFS how this parameter is related to Maximum number of DPCH per RL and Maximum number of PDSCH.

There is no specific configuration parameter.

4.5.4 FDD physical channel parameters in uplink

Maximum number of DPDCH

Defines the multi-code transmission capability of the UE

UTRAN must ensure that there is no TFC within the TFCS for which the resulting CCTrCH bit rate requires more DPDCHs than what is supported by the UE.

Minimum SF

UTRAN must ensure that there is no TFC within the TFCS for which the resulting CCTrCH bit rate requires a lower SF than what is supported by the UE.

Support of PCPCH

Support of PCPCH is only required for some RAB realisations, and is therefore a UE capability.

There is no specific configuration parameter.

4.5.5 TDD physical channel parameters in downlink

Maximum number of timeslots per frame

Defines the maximum number of timeslots per frame that the UE can receive.

Maximum number of physical channels per frame

This parameter defines how many physical channels can be received during one frame. The distribution of the received physical channels on the received timeslots can be arbitrary.

Support of PDSCH

Defines whether PDSCH is supported or not.

4.5.6 TDD physical channel parameters in uplink

Maximum Number of timeslots per frame

Defines the maximum number of timeslots per frame that the UE can transmit.

Maximum number of physical channels per timeslot

Defines the maximum number physical channels transmitted in parallel during one timeslot.

Minimum SF

Defines the minimum SF supported by the UE.

Support of PUSCH

Defines whether PUSCH is supported or not.

4.5.7 RF parameters

UE power class

The value is fixed per UE and is not related to any configuration parameter.

Radio frequency bands

Defines the uplink and downlink frequency bands supported by the UE.

Configuration parameters are *UTRA RF Channel numbers* for uplink and downlink which are part of *Frequency info*.

Tx/Rx frequency separation

Defines the uplink/downlink frequency separations supported by the UE.

Configuration parameters are *UTRA RF Channel numbers* for uplink and downlink which are part of *Frequency info*.

Chip rate capability

Chip rates supported by the UE.

Corresponding configuration parameter is *chip rate* which is part of *Frequency info.*

4.6 Multi-mode related parameters

Support of UTRA FDD/TDD

Defines whether UTRA FDD and/or TDD are supported.

There is no explicit configuration parameter.

4.7 Multi-RAT related parameters

Support of GSM

Defines whether GSM is supported or not.

There is no explicit configuration parameter.

Support of multi-carrier

Defines whether multi-carrier is supported or not.

There is no explicit configuration parameter.

4.8 LCS related parameters

LCS support

Defines the positioning methods supported..

Editors note: This necessity of this parameter and the value range depends on the decision on which (and how many) positioning methods will be mandatory or optional for the UE.

There is no explicit configuration parameter.

4.9 Measurement related capabilities

Uplink compressed mode

Defines whether the UE supports an independent use of compressed mode in uplink and downlink.

5 Possible UE radio access capability parameter settings

5.1 Value ranges

The value ranges are, depending on the particular parameter, specified according to either on of the following alternatives.

1. Value range: Yes/No (support or not support)
2. Value range: MIN, GRANULARITY, MAX

   minimum value for providing the baseline capability

   granularity

   maximum value should be defined so that a wide variety of UE's (with different capabilities) can exist in the future.

3. Some distinctive values between **minimum value** and **maximum value**, not necessarily with a linear granularity.

Editors note: It has been suggested to leave the maximum value open whenever possible (number of bits in the information element of UE Radio Access Capability message could set the upper pound)

Table 1. UE radio access capability parameter value ranges

	UE radio access capability parameter	**Value range**
PDCP parameters	Header compression algorithm supported	FFS
RLC parameters	Total RLC AM buffer size	FFS
	Maximum number of radio bearers	FFS

PHY parameters	Transport channel parameters in downlink	Maximum total number of bits of all transport blocks received in TTIs that end at the same time	FFS
		Maximum number of simultaneous transport channels	FFS
		Maximum number of simultaneous CCTrCH (TDD) (FFS for FDD)	FFS
		Maximum total number of transport blocks received within TTIs that end at the same time	FFS
		Maximum number of TFC in the TFCS	FFS
		Support for turbo decoding	Yes/No
		Support of 24 bits CRC	Yes/No
		Support of blind rate detection (FFS)	Yes/No
	Transport channel parameters in uplink	Maximum total number of bits of all transport blocks transmitted in TTIs that start at the same time	FFS
		Maximum number of simultaneous transport channels	FFS
		Maximum number of simultaneous CCTrCH (TDD)	FFS
		Maximum total number of transport blocks transmitted within TTIs that start at the same time	FFS
		Maximum number of TFC in the TFCS	FFS
		Support for turbo encoding	Yes/No
		Support of 24 bits CRC	Yes/No
	FDD Physical channel parameters in downlink	Maximum number of DPCH per RL	FFS
		Minimum SF	FFS
		Support for SF 512	Yes/No
		Support of PDSCH	Yes/No
		Maximum number of PDSCH	FFS
		Simultaneous reception of SCCPCH and DPCH	Yes/No
	FDD Physical channel parameters in uplink	Maximum number of DPDCH	FFS

		Minimum SF	FFS
		Support of PCPCH	FFS
	TDD physical channel parameters in downlink	Maximum number of timeslots per frame	[1..14]
		Maximum number of physical channels per frame	[1,2,..,224]
		Support of PDSCH	Yes/No
	TDD physical channel parameters in uplink	Maximum Number of timeslots per frame	[1..14]
		Maximum number of physical channels per timeslot	[1, 2]
		Minimum SF	[16,8,4,2,1]
		Support of PUSCH	Yes/No
RF parameters		UE power class	(reference to WG4 spec. to be included)
		Radio frequency bands	FFS
		Tx/Rx frequency separation	FFS
		Chip rate capability	FFS
Multi-mode related parameters		Support of UTRA FDD/TDD	FDD, TDD, FDD+TDD
Multi-RAT related parameters		Support of GSM	Yes/No
		Support of multi-carrier	Yes/No
LCS related parameters		LCS support	FFS
Measurement related capabilities (FFS)		Uplink compressed mode	Yes/No

5.2 Possible combinations of parameter values

< Possible combinations of parameter values will be listed here as exemplified in the table below. Each combination defines the UE radio capabilities for a given UE implementation. The selected combinations should not be too close to each other from an implementation perspective. At the same time the combinations should allow for enough freedom from a RAB realisation perspective.>

Table 2. UE radio access capability parameter combinations

UE radio access capability parameter	*Combination 1*	*Combination 2*	*Combination 3*	*…*
Parameter 1	*Yes*	*No*	*Yes*	
Parameter 2	*1*	*10*	*5*	
Parameter 3	*100*	*100*	*5000*	

UE radio access capability parameter	*Combination 1*	*Combination 2*	*Combination 3*	…
…				

6 Usage of UE radio access capabilities

< The rationale for the parameter combination settings will be explained here. >

History

Document history		
Date	**Version**	**Comment**
November 99	0.1.0	First version agreed at RAN-WG2#8, including parameters and value ranges for some of these.

Rapporteur for TR 25.926 is:

Johan Lundsjö

Ericsson

Tel. : +46 8 757 3294
Fax : +46 8 757 5720
Email : johan.lundsjo@era.ericsson.se

This document is written in Microsoft Word 97.