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Foreword

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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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1 Scope

The present document defines the service offered by the physical layer (3GPP TS 45-series of Technical Specifications) of the MS-BS interface (3GPP TS 45- and 44-series of Technical Specifications). Its main objective is to be a guidance for the interface between the 3GPP Technical Specifications in the 45-series and the 44-series. It also specifies the format of signalling channels and the order of bit transmission.

As far as possible, the present document makes use of the layering principles of the Reference Model for Open System Interconnection (OSI) as contained in ITU-T Recommendations X.200 and X.210.

1a 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. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 22.011: "Service accessibility".

[3] 3GPP TS 43.013: "Discontinuous Reception (DRX) in the GSM System".

[4] 3GPP TS 43.020: "Security-related network functions".

[5] Void.

[6] Void.

[7] 3GPP TS 44.003: "Mobile Station - Base Station System (MS - BSS) interface; Channel structures and access capabilities".

[8] 3GPP TS 44.005: "Data Link (DL) layer; General aspects".

[9] 3GPP TS 44.006: "Mobile Station - Base Station System (MS - BSS) interface; Data Link (DL) layer specification".

[10] Void.

[11] 3GPP TS 44.018: "Mobile radio interface layer 3 specification; Radio Resource Control Protocol".

[12] Void.

[13] Void.

[14] 3GPP TS 44.012: "Short Message Service Cell Broadcast (SMSCB) support on the mobile radio interface".

[15] Void.

[16] Void.

[17] Void.

[17a] 3GPP TS 44.060: "General Packet Radio Service (GPRS); Mobile Station (MS) - Base Station System (BSS) interface; Radio Link Control/Medium Access Control (RLC/MAC) protocol".

[18] Void.

[19] Void.

[20] Void.

[21] Void.

[22] Void.

[23] Void.

[24] Void.

[25] Void.

[26] Void.

[26a] 3GPP TS 44.118: "Mobile radio interface layer 3 specification; Radio Resource Control (RRC) Protocol, Iu Mode".

[26b] 3GPP TS 44.160: "Radio Link Control/Medium Access Control (RLC/MAC) protocol, Iu Mode"

[27] 3GPP TS 45.001: "Physical Layer on the Radio Path (General Description)".

[28] 3GPP TS 45.002: "Multiplexing and multiple access on the radio path".

[29] 3GPP TS 45.003: "Channel coding".

[30] Void.

[31] 3GPP TS 45.005: "Radio transmission and reception".

[32] 3GPP TS 45.008: "Radio subsystem link control".

[33] 3GPP TS 45.010: "Radio subsystem synchronization".

[34] Void.

[35] ITU-T Recommendation X.200: "Information technology; Open Systems Interconnection; Basic Reference Model: The basic model".

[36] ITU-T Recommendation X.210: "Information technology - Open systems interconnection - Basic Reference Model: Conventions for the definition of OSI services".

[37] 3GPP TS 48.058: 'Base Station Controler - Base Transceiver Station (BCS-BTS) Interface Layer 3 Specification'.

[38] 3GPP TR 45.902: 'Flexible Layer One'.

2 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. These bit streams are transferred on traffic channels, packet data traffic channels and control channels as defined in 3GPP TS 44.003.

NOTE: For GSM application the physical layer may also be referred to as the radio subsystem. However, the radio subsystem supports functions additional to those described in the present document.

The physical layer interfaces the Data Link Layer, the Radio Link Control and Medium Access Control layer and the supported functional units of the application (figure 2).

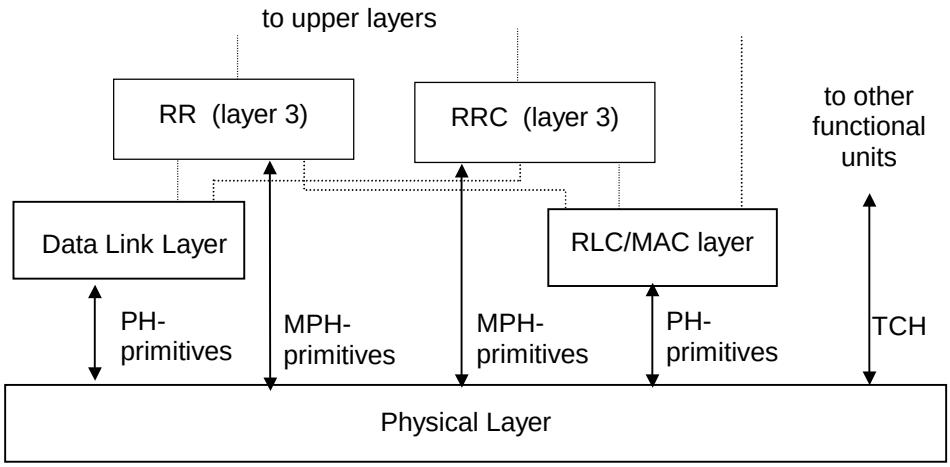

Figure 2: Interfaces with the Physical Layer

2.1 Interface to the Data Link Layer

The physical layer interfaces the data link layer. On this interface control channels are supported. The data link layer is specified in 3GPP TS 44.005 and 44.006. Communication between the Physical Layer and the Data Link Layer is in an abstract way performed by means of PH-primitives. They do not constrain implementations.

NOTE: The terms physical layer and layer 1, and data link layer and layer 2, will be used synonymously in the present document.

The PH-primitives exchanged between the physical layer and the data link layer are used for the transfer of layer 2 frames. They are also used to indicate the establishment of channels to layer 2.

2.1a Interface to the Radio Link Control and Medium Access Control layer

The physical layer interfaces the Radio Link Control and Medium Access Control (RLC/MAC) layer. On this interface packet data control channels and packet data traffic channels are supported when MS is operating in *A/Gb mode*; when MS is operating in *Iu mode*, traffic channels, dedicated control channels, packet data control channels and packet data traffic channels are supported. The RLC/MAC layer is specified in 3GPP TS 44.060 (*A/Gb mode*) and 3GPP TS 44.160 (*Iu mode*). Communication between the Physical Layer and the RLC/MAC layer is in an abstract way performed by means of PH-primitives. They do not constrain implementations.

The PH-primitives exchanged between the physical layer and the RLC/MAC layer are used for the transfer of RLC/MAC blocks. They are also used to indicate the establishment of packet data physical channels (*A/Gb mode*) or shared basic physical subchannels (*Iu mode*) to the RLC/MAC layer.

2.1b Flexible Layer One Interface to the Radio Link Control and Medium Access Control layer

In *Iu mode*, when the Flexible Layer One is used the physical layer interfaces the Radio Link Control and Medium Access Control (RLC/MAC) layer (see 3GPP TR 45.902). On this interface transport channels are supported. The RLC/MAC layer is specified in 3GPP TS 44.160. Communication between the Physical Layer and the RLC/MAC layer is in an abstract way performed by means of PH-primitives. They do not constrain implementations.

The PH-primitives exchanged between the physical layer and the RLC/MAC layer are used for the transfer of transport blocks.

2.2 Interface to radio resource management

The physical layer interfaces the radio resource management (RR or RRC) entity of layer 3 in the MS and in the network. When the MS is operating in *A/Gb mode* the radio resource management is provided by the RR entity whilst when operating in *Iu mode* the radio resource management is provided by the RRC entity.

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

The primitives exchanged with the RR-management entity are related to the assignment of channels, physical layer system information (including measurement results), etc.

2.3 Interface to other functional units

The physical layer interfaces other functional units in the MS and in the network for supporting traffic channels. These interfaces are described in the 26, 27 and 46 series of Technical Specifications.

3 Service of the physical layer

The physical layer supports transfer of bit streams on the radio medium according to the Technical Specifications of the 45-series. The scope of the 45-series of Technical Specifications is the definition of a framework for operation on the radio medium. The application of this framework on the radio medium results in a transmission service. General characteristics of the service obtained by applying the framework of the 45-series at the operation on the radio medium are described in this clause.

3.1 Service Access Point

In the Reference Model for Open System Interconnection, Service Access Points (SAPs) of a layer are defined as gates through which services are offered to an adjacent higher layer (figure 3.1.a). Through a SAP the physical layer offers a service to the data link layer. The SAP is used both for the control of the service providing entity (in case this is the physical layer; commands related to the establishment and release of channels) and the transfer of data (in case of the physical layer; the transfer of bits). The physical layer service access points defined in the present document differ from the OSI physical layer Service Access Points; the layer 3 RR-management instead of the data link layer controls the SAPs (establishment and release of channels).

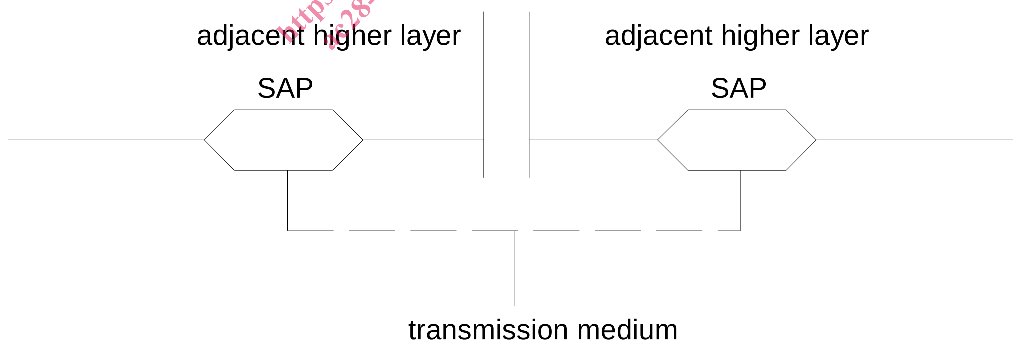

Figure 3.1.a: Service Access Point principle

On the physical layer of the GSM system a SAP is defined between the physical layer and the data link layer for each control channel (figure 3.1.b and figure 3.1.b1). The characteristics of SAPs (channels) are listed in 3GPP TS 44.003.

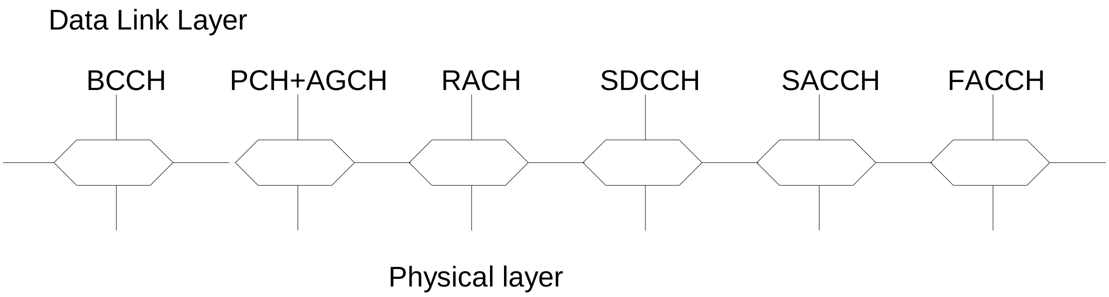

Figure 3.1.b: SAPs between the physical layer and the data link layer when the MS is operating in *A/Gb mode*

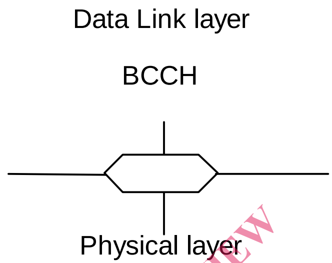

Figure 3.1.b1: SAPs between the physical layer and the data link layer when the MS is capable of operating in *Iu mode*

Moreover, on the physical layer of the GSM system a SAP is defined between the physical layer and the RLC/MAC layer for the packet data control channels, dedicated control channels (*Iu mode*), traffic channels (*Iu mode*) and the packet data traffic channel and the transport channels (FLO in *Iu mode*) (see figure 3.1.c, figure 3.1.d and figure 3.1.e). Multiplexing of these channels is controlled by the RLC/MAC layer, see 3GPP TS 44.060 (*A/Gb mode*) and 3GPP TS 44.160 (*Iu mode*). The characteristics of channels are listed in 3GPP TS 44.003.

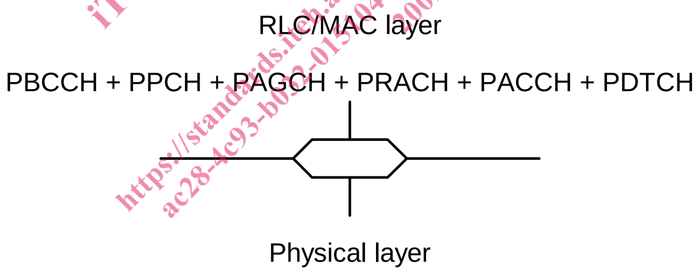

Figure 3.1.c: SAP between the physical layer and the RLC/MAC layer when the MS is operating in *A/Gb mode*

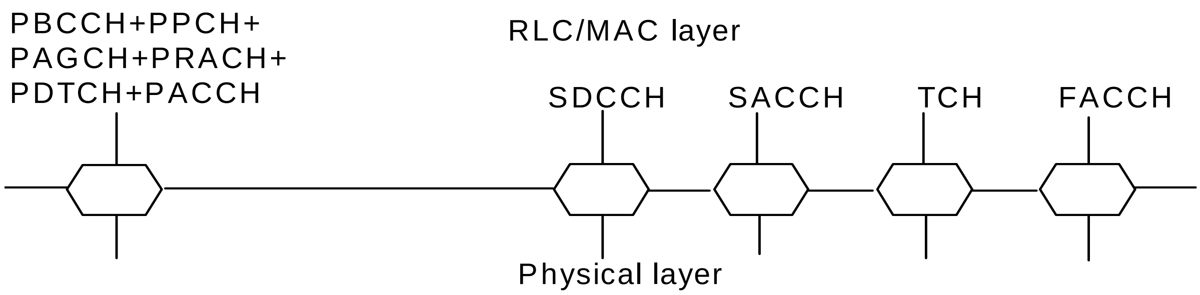

Figure 3.1.d: SAP between the physical layer and the RLC/MAC layer when the MS is operating in *Iu mode*

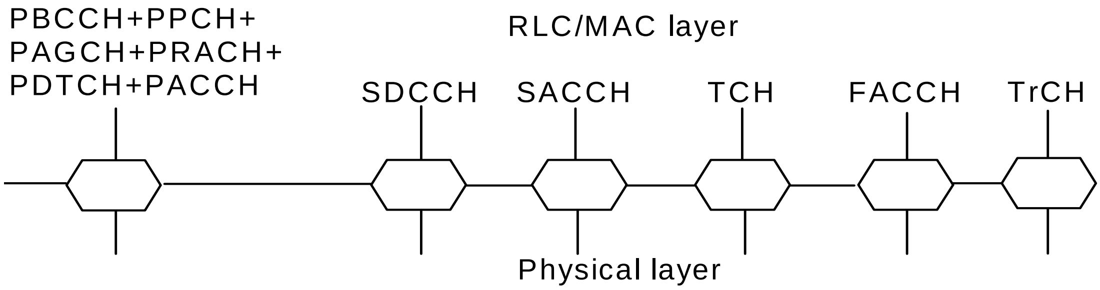

Figure 3.1.e: SAP between the physical layer and the RLC/MAC layer when the MS is operating in *Iu mode* with FLO

3.2 Service of the physical layer

The physical layer offers a transmission service on a limited set of logical channels. Additionally with FLO in *Iu mode*, the physical layer offers a transmission service on transport channels. The BS and MS access capabilities and the characteristics of logical channels (SAPs) are defined in 3GPP TS 44.003.

NOTE: Between 3GPP TS 44.003 and the 3GPP TS 45.0xx series there is a slight difference in terminology. The "channels" mentioned in 3GPP TS 44.003 are "logical channels" according to the 3GPP TS 45.0xx series (especially 3GPP TS 45.002). The "CCCH", a channel name commonly used in the 3GPP TS 44.0xx series, covers the logical channels of the type RACH, PCH and AGCH. Similarly, the 'PCCCH' covers the logical channels of the type PPCH, PAGCH and PRACH.

For an MS operating in *A/Gb mode*, logical channels are multiplexed on physical channels. Physical channels are the units scheduled on the radio medium. Some are reserved by the network for common use (e.g. a combination of CCCH and BCCH), others are assigned to dedicated connections with MSs (dedicated physical channels), or are assigned to a shared usage between MSs for packet switched data traffic (packet data physical channels). In time, the combination of logical channels used on an assigned physical channel may change. Allowed combinations of logical channels on a physical channel are defined in 3GPP TS 44.003. Data on SAPs of control channels is exchanged in discrete blocks with a size of 23 or 21 (SACCH) octets. Data on a SAP of packet data traffic channels is exchanged in discrete blocks with a size dependent on the block type (see clause 7).

For an MS operating in *Iu mode*, logical channels are multiplexed on basic physical subchannels. Basic physical subchannels are the units scheduled on the radio medium. Some basic physical channels are reserved by the network for common use (e.g. BCCH); dedicated basic physical subchannels are assigned to dedicated connections with MSs, shared basic physical subchannels are assigned to a shared usage between MSs for packet switched data traffic. In time, the combination of logical channels used on an assigned basic physical subchannel may change. Allowed combinations of logical channels on a basic physical subchannel are defined in 3GPP TS 44.003. Data on SAPs of control channels is exchanged in discrete blocks with a size of 23 or 21 (SACCH) octets. Data on a SAP of packet data traffic channels is exchanged in discrete blocks with a size dependent on the block type (see clause 7).

For an MS operating in *Iu mode* with FLO, transport channels are multiplexed on dedicated basic physical subchannels. The combination of transport channels used on an assigned basic physical subchannel may change in time. Data on SAPs of transport channels is exchanged in discrete transport blocks.

Synchronization between layer 1 and layer 2 (data link layer) is provided for piggy-backing of RR (receive ready) frames, and the starting of timers (T200). See also 3GPP TS 44.006. Synchronization between the physical layer and the RLC/MAC layer is provided for the handling of timers, and the multiplexing of logical channels. See also 3GPP TS 44.060 (*A/Gb mode*) and 3GPP TS 44.160 (*Iu mode*).

- **Error detection:**

The physical layer offers an error protected transmission service, it includes error detection functions and to a lower level, error correction functions. Erroneous received frames are not offered to the data link layer or the RLC/MAC layer. The probability of one or more errors in a physical block transferred by the physical layer is defined in 3GPP TS 45.005. Due to not specified methods of quality detection, the probability of residual errors in transferred blocks may vary between implementations.

- **Encryption:**

Security related functions implemented at the physical layer are described in 3GPP TS 43.020.

An overview of the functions specified in the 45-series which create the service of the physical layer can be found in 3GPP TS 45.001.

3.2.1 Specific services of the physical layer in the MS

The access capability service of the physical layer in the MS differs depending on the nature of the channel (traffic, packet data traffic or broadcast/common channels).

- **Establishment of dedicated physical channels (*A/Gb Mode*):**

Establishment of dedicated physical channels on the physical layer is controlled by the radio resources management of layer 3 (3GPP TS 44.018). During operation on a dedicated physical channel, the physical layer measures the signals of neighbouring base stations and the signal quality of the used dedicated physical channel. Measurements are transferred to layer 3, measurement control information is offered by layer 3.

- **Establishment of dedicated basic physical subchannels (*Iu mode*):**

Establishment of dedicated basic physical subchannels on the physical layer is controlled by the radio resources management of layer 3 (3GPP TS 44.018 and 3GPP TS 44.118). During operation on a dedicated basic physical subchannel, the physical layer measures the signals of neighbouring base stations and the signal quality of the used dedicated basic physical subchannel. Measurements are transferred to layer 3, measurement control information is offered by layer 3.

- **Establishment of packet data physical channels (*A/Gb mode*):**

Establishment of packet data physical channels on the physical layer is controlled by the radio resource management of layer 3. Packet access and the reservation of radio resource on packet data physical channels is controlled by the RLC/MAC layer in co-operation with layer 3 (3GPP TS 44.060 and 3GPP TS 44.118). During operation on packet data physical channels, the physical layer measures the signals of neighbouring base stations and the signal quality of the used packet data physical channel. Measurements are transferred to layer 3, measurement control information is offered by layer 3.

- **Establishment of shared basic physical subchannels (*Iu mode*):**

Establishment of shared basic physical subchannels on the physical layer is controlled by the radio resource management of layer 3. Packet access and the reservation of radio resource on shared basic physical subchannels is controlled by the RLC/MAC layer in co-operation with layer 3 (3GPP TS 44.160 and 3GPP TS 44.118). During operation on shared basic physical subchannels, the physical layer measures the signals of neighbouring base stations and the signal quality of the used shared basic physical subchannel. Measurements are transferred to layer 3, measurement control information is offered by layer 3.

- **cell/PLMN selection in idle mode or in packet mode:**

In idle mode or in packet mode, the physical layer selects the best cell with its BCCH/CCCH in close co-operation with layer 3, meeting requirements for PLMN selection specified in 3GPP TS 22.011. The idle mode procedures are not modelled within the present document. Examples of procedures for cell selection are described in 3GPP TS 45.008. The physical layer performs automatic crossover.

4 Primitives of the physical layer

The Physical layer interacts with other entities as illustrated in figure 2.1. The interactions with the data link layer of Dm channels and the interactions with the RLC/MAC layer of packet data physical channels (*A/Gb mode*), shared or dedicated basic physical subchannels (*Iu mode*) are shown in terms of primitives where the primitives represent the logical exchange of information and control between the physical layer and adjacent layers. They do not specify or constrain implementations. The interactions between the physical layer and layer 1 entities for Bm/Lm channels are for further study. For the physical layer two sets of primitives are defined:

- **Primitives between physical layer and data link layer and RLC/MAC layer respectively:**

PH - Generic name - Type: Parameters.