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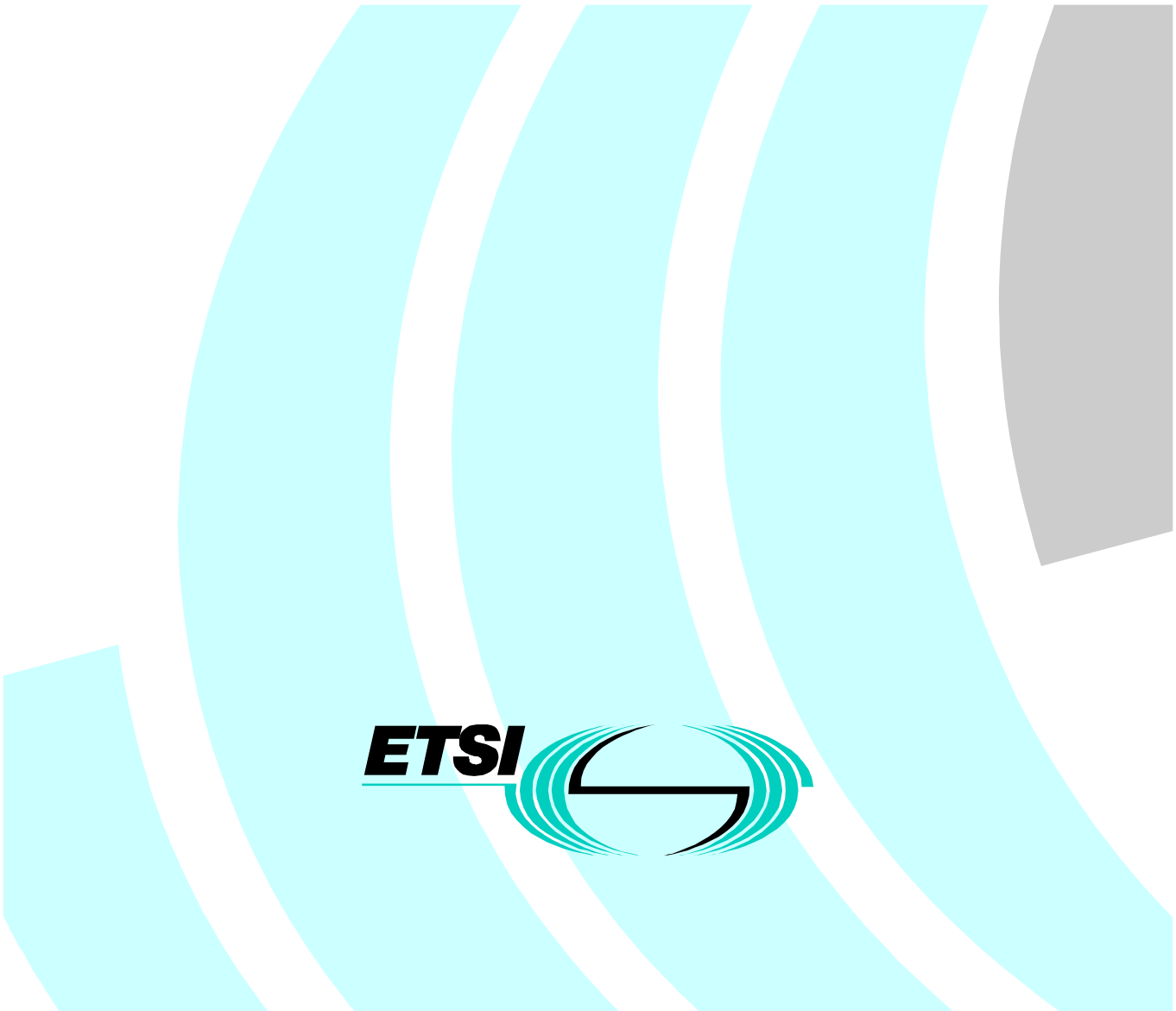
Technical Specification

Terrestrial Trunked Radio (TETRA); Digital Advanced Wireless Service (DAWS); Physical Layer (PHY) Service Description



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Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Project Terrestrial Trunked Radio (TETRA).

The present document is one of the three documents specifying the requirements for TETRA Digital Advanced Wireless Service (DAWS):

- TS 101 658: Logical Link Control (LLC) Service Description;
- TS 101 659: Medium Access Control (MAC) Service Description;
- **TS 101 660: Physical Layer (PHY) Service Description.**

An overview of the requirements for DAWS can be found in TR 101 156 [1].

Introduction

The DAWS protocol architecture is provided in [1]. The Physical Layer (PHY) provides services to the Medium Access Controller (MAC) [2]. The present document provides the requirements the PHY service shall satisfy to operate successfully within a Digital Advanced Wireless Service (DAWS) network. The requirements in the present document apply to the integrated DAWS subnet described in [1].

The prefix PHY will be used when a requirement applies to both the BS and MS PHY layers. The prefix BS_PHY or MS_PHY will be used when a requirement applies only to the BS or MS PHY layers, respectively.

As shown in figure 1, the Medium Access Controller (MAC) accesses PHY services via service access points (SAPs) A and B. PHY_SAP_A is for data transfer service primitives and PHY_SAP_B is for local control and status service primitives.

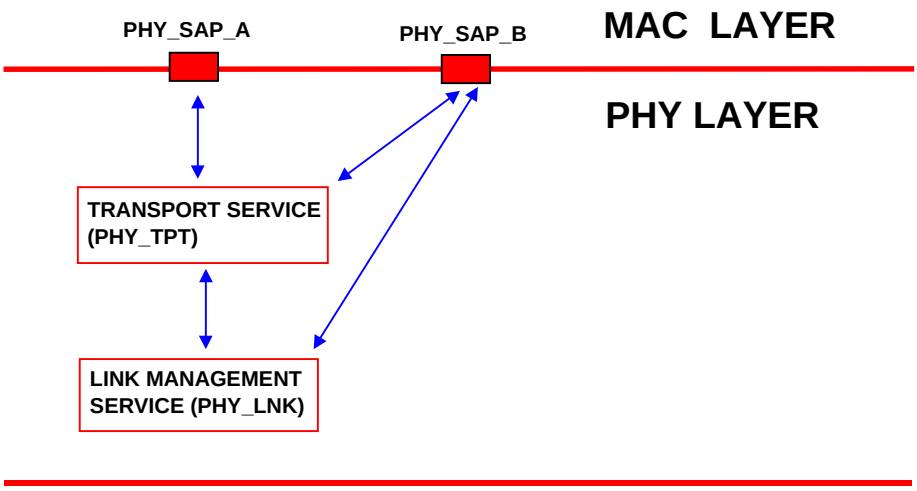

Figure 1: DAWS PHY Architecture

Requirements for the transport and link management services are provided in the clauses 4and 5 Service primitives and associated service data units are provided in clause 6.

1 Scope

The present document specifies the service requirements for the Digital Advanced Wireless Service (DAWS) Physical (PHY) layer. The document describes the general service characteristics of a DAWS PHY layer which can interwork successfully with a DAWS MAC. Specific service details will be provided in a future version of the present document.

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, subsequent revisions do apply.
- 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 TR 101 156: "Terrestrial Trunked Radio (TETRA); Technical requirements specification for Digital Advanced Wireless Service (DAWS)".

[2] ETSI TS 101 659: "Terrestrial Trunked Radio (TETRA); Digital Advanced Wireless Service (DAWS); Medium Access Control (MAC) service description".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

base station: piece of equipment providing simultaneous, bi-directional network access to mobile stations.

block: fixed-length sequence of bytes from a MAC PDU.

downlink: general term meaning "from the base station to the mobile station".

mobile station: piece of equipment able to create and consume data but only having network access via a base station.

slot: minimum time period reserved for transmission by a single mobile station on a single frequency.

frame: time period consisting of an integral number of frames between base station broadcasts specifying mobile station slot assignments.

protocol data unit: set of parameters and/or data passed from peer to peer by a protocol primitive.

protocol primitive: request, response, or informative message sent from peer to peer.

service data unit: set of parameters and/or data passed between adjacent layers by a service primitive.

service primitive: request, response, or informative message sent between adjacent layers.

uplink: general term meaning "from the mobile station to the base station".

3.2 Abbreviations

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

BS	Base Station
DAWS	Digital Advanced Wireless Services
IP	Internet Protocol
LLC	Logical Link Controller
MAC	Medium Access Controller
MPDU	MAC Protocol Data Unit
MS	Mobile Station
PDU	Protocol Data Unit
PHY	Physical Layer
PHY_LNK	PHY Link Management Service
PHY_TPT	PHY Transport Service
SAP	Service Access Point
SDU	Service Data Unit

4 Link Management Services

The PHY link management service (PHY_LNK) manages the wireless link between the BS and MS, including modulating and demodulating RF carriers with bit patterns (blocks) provided by PHY_TPT.

BS_PHY_LNK is responsible for generating and transmitting the synchronization block and for transmitting any downlink data blocks provided by BS_PHY_TPT. BS_PHY_LNK is also responsible for receiving uplink data blocks and transferring them to BS_PHY_TPT for uplink PDU reconstruction.

MS_PHY_LNK synchronizes with BS_PHY_LNK based on received timing information. MS_PHY_LNK is responsible for sending uplink blocks and receiving downlink blocks. MS_PHY_LNK transfers downlink blocks to MS_PHY_TPT for downlink PDU reconstruction. MS_PHY_LNK performs power management, including support for power-saving modes of operation. MS_PHY_LNK handles MAC hunt requests and cell service requests, and performs channel quality monitoring.

4.1 Downlink MAC PDU transfers over the PHY

Figure 2 provides a flow diagram illustrating the messages exchanged to transfer downlink MAC PDUs using dynamic bandwidth allocation. The message flow can be traced as follows:

1) BS_MAC sends a **PHY_frame_assignment_request** service primitive to BS_PHY during multiframe N containing slot assignments for multiframe N + 2. A slot assignment specifies whether the BS, a particular MS, or all MS are permitted to transmit in the slot;

2) BS_PHY sends the slot assignment information to the MS_PHY during slot 0 of frame N + 1. MS_PHY immediately transfers the slot assignment information to MS_MAC;

3) During frame N + 1, BS_MAC issues MAC PDU transfer request service primitives to BS_PHY to fill its assigned downlink slots during multiframe N + 2. BS_PHY performs MAC PDU block encoding and any other tasks necessary to prepare the PDU blocks for transfer during multiframe N + 2;

4) BS_PHY transfers PHY PDU blocks to MS_PHY in its assigned slots during frame N + 2;

5) MS_PHY recreates each downlink MAC PDU and sends it to MS_MAC.

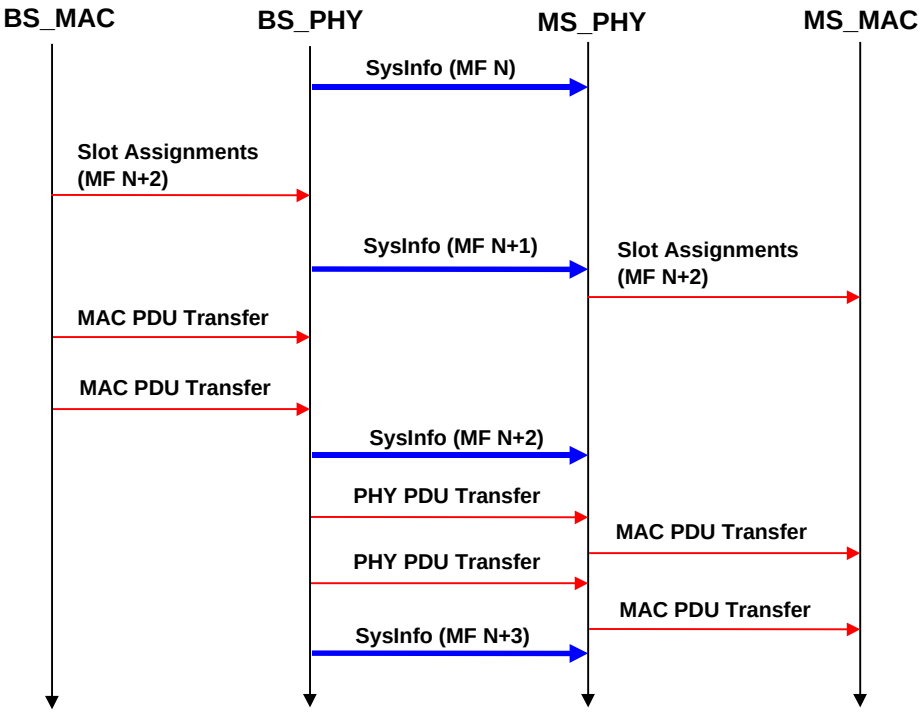

Figure 2: Downlink MAC PDU Transfers Using Dynamic Bandwidth Allocation

4.2 Uplink MAC PDU transfers over the PHY

Figure 3 provides a flow diagram illustrating the messages exchanged to transfer uplink MAC PDUs using dynamic bandwidth allocation. The message flow can be traced as follows:

1) BS_MAC sends a **PHY_frame_assignment_request** service primitive to BS_PHY during frame N containing slot assignments for frame N + 2. A slot assignment specifies whether the BS, a particular MS, or all MS are permitted to transmit in the slot;

2) BS_PHY sends the slot assignment information to the MS_PHY during slot 0 of multiframe N + 1. MS_PHY immediately transfers the slot assignment information to MS_MAC;

3) During frame N + 1, MS_MAC issues MAC PDU transfer request service primitives to MS_PHY to fill its assigned uplink slots during frame N + 2. MS_PHY performs MAC PDU block encoding and any other tasks necessary to prepare the PDU blocks for transfer during frame N + 2;

4) MS_PHY transfers PHY PDU blocks to the BS_PHY in its assigned slots during frame N + 2;

5) BS_PHY reassembles the uplink MAC PDUs from the received PHY PDUs and sends them to BS_MAC.

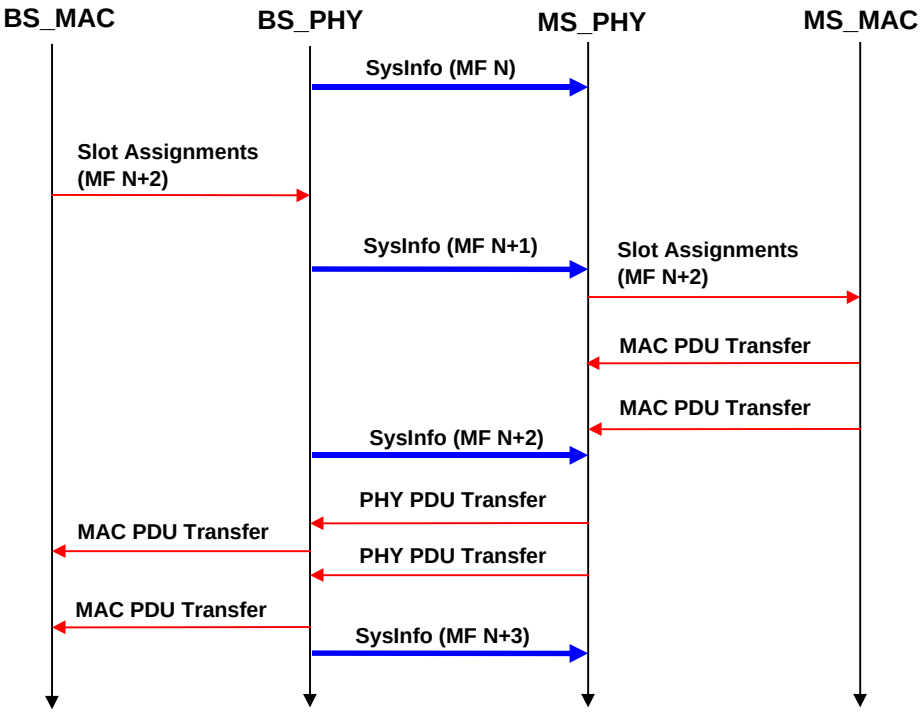

Figure 3: Uplink MAC PDU Transfers Using Dynamic Bandwidth Allocation

5 Transport Services

The PHY transport service (PHY_TPT) performs all of the operations necessary on the send side to prepare the data blocks associated with a PDU for transmission over the physical medium, and performs all of the operations necessary on the receive side to reconstruct the PDU from received data blocks. PHY_TPT may perform operations such as encoding/decoding and interleaving/de-interleaving.

PHY_TPT shall implement an encoding/decoding scheme which permits the detection, but not necessarily the correction, of a bit error in a block. PHY_TPT shall pass received block condition information along with block data to the MAC.

6 Service Primitives

6.1 Primitive Definitions

6.1.1 PHY_transfer_request

PHY_transfer_request	
Usage	BS and MS
Source	MAC Layer
Destination	PHY Layer
Service Access Point	A
Multiple Outstanding	No
SDU Parameters	*MPDU*
	slot_number

This primitive is used by the MAC layer to pass a MPDU to the PHY layer for transfer to one or more peer PHY SAP As. The slot number specified is in the next frame.

6.1.2 PHY_transfer_confirm

PHY_transfer_confirm	
Usage	BS and MS
Source	PHY Layer
Destination	MAC Layer
Service Access Point	A
SDU Parameters	*transfer_receipt_ack*

This primitive acknowledges the receipt of the MPDU associated with a PHY_transfer_request. It does not indicate that the MPDU has been transferred to one or more peer SAPs.

6.1.3 PHY_transfer_indication

PHY_transfer_indication	
Usage	BS and MS
Source	PHY Layer
Destination	MAC Layer
Service Access Point	A
SDU Parameters	*MPDU*

This primitive is used by the PHY to pass a received MPDU to the MAC layer.

6.1.4 PHY_hunt_request

PHY_hunt_request	
Usage	MS
Source	MAC Layer
Destination	PHY Layer
Service Access Point	B
Multiple Outstanding	No
SDU Parameters	-

This primitive tells the PHY to report adjacent cell signal strength and quality.

6.1.5 PHY_hunt_confirm

PHY_hunt_confirm	
Usage	MS
Source	PHY Layer
Destination	MAC Layer
Service Access Point	B
SDU Parameters	*hunt_result*

This primitive reports adjacent cell signal strength and quality.

6.1.6 PHY_service_request

PHY_service_request	
Usage	MS
Source	MAC Layer
Destination	PHY Layer
Service Access Point	B
Multiple Outstanding	No
SDU Parameters	*base_station_ID*

This primitive tells the PHY to camp on the BS specified by *base_station_ID*.

6.1.7 PHY_service_confirm

PHY_service_confirm	
Usage	MS
Source	PHY Layer
Destination	MAC Layer
Service Access Point	B
SDU Parameters	*service_result*

This primitive confirms a service request.

6.1.8 PHY_service_indication

PHY_service_indication	
Usage	MS
Source	PHY Layer
Destination	MAC Layer
Service Access Point	B
SDU Parameters	*service_status*

This primitive is used by the PHY to provide the MAC with the latest service status.

6.1.9 PHY_slot_assignment_request

PHY_slot_assignment_request	
Usage	BS
Source	MAC Layer
Destination	PHY Layer
Service Access Point	B
Multiple Outstanding	No
SDU Parameters	*slot_assignments*

This service primitive defines the uplink and downlink slot assignments for a frame. If the primitive is issued during frame N, then the assignments are for slots in frame N + 2.

6.1.10 PHY_slot_assignment_confirm

PHY_slot_assignment_confirm _assignment_confirm	
Usage	BS
Source	PHY Layer
Destination	MAC Layer
Service Access Point	B
SDU Parameters	*slot_assignment_result*

This primitive confirms a slot assignment request.

6.2 Parameter Definitions

6.2.1 *transfer_receipt_ack*

transfer_receipt_ack	
0	success: receipt acknowledged
1	failure: transfer request already pending

6.2.2 base_station_ID

This parameter specifies a particular DAWS BS.

6.2.3 *slot_assignment_result*

slot_assignment_result	
0	success: slots defined
1	failure: could not complete request

6.2.4 *slot_assignments*

This parameter defines for each slot in a frame whether the BS, a particular MS, or all MS are permitted to transmit during the slot.

6.2.5 *slot_number*

This parameter specifies a particular slot within the frame. Slot number 0 is reserved for the system information broadcast.

6.2.6 *hunt_result*

This parameter contains a list of current and adjacent cell signal strength and quality measurements.

6.2.7 *MPDU*

This parameter will be defined in the DAWS MAC protocol specification document.

6.2.8 *service_result*

service_result	
0	success: requested service now available
1	failure: could not complete request

Bibliography

The following material, though not specifically referenced in the body of the present document (or not publicly available), gives supporting information.

- RFC 1112: "Host Extensions for IP Multicasting".
- RFC 791: "Internet Protocol DARPA internet program protocol specification".
- RFC 2211: "Specification of the Controlled-Load Network Element Service".
- RFC 2205: "Resource ReSerVation Protocol (RSVP) - Version 1 Functional Specification".
- RFC 2215: "General Characterization Parameters for Integrated Service Network Elements".

History

Document history		
V1.1.1	April 1999	Publication
V1.2.1	April 2000	Publication