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99. Physical Medium Attachment (PMA) Sublayer, Physical Medium Dependent (PMD) Sublayer, and Medium for Coaxial Distribution Networks, Type <EPoC_PMD_NAME>

99.1 Overview

This clause describes the Physical Medium Attachment (PMA), the Physical Medium Dependent (PMD) sublayer, and Medium Dependent Interface (MDI) used with {EPoC_PMD_NAME} point-to-multipoint (P2MP) networks. These are passive or active multipoint coaxial distribution networks (CDN) that connect multiple DTEs using a single shared coaxial link. The architecture is asymmetric, based on a tree and branch topology utilizing passive or active coaxial splitters. This type of network requires that the Multipoint MAC Control sublayer exists above MAC instances, as described in {Clause 102}.

99.1.1 Terminology and Conventions

The notation used in the state diagrams in this clause follows the conventions in {21.5}. Should there be a discrepancy between a state diagram and descriptive text, the state diagram prevails. The notation ++ after a counter indicates it is to be incremented by 1. The notation — after a counter indicates it is to be decremented by 1. The notation –= after a counter indicates that the counter value is to be decremented by the following value. The notation += after a counter indicates that the counter value is to be incremented by the following value. Code examples given in this clause adhere to the style of the “C” programming language.

99.1.2 Goals and Objectives

99.1.3 Positioning of the PMA and PMD Sublayers within the IEEE 802.3 Architecture

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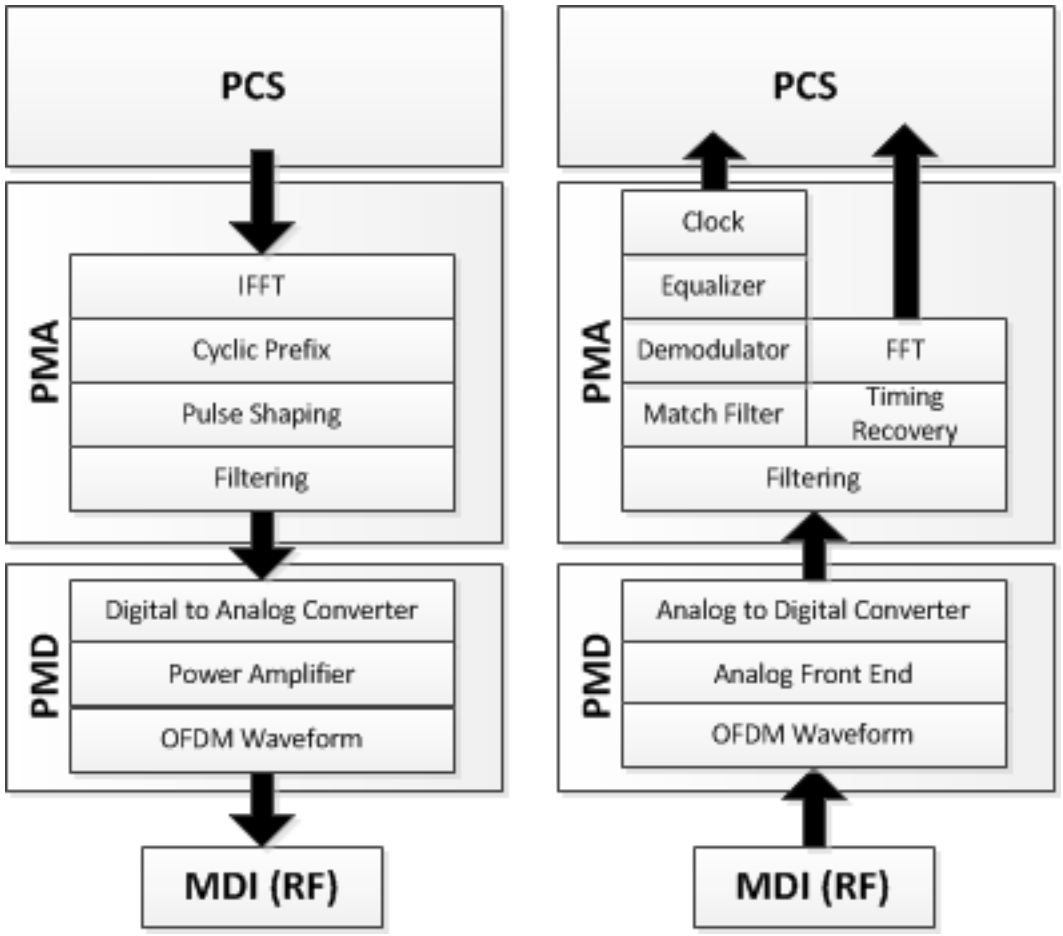
99.1.4 PMA/PMD Block Diagram

Figure 1—PMA/PMD Block Diagram



This section might need to be expanded into much more detail than what was shown in 10G-EPON. What we need to show is interaction between PMD and PMA similar to Figure 95-3, but we can also show more details on internal PMD structure, relative to functional blocks etc.

99.2 PMA Functional Specification

99.2.1 PMA Service Interface

99.2.1.1 Delay Constraints

A critical subclause which provides delay constraints for PMD we specify for EPoC. Usually, we provide delay and variability (jitter) in here, expressed in units of TQ.

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99.2.1.1.1 Relative Processing Delays

Requirements for messaging processing delay through the PMD

99.2.1.2 PMA_UNITDATA.request

Describes how the data is transferred from PMA (digital interface) into analog front-end

99.2.1.3 PMA_UNITDATA.indication

Describes how the data is transferred to PMA (digital interface) from analog front-end

99.2.1.4 PMA_SIGNAL.request

Describes how the PMA controls the transmitter state (on / off). It will be needed for burst mode transmission. We could also control the status of the auto-negotiation process, data rate control etc. To be discussed in more detail later.

99.2.1.5 PMA_SIGNAL.indication

Describes how the PMA learns about the incoming signal (presence of data). It will be needed for burst mode transmission and continuous mode transmission alike. Here, we will be also able to indicate whether the link is operating, in hunting mode, stable, etc.

99.2.2 Downstream OFDM Numerology

99.2.2.1 Number of Channels, Channel size and Sampling Frequency

99.2.2.2 FFT size(s)

99.2.2.3 Available Subcarriers

Total subcarriers available for payload after all of the overhead is accounted for.

99.2.2.4 Cyclic prefix

99.2.2.5 Pulse Window Shaping (alpha and filter type)

99.2.2.6 Guard Size

99.2.2.7 Cyclic Prefix Prepend

Describes the size and structure of the cyclic prefix

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99.2.3 Upstream OFDMA Numerology

99.2.3.1 Number of Channels, Channel Size, and Sampling Frequency

99.2.3.2 Sub-Band width(s)

99.2.3.3 FFT size(s)

99.2.3.4 Subcarrier width

99.2.3.5 Number of Subcarriers

99.2.3.6 Subcarrier Group Size

99.2.3.7 Subcarrier Per Transmitter

99.2.3.8 Available Subcarriers

Total subcarriers available for payload after all of the overhead is accounted for.

99.2.3.9 Cyclic prefix/Guard Size

99.2.3.10 Pulse Window Shaping (alpha and filter type)

99.3 PMD Functional Specification

99.3.1 PMD Service Interface

99.3.1.1 Delay Constraints

A critical subclause which provides delay constraints for PMD we specify for EPoC. Usually, we provide delay and variability (jitter) in here, expressed in units of TQ.

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99.3.1.1.1 Relative Processing Delays

Requirements for messaging processing delay through the PMD

99.3.1.2 PMD_UNITDATA.request

Describes how the data is transferred from PMD (digital interface) into analog front-end

99.3.1.3 PMD_UNITDATA.indication

Describes how the data is transferred to PMD (digital interface) from analog front-end

99.3.1.4 PMD_SIGNAL.request

Describes how the PMD controls the transmitter state (on / off). It will be needed for burst mode transmission. We could also control the status of the auto-negotiation process, data rate control etc. To be discussed in more detail later.

99.3.1.5 PMD_SIGNAL.indication

Describes how the PMD learns about the incoming signal (presence of data). It will be needed for burst mode transmission and continuous mode transmission alike. Here, we will be also able to indicate whether the link is operating, in hunting mode, stable, etc.

99.3.2 PMD Transmit Function

99.3.2.1 Modulation Formats

Details the modulation formats that must be supported for each channel - PLC, Data, and pilots for DS and US (e.g.256QAM, 512QAM, 1024QAM etc.)

99.3.2.1.1 Total Information Data Rate for OFDM Channels

Describes the data capacity of the data and signaling channels

99.3.2.2 Frequency Plan

Range of transmitter frequencies

99.3.2.2.1 FDD/TDD DS

99.3.2.2.2 TDD US

99.3.2.3 Carrier Muting

99.3.3 Downstream Transmitter Requirements

99.3.3.1 Transmit Power Requirements

Transmit power requirements for the FCU, including range of reported transmit power per channel, step size of power commands, step size accuracy, and absolute accuracy of FCU.

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99.3.3.1.1 OFDM Transmit Power Calculations

99.3.3.1.2 Transmit Power Step Size

99.3.3.1.3 PAPR

99.3.3.2 Fidelity Requirements

99.3.3.2.1 Spectral Nulling

99.3.3.2.2 Adjacent Channel Spurious Emissions

99.3.3.2.3 Spurious Emissions in the Frequency Range

99.3.3.2.4 Spurious Emissions During Burst On/Off Transients

99.3.3.2.5 Modulation Error Ratio

Includes definitions and requirements

99.3.3.2.6 Filter Distortion

99.3.3.2.7 Carrier Phase Noise

99.3.3.2.8 Channel Frequency Accuracy

99.3.3.2.9 Modulation Rate Accuracy

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99.3.3.2.10 Modulation Timing Jitter

99.3.4 Upstream Transmitter Requirements

99.3.4.1 CNU Transmitter Pre-Equalizer

99.3.4.2 CNU Transmit Power Requirements

Transmit power requirements the CNU, including range of reported transmit power per channel, step size of power commands, step size accuracy, and absolute accuracy of CNU.

99.3.4.2.1 OFDMA Transmit Power Calculations

99.3.4.2.2 Transmit Power Step Size

99.3.4.2.3 Transmit Power Requirements with Multiple Transmitters

99.3.4.2.4 PAPR

99.3.4.3 Burst Timing Ramp Up/Down

99.3.4.4 Upstream Frequency Agility and Range

99.3.4.5 CNU Transmitter Capabilities

Describes what CNU capabilities the CNU must report to the FCU and OLT - TDD capable, for example

99.3.4.6 CNU Transmitter Fidelity Requirements

99.3.4.6.1 Adjacent Channel Spurious Emissions

99.3.4.6.2 Spurious Emissions in the Upstream Frequency Range

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99.3.4.6.3 Spurious Emissions During Burst On/Off Transients

99.3.4.6.4 Modulation Error Ratio

99.3.4.6.5 Carrier Phase Noise

99.3.4.6.6 Channel Frequency Accuracy

99.3.4.6.7 Modulation Rate Accuracy

99.3.4.6.8 Modulation Timing Jitter

99.3.4.6.9 Clock Recovery

99.4 PMD Receive Function

99.4.1 CNU Receive

99.4.1.1 Input Signal Characteristics at CNU Receiver

Describes the characteristics of the input signal at the receiver(e.g, signal level, power spectral density (PSD) etc.),.

99.4.1.2 Tuner Frequency Range

99.4.1.3 Frame Error Rate

Specifies the downstream frame error ratio. From objectives: better than 10^-6 at the MAC/PLS service interface. Complete details required (channel conditions, frame sizes, etc.).

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99.4.1.4 Input Return Loss

99.4.1.5 Input Impedance

99.4.1.6 Image Rejection Performance

For example: Performance MUST be met with an analog or a digital signal at +10 dBc in any portion of the RF band.

99.4.1.6.1 Adjacent Channel

99.4.1.6.2 Non-Adjacent Channel

99.4.1.7 Multi-Channel Receiver Operation

Are there any requirements for multi-channel receiver requirements needed?

99.4.1.8 Reconfiguration of CNU Receiver

Specifies requirements for the CNU to dynamically change the receive channel parameters it is currently using. This could be used for modulation profiles, bit loading, etc.

99.4.1.9 PMD Transmit Enable Function (CNU)

Assuming burst mode transmission is done in upstream only

99.4.1.10 PMD Auto-Negotiation Function

This subclause will be brand new and will describe the process of auto-negotiating data rate across EPoC link

99.4.2 CLT Receive

99.4.2.1 Input Signal Characteristics at CLT Receiver

Describes the characteristics of the input signal at the receiver (e.g, signal level, power spectral density (PSD), .

99.4.2.2 CLT Tuner Frequency Range

99.4.2.3 CLT Frame Error Rate

Specifies the downstream frame error ratio. From objectives: better than 5x10^-5 at the MAC/PLS service interface. Complete details required (channel conditions, frame sizes, etc.).

99.4.2.4 Input Return Loss

99.4.2.5 Input Impedance

99.4.2.6 Image Rejection Performance

Performance MUST be met with an analog or a digital signal at +10 dBc in any portion of the RF band.

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99.4.2.6.1 Adjacent Channel

99.4.2.6.2 Non-Adjacent Channel

99.4.2.7 Multi-Channel Receiver Operation

Are there any requirements for multi-channel receiver requirements needed? Not defined yet.

99.4.2.8 PMD Signal Detect

Table similar to Table 95-4 will need to be specified in here, indicating when and how signal presence is detected and when it is not

99.4.2.8.1 CNU PMD Signal Detect

99.4.2.8.2 CLT PMD Signal Detect

99.5 Definitions of Parameters and Measurement Methods

10G-EPON spec contains several subclauses which are not going to be applicable to coaxial plant. The list below accounts for the subclauses most likely to apply to coaxial section, but also other (new) subclauses are possible, as long as TF agrees to their presence.

99.5.1 Insertion Loss?

Is this channel model defined

99.5.2 Test Patterns

99.5.3 Frequency and Frequency Range Measurement

99.5.4 RF Power Measurements

99.5.5 Transmit Waveform and MER (Constellation diagram)

99.5.6 Transmit Penalty?

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99.5.7 Receive Sensitivity

99.5.8 Stressed Receiver Conformance Test

We will need to discuss whether such a test makes sense for RF devices.

99.5.9 Jitter Measurements

99.5.10 Transmitter On/Off Timing Measurements

Might be needed if transmitter is indeed switched on/off between bursts.

99.5.11 Receiver Settling Timing Measurement

Might be needed for CLT Rx, where bursts from individual CNUs are incoming time interleaved.

99.6 Environmental, Safety, and Labeling

10G-EPON spec contains several subclauses which are not going to be applicable to coaxial plant. The list below accounts for the subclauses most likely to apply to coaxial section, but also other (new) subclauses are possible, as long as TF agrees to their presence. The set below is a minimum set which has been used for PMD description in the past. This set is likely to be extended

99.6.1 General Safety

99.6.2 RF Safety

99.6.3 Installation

99.6.4 Environment

99.6.5 PMD Labeling?

99.7 Channel Characteristics

The channel is composed of coax, active components (amps,) and passive components (taps, etc). This should refer to the channel model appendix.

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99.7.1 Coaxial Cabling Model

99.7.2 Coaxial Cable

99.7.3 Coaxial Connectors

99.7.4 Medium Dependent Interface (MDI)

99.8 EEE Capability

This subclause might contain summary of the EEE capabilities for this PMD type. Given that it is a new PMD design, the suggestion is to in-build EEE capability from day one, rather than add it in a fashion similar to P802.3az project. This material will all be new in 802.3bn

99.9 TimeSync Capability

This subclause might contain summary of the TimeSync capabilities for this PMD type. Given that it is a new PMD design, we can embed TimeSync capability from day one. This involves primarily guaranteeing repeatable and stable delay as well as support for specific capability registers. See Clause 90 for more details.

99.10 Protocol implementation conformance statement (PICS) proforma for Clause 100, Physical Medium Dependent (PMD) sublayer and medium for coaxial distribution networks, type EPoc_PMD_Name

To be filled in once the main spec is ready (Clause 100 work is largely technically complete)

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