

<b>1</b>	<b>INTRODUCTION.....</b>	<b>5</b>
1.1	.....	5
1.1.2	Basic concepts.....	5
1.3	Normative references.....	5
1.4	Definitions.....	5
1.5	Abbreviations.....	5
<b>30</b>	<b>MANAGEMENT.....</b>	<b>6</b>
30.5	.....	6
30.5.1	.....	6
30.5.1.1	.....	6
30.5.1.1.2	aMAUType.....	6
<b>45</b>	<b>MANAGEMENT DATA INPUT/OUTPUT (MDIO) INTERFACE .....</b>	<b>8</b>
45.2	.....	8
45.2.1	.....	8
45.2.1.6	PMA/PMD control 2 register (Register 1.7) .....	8
<b>56</b>	<b>INTRODUCTION TO ETHERNET FOR SUBSCRIBER ACCESS NETWORKS .....</b>	<b>9</b>
56.1	Overview .....	9
56.1.2	Summary of P2MP sublayers .....	9
56.1.2.1	Multipoint MAC Control Protocol (MPCP).....	9
56.1.2.2	Reconciliation Sublayer (RS) and media independent interfaces .....	9
56.1.2.3	Physical Layer signaling systems .....	9
56.1.2.5	Unidirectional transmission .....	9
<b>57</b>	<b>OPERATIONS, ADMINISTRATION, AND MAINTENANCE (OAM).....</b>	<b>10</b>
57.1	Overview .....	10
57.2	Functional specifications.....	10
57.3	Detailed functions and state diagrams.....	10
57.4	OAMPDUs.....	10
57.5	OAM TLVs .....	10
<b>95</b>	<b>PHYSICAL MEDIUM DEPENDENT (PMD) SUBLAYER AND MEDIUM FOR COAXIAL DISTRIBUTION NETWORKS, TYPE EPOC_PMD_NAME .....</b>	<b>11</b>
95.1	Overview .....	11
95.1.1	Terminology and conventions.....	11
95.1.2	Goals and objectives .....	11
95.1.3	PMD classes.....	11
95.1.4	Positioning of PMD sublayer within the IEEE 802.3 architecture .....	11
95.2	PMD types .....	11
95.2.1	Mapping of PMDs to PMD classes .....	11

<b>95.3</b>	<b>PMD functional specifications.....</b>	<b>11</b>
95.3.1	PMD service interface .....	11
95.3.1.1	Delay constraints .....	11
95.3.1.2	PMD_UNITDATA.request .....	11
95.3.1.3	PMD_UNITDATA.indication.....	11
95.3.1.4	PMD_SIGNAL.request.....	11
95.3.1.5	PMD_SIGNAL.indication .....	11
95.3.2	PMD block diagram .....	12
95.3.3	PMD transmit function.....	12
95.3.4	PMD receive function.....	12
95.3.5	PMD signal detect function.....	12
95.3.5.1	CNU PMD signal detect .....	12
95.3.5.2	CLT PMD signal detect.....	12
95.3.6	PMD transmit enable function for CNU .....	12
95.3.7	PMD auto-negotiation function .....	12
<b>95.4</b>	<b>PMD to MDI specifications for EPoC CLT PMDs .....</b>	<b>12</b>
95.4.1	Transmitter specifications .....	12
95.4.2	Receiver specifications.....	12
<b>95.5</b>	<b>PMD to MDI specifications for EPoC CNU PMDs .....</b>	<b>12</b>
95.5.1	Transmitter specifications .....	12
95.5.2	Receiver specifications.....	12
<b>95.6</b>	<b>Definitions of parameters and measurement methods.....</b>	<b>12</b>
95.6.1.1	Insertion loss .....	13
95.6.1.2	Test patterns .....	13
95.6.1.3	Frequency and frequency range measurement .....	13
95.6.1.4	RF power measurements .....	13
95.6.1.5	Transmit waveform (transmit eye).....	13
95.6.1.6	Transmit penalty .....	13
95.6.1.7	Receive sensitivity .....	13
95.6.1.8	Stressed receiver conformance test.....	13
95.6.1.9	Jitter measurements.....	13
95.6.1.10	Transmitter on/off timing measurement .....	13
95.6.1.11	Receiver settling timing measurement.....	13
<b>95.7</b>	<b>Environmental, safety, and labeling.....</b>	<b>13</b>
95.7.1	General safety .....	13
95.7.2	RF safety.....	13
95.7.3	Installation .....	13
95.7.4	Environment.....	13
95.7.5	PMD labeling .....	13
<b>95.8</b>	<b>Characteristics of the coaxial cabling .....</b>	<b>13</b>
95.8.1	Coaxial cabling model .....	14
95.8.2	Coaxial cable .....	14
95.8.3	Coaxial connection .....	14
95.8.4	Medium Dependent Interface (MDI) .....	14
<b>95.9</b>	<b>EEE capability.....</b>	<b>14</b>
<b>95.10</b>	<b>TimeSync capability .....</b>	<b>14</b>
<b>95.11</b>	<b>Protocol implementation conformance statement (PICS) proforma for Clause 95, Physical Medium Dependent (PMD) sublayer and medium for coaxial distribution networks, type EPoC_PMD_Name.....</b>	<b>14</b>
<b>96</b>	<b>RECONCILIATION SUBLAYER, PHYSICAL CODING SUBLAYER, AND PHYSICAL MEDIA ATTACHMENT FOR EPOC .....</b>	<b>15</b>

<b>96.1</b>	<b>Overview .....</b>	<b>15</b>
96.1.1	Conventions .....	15
96.1.2	Constraints for delay through RS, PCS, and PMA.....	15
<b>96.2</b>	<b>Reconciliation Sublayer (RS) for EPoC .....</b>	<b>15</b>
96.2.1	Overview of RS operation .....	15
96.2.2	Summary of major concepts .....	15
96.2.3	10 Gbps Media Independent Interface (XGMII).....	15
96.2.3.1	XGMII structure .....	15
96.2.3.2	XGMII operation .....	15
96.2.3.3	Mapping of XGMII signals to PLS service primitives.....	15
96.2.3.3.1	Functional specifications for multiple MACs.....	15
96.2.3.3.2	Variables.....	15
96.2.3.3.3	RS Transmit function .....	15
96.2.3.3.4	RS Receive function .....	15
96.2.3.3.5	SLD.....	15
96.2.3.3.6	LLID.....	15
96.2.3.3.7	CRC-8.....	15
<b>96.3</b>	<b>Physical Coding Sublayer (PCS) for EPoC .....</b>	<b>15</b>
96.3.1	Overview .....	15
96.3.1.1	EPoc_PMD_Name PCS.....	15
96.3.2	PCS transmit function.....	15
96.3.2.1	Idle control character deletion.....	15
96.3.2.2	Preferred_Line_Code Encode .....	15
96.3.2.3	Scrambler / Interleaver .....	15
96.3.2.4	FEC encoding process .....	16
96.3.2.5	Data Detector .....	16
96.3.2.6	Gearbox .....	16
96.3.3	PCS receive Function .....	16
96.3.3.1	CLT synchronizer .....	16
96.3.3.2	CNU Synchronizer.....	16
96.3.3.3	FEC decoding process .....	16
96.3.3.4	BER monitor .....	16
96.3.3.5	Descrambler / Interleaver .....	16
96.3.3.6	Preferred_Line_Code Decode.....	16
96.3.3.7	Idle Insertion .....	16
<b>96.4</b>	<b>EPoc_PMD_Name PMA .....</b>	<b>16</b>
<b>96.5</b>	<b>EEE capability.....</b>	<b>16</b>
<b>96.6</b>	<b>TimeSync capability .....</b>	<b>16</b>
<b>96.7</b>	<b>Protocol implementation conformance statement (PICS) proforma for Clause 96, Reconciliation Sublayer, Physical Coding Sublayer, and Physical Media Attachment for EPoC.....</b>	<b>17</b>
<b>97</b>	<b>MULTIPOINT MAC CONTROL FOR EPOC.....</b>	<b>18</b>
<b>97.1</b>	<b>Overview .....</b>	<b>18</b>
<b>97.2</b>	<b>Multipoint MAC Control operation .....</b>	<b>18</b>
97.2.1	Principles of Multipoint MAC Control .....	18
97.2.2	Multipoint transmission control, Control Parser, and Control Multiplexer .....	18
<b>97.3</b>	<b>Multipoint Control Protocol (MPCP) .....</b>	<b>18</b>
97.3.1	Principles of Multipoint Control Protocol .....	18
97.3.2	Compatibility considerations .....	18
97.3.3	Discovery processing.....	18
97.3.4	Report Processing .....	18

97.3.5	Gate Processing.....	18
97.3.6	MPCPDU structure and encoding .....	18
<b>97.4</b>	<b>Discovery Process in dynamic data-rate EPoC systems .....</b>	<b>18</b>
<b>97.5</b>	<b>Protocol implementation conformance statement (PICS) proforma for Clause 97, Multipoint MAC Control .....</b>	<b>18</b>

# **1 Introduction**

## **1.1**

### **1.1.2 Basic concepts**

*If TDD and FDD modes of operation are introduced, we might to add description of the TDD mode. TDD would extend the definition of “Half duplex operation” mode for MAC, i.e. 1.1.2.1 Half duplex operation*

### **1.3 Normative references**

*Add normative references for cable industry, including coaxial plant reference models, collections of requirements etc.*

### **1.4 Definitions**

*Add definitions specific to coaxial distribution plant, EPoC, EPoC specific mode of operation etc.*

### **1.5 Abbreviations**

*Add abbreviations specific to coaxial distribution plant, EPoC, EPoC specific mode of operation etc.*

## **30 Management**

### **30.5**

#### **30.5.1**

##### **30.5.1.1**

##### **30.5.1.1.2 aMAUType**

*Need to add a new entry for EPoC PMD type, when defined.*

*More detail analysis is needed once PHY is designed, to see whether new entity diagram is needed. At this time, we have DTE System (Figure 30–3), Repeater (Figure 30–4), Midspan (Figure 30–5), Link Layer Discovery Protocol (Figure 30–6).*

*To be filled in once the main spec is ready (Clause 95, 96 and 97 work is largely technically complete)*

## Annex 31A MAC control opcode assignments

*Table 31A–1 might need to be extended if new MAC Control messages are added for EPoC specific use. When new messages are added, their definition also needs to be provided in a tabular way, similar to Table 31A–2 through Table 31A–7.*

## **45 Management Data Input/Output (MDIO) Interface**

### **45.2**

#### **45.2.1**

##### **45.2.1.6 PMA/PMD control 2 register (Register 1.7)**

*Need to insert a new entry in Table 45–7—PMA/PMD control 2 register bit definitions to designate the new EPoC PMD type, when defined.*

*Other instances of registers will be added in 45.2 when PHY design is more concrete and we have more details available. Examples include PMA/PMD registers (45.2.1), PCS registers (45.2.3), Auto-Negotiation registers (45.2.7).*

*To be filled in once the main spec is ready (Clause 95, 96 and 97 work is largely technically complete)*



## **56 Introduction to Ethernet for subscriber access networks**

### **56.1 Overview**

*Need to extend the existing text of introduction to EFM, especially in the part of copper EFM and make a drawing similar to Figure 56-4 showing CLT – CNU connection.*

#### **56.1.2 Summary of P2MP sublayers**

*Extend the description with P2MP coaxial topologies similar to the description included for P2MP optical topologies*

##### **56.1.2.1 Multipoint MAC Control Protocol (MPCP)**

*This section will need to be extended to account for the use of MPCP in EPoC environment*

##### **56.1.2.2 Reconciliation Sublayer (RS) and media independent interfaces**

*This section will need to be extended to account for the use of RS and LLID filtering in EPoC environment*

##### **56.1.2.3 Physical Layer signaling systems**

*This section will need to be extended to account for new copper signaling, adding to what is already defined for EFM copper cabling technologies.*

*Table 56–1 will have to be extended to add EPoC PHY types*

*Table 56–3 will have to be extended to add EPoC PHY types (P2MP type)*

##### **56.1.2.5 Unidirectional transmission**

*This section will have to be extended to account for unidirectional transmission in P2MP EPoC environment. Now it covers only EPON*

## **57 Operations, Administration, and Maintenance (OAM)**

*Unless otherwise stated, each subclause will be modelled after Clause 57 OAM, focusing on minimum augmentation needed to support EPoC*

### **57.1 Overview**

*If any changes in the overview are needed, this is where we would be doing them*

### **57.2 Functional specifications**

*Not likely to be affected by EPoC*

### **57.3 Detailed functions and state diagrams**

*Not likely to be affected by EPoC*

### **57.4 OAMPDUs**

*If any new OAMPDUs are needed, this is where they would go*

### **57.5 OAM TLVs**

*If any new TLVs are needed, this is where they would go*

# **95 Physical Medium Dependent (PMD) sublayer and medium for coaxial distribution networks, type EPoc\_PMD\_Name**

*DISCLAIMER: we will need to come up with the PMD name (EPoc\_PMD\_Name) at some point of time, based on capabilities and encoding*

*Unless otherwise stated, each subclause will be modelled after Clause 75 for 10G-EPON*

## **95.1 Overview**

### **95.1.1 Terminology and conventions**

### **95.1.2 Goals and objectives**

### **95.1.3 PMD classes**

*Unclear at this time whether it is needed for EPoC*

### **95.1.4 Positioning of PMD sublayer within the IEEE 802.3 architecture**

## **95.2 PMD types**

*Describe the CNU type and CLT type, their general capabilities, supported data rates are frequency ranges*

### **95.2.1 Mapping of PMDs to PMD classes**

*Only if needed, i.e. if we specify more than one PMD class*

## **95.3 PMD functional specifications**

### **95.3.1 PMD service interface**

#### **95.3.1.1 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.*

#### **95.3.1.2 PMD\_UNITDATA.request**

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

#### **95.3.1.3 PMD\_UNITDATA.indication**

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

#### **95.3.1.4 PMD\_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.*

#### **95.3.1.5 PMD\_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.*

### **95.3.2 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.*

### **95.3.3 PMD transmit function**

### **95.3.4 PMD receive function**

### **95.3.5 PMD signal detect function**

*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*

#### **95.3.5.1 CNU PMD signal detect**

#### **95.3.5.2 CLT PMD signal detect**

### **95.3.6 PMD transmit enable function for CNU**

*Assuming burst mode transmission is done in upstream only.*

### **95.3.7 PMD auto-negotiation function**

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

## **95.4 PMD to MDI specifications for EPoC CLT PMDs**

*This is the collection of all parameters required to describe the RF interface of the CLT*

### **95.4.1 Transmitter specifications**

### **95.4.2 Receiver specifications**

## **95.5 PMD to MDI specifications for EPoC CNU PMDs**

*This is the collection of all parameters required to describe the RF interface of the CNU*

### **95.5.1 Transmitter specifications**

### **95.5.2 Receiver specifications**

## **95.6 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.*

- 95.6.1.1 Insertion loss**
- 95.6.1.2 Test patterns**
- 95.6.1.3 Frequency and frequency range measurement**
- 95.6.1.4 RF power measurements**
- 95.6.1.5 Transmit waveform (transmit eye)**
- 95.6.1.6 Transmit penalty**
- 95.6.1.7 Receive sensitivity**
- 95.6.1.8 Stressed receiver conformance test**

*Will need discussion whether such a test makes sense for RF devices*

- 95.6.1.9 Jitter measurements**
- 95.6.1.10 Transmitter on/off timing measurement**

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

- 95.6.1.11 Receiver settling timing measurement**

*Might be needed for CLT Rx, where bursts from individual CNU's are incoming time interleaved*

## **95.7 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*

- 95.7.1 General safety**
- 95.7.2 RF safety**
- 95.7.3 Installation**
- 95.7.4 Environment**
- 95.7.5 PMD labeling**

## **95.8 Characteristics of the coaxial cabling**

*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 coaxial plant description in the past. This set is likely to be extended*

### **95.8.1 Coaxial cabling model**

### **95.8.2 Coaxial cable**

### **95.8.3 Coaxial connection**

### **95.8.4 Medium Dependent Interface (MDI)**

## **95.9 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 be all new in P802.3bn*

## **95.10 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.*

*This material will be all new in P802.3bn*

## **95.11 Protocol implementation conformance statement (PICS) proforma for Clause 95, 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 95 work is largely technically complete)*

# **96 Reconciliation Sublayer, Physical Coding Sublayer, and Physical Media Attachment for EPoC**

*Unless otherwise stated, each subclause will be modelled after Clause 76 for 10G-EPON*

*It is unclear at this time whether we need any elements of the auto-negotiation function to be also embedded in*

## **96.1 Overview**

### **96.1.1 Conventions**

### **96.1.2 Constraints for delay through RS, PCS, and PMA**

## **96.2 Reconciliation Sublayer (RS) for EPoC**

### **96.2.1 Overview of RS operation**

### **96.2.2 Summary of major concepts**

### **96.2.3 10 Gbps Media Independent Interface (XGMII)**

#### **96.2.3.1 XGMII structure**

#### **96.2.3.2 XGMII operation**

#### **96.2.3.3 Mapping of XGMII signals to PLS service primitives**

##### **96.2.3.3.1 Functional specifications for multiple MACs**

##### **96.2.3.3.2 Variables**

##### **96.2.3.3.3 RS Transmit function**

##### **96.2.3.3.4 RS Receive function**

##### **96.2.3.3.5 SLD**

##### **96.2.3.3.6 LLID**

##### **96.2.3.3.7 CRC-8**

## **96.3 Physical Coding Sublayer (PCS) for EPoC**

### **96.3.1 Overview**

#### **96.3.1.1 EPoc\_PMD\_Name PCS**

### **96.3.2 PCS transmit function**

#### **96.3.2.1 Idle control character deletion**

*Part of the data rate adaptation mechanism*

#### **96.3.2.2 Preferred\_Line\_Code Encode**

*At this time, TBD*

#### **96.3.2.3 Scrambler / Interleaver**

*At this time, TBD which one will be used and whether it will be used at all*

#### **96.3.2.4 FEC encoding process**

*At this time, TBD – need to define what FEC is used, whether we use stream based or frame based FEC, what family FEC is used etc.*

#### **96.3.2.5 Data Detector**

*For CLT and CNU*

#### **96.3.2.6 Gearbox**

*Any data rate adaptation is further done in here to adapt it to the PMA rate*

### **96.3.3 PCS receive Function**

#### **96.3.3.1 CLT synchronizer**

*At this time, unclear whether CLT and CNU synchronizers will be the same or not*

#### **96.3.3.2 CNU Synchronizer**

*At this time, unclear whether CLT and CNU synchronizers will be the same or not*

#### **96.3.3.3 FEC decoding process**

*At this time, TBD – need to define what FEC is used, whether we use stream based or frame based FEC, what family FEC is used etc.*

#### **96.3.3.4 BER monitor**

#### **96.3.3.5 Descrambler / Interleaver**

*At this time, TBD which one will be used and whether it will be used at all*

#### **96.3.3.6 Preferred\_Line\_Code Decode**

*At this time, TBD.*

#### **96.3.3.7 Idle Insertion**

### **96.4 EPoc\_PMD\_Name PMA**

*Will be largely derived from the 10GBASE-R PMA defined in Clause 51. Only specific changes will be listed in this subclause*

### **96.5 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 be all new in P802.3bn*

### **96.6 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.*

*This material will be all new in P802.3bn*



**96.7 Protocol implementation conformance statement (PICS) proforma for Clause 96, Reconciliation Sublayer, Physical Coding Sublayer, and Physical Media Attachment for EPoC**

## **97 Multipoint MAC Control for EPoC**

*Unless otherwise stated, each subclause will be modelled after Clause 77 for 10G-EPON*

### **97.1 Overview**

### **97.2 Multipoint MAC Control operation**

#### **97.2.1 Principles of Multipoint MAC Control**

#### **97.2.2 Multipoint transmission control, Control Parser, and Control Multiplexer**

### **97.3 Multipoint Control Protocol (MPCP)**

#### **97.3.1 Principles of Multipoint Control Protocol**

#### **97.3.2 Compatibility considerations**

#### **97.3.3 Discovery processing**

#### **97.3.4 Report Processing**

#### **97.3.5 Gate Processing**

#### **97.3.6 MPCPDU structure and encoding**

### **97.4 Discovery Process in dynamic data-rate EPoC systems**

### **97.5 Protocol implementation conformance statement (PICS) proforma for Clause 97, Multipoint MAC Control**