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Ethernet in the First Mile Copper (EFMCu) Interfaces MIB
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Status of this Memo

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Abstract

This document defines a portion of the Management Information Base (MIB) for use with network management protocols in TCP/IP based internets. This document proposes an extension to the Ethernet-like Interfaces MIB and MAU MIB with a set of objects for managing an Ethernet in the First Mile Copper (EFMCu) interfaces 10PASS-TS and 2BASE-TL, defined in IEEE Std 802.3ah-2004.

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1. Introduction

New Ethernet like interfaces have been defined in the Institute of Electrical and Electronics Engineers (IEEE) 802.3ah project a.k.a. Ethernet in the First Mile (EFM) [802.3ah]. In particular 2BASE-TL and 10PASS-TS physical interfaces (PHYs), defined over voice-grade copper pairs, have been specified for the long and short reach respectively. These interfaces, collectively called EFMCu, are based on ITU-T G.SHDSL and VDSL specifications and support variable rates and optional Physical Medium Entity (PME) aggregation (a.k.a. multi-pair bonding).

2BASE-TL PHY is capable of providing at least 2Mbps over 2700 m long single copper pair with a mean Bit Error Rate (BER) of 10^-7 (using 5dB target noise margin).

10PASS-TS PHY is capable of providing at least 10Mbps over 750 m long single copper pair with a mean BER of 10^-7 (using 6dB target noise margin).

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community to manage EFMCu interfaces.

Note that managed objects for Operation, Administration and Management (OAM) and Ethernet over Passive Optical Networks (EPON) clauses of IEEE 802.3ah are defined in EFM-COMMON-MIB [I-D.ietf-hubmib-efm-mib] and EFM-EPON-MIB [I-D.ietf-hubmib-efm-epon-mib] respectively.

2. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [RFC3410].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIv2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580]. A detailed introduction to the current SNMP Management Framework can be found in RFC 2570 [RFC2570].

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this

document are to be interpreted as described in RFC 2119 [RFC2119].

3. Relation to other MIBs

This section outlines the relationship of this MIB with other MIB modules described in the relevant RFCs. Specifically, Interfaces Group MIB (IF-MIB), Ethernet-Like (EtherLike-MIB), MAU (MAU-MIB), SHDSL (HDSL2-SHDSL-LINE-MIB) and VDSL (VDSL-LINE-EXT-MCM-MIB) are discussed.

3.1 Relation to Interfaces Group MIB

2BASE-TL and 10PASS-TS PHY's specified in this MIB are stacked Ethernet interfaces and as such are managed using generic interface management objects defined in the IF-MIB [RFC2863]. The stack management is done via the ifStackTable, as defined in the IF-MIB [RFC2863] and ifInvStackTable, as defined in the IF-INVERTED-STACK-MIB [RFC2864].

3.1.1 Layering Model

An EFMCu interface can aggregate up to 32 Physical Medium Entity (PME) sub-layer devices (modems), using so called PME Aggregation Function (PAF).

A generic EFMCu device can have a number of Physical Coding Sublayer (PCS) ports, connected to a MAC via Medium Independent Interface (MII) at the upper layer, and cross-connected to a number of underlying PMEs, with a single PCS per PME relationship, see clause 61.1 of [802.3ah] for more details.

Each PME in the aggregated EFMCu port is represented in the Interface table (ifTable) as a separate port with ifType of shdsl(169) for 2BASE-TL or vdsl(97) for 10PASS-TS. The ifType values are defined in [IANAifType-MIB].

ifSpeed for each PME shall return the actual data bitrate of the active PME or a configured bitrate for pre-activated modems (e.g. for 2BaseTL PMEs it is a multiple of 64Kbps). The ifSpeed of the PCS is the sum of the current operating data rates of all modems in the aggregation group, without the 64/65B encapsulation overhead and PAF overhead, but acounting for the Inter-Frame Gaps (IFG).

The following configuration shall have no frame loss (the test-sets are configured to generate 100% of back to back traffic, i.e. minimal IFG, at 10Mbps; the EFM interfaces are obviously aggregated)):

```
[testset]--10BaseT--[CO]--2BaseTL--[CPE]--10BaseT--[testset]
        ifSpeed=10Mbps ifSpeed=10Mbps  ifSpeed=10Mbps

[testset]--100BaseT--[CO]--10PassTS--[CPE]--100BaseT--[testset]
        ifSpeed=100Mbps ifSpeed=100Mbps  ifSpeed=100Mbps
```

Figure 1: Example configuration with no frame loss

The following figure shows the layering diagram and corresponding use of ifTable and ifMauTable:

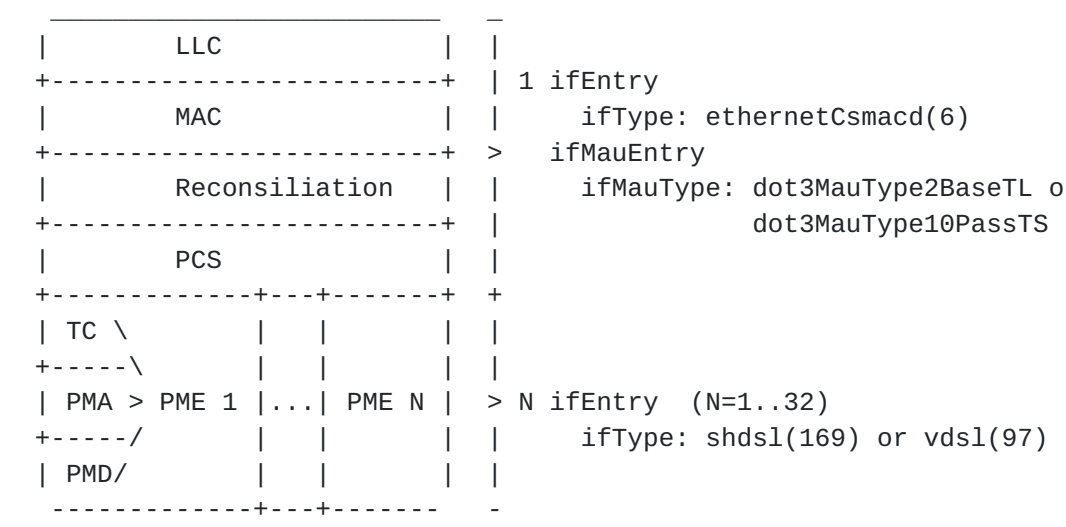

Figure 2: Use of ifTable and ifMauTable for EFMCu ports

The ifStackTable is indexed by the ifIndex values of the aggregated EFMCu port (PCS) and the PMEs connected to it. ifStackTable allows a Network Management application to determine which PMEs are connected to a particular PCS and change connections (if supported by the application). The ifInvStackTable, being an inverted version of the ifStackTable, provides an efficient means for a Network Management application to read a subset of the ifStackTable and thereby determine which PCS runs on top of a particular PME.

A new table ifAvailableStackTable defined in this MIB, specifies for each PCS a list of PMEs, which can possibly be cross-connected to that PCS, determined by the cross-connect capability of the device. This table, modeled after ifStackTable, is read only, reflecting current cross-connect capability, which can be dynamic in some

implementations (e.g. if PMEs are located on a pluggable module and the module is pulled out). Note that PME availability per PCS, described by ifAvailableStackTable, can be constrained by other parameters, for example by aggregation capacity of a PCS or by the PME in question being already connected to another PCS. So, in order to ensure that a particular PME can be connected to the PCS, all respective parameters (e.g. ifAvailableStackTable, ifStackTable and efmCuPAFCapacity) SHALL be inspected.

*EdNote: Add ifInvAvailableStackTable describing which PCS ports can be connected to a particular PME. Add it to the ifStackCapabilityGroup conformance statement. *

3.1.2 PME Aggregation Function (PAF)

The PME Aggregation Function (PAF) is OPTIONAL. Note however that the agent is REQUIRED to report on the PAF capability for all EFMCu ports (2BASE-TL and 10PASS-TS).

EdNote: Add more info.

3.1.3 Discovery Operation

The EFMCu ports may optionally support discovery operation, whereby PMEs, during initialization, exchange information about their respective aggregation groups (PCS). This information can then be used to detect copper missconnections or for an automatic assignment of the local PMEs into aggregation groups instead of fixed pre-configuration.

This MIB allows a Network Management application to control EFM Discovery mechanism and query its results. Note that the Discovery mechanism can work only if PAF is supported and enabled.

Two tables are used by Discovery mechanism: ifStackTable and ifAvailableStackTable defined. The following pseudo-code defines an example of Discovery and automatic PME assignment for a generic PAF enabled multi-PCS EFMCu device, located at Central Office (CO) [Note that automatic PME assignment is only shown here for the purposes of the example. Fixed PME pre-assignment or manual assignment may be chosen by a particular implementation]:

```
FOREACH pcs[i] IN co_device
{ // Discover only on PAF enabled ports with room for more PMEs
  IF ( pcs[i].PAFSupported AND pcs[i].NumPMEs < pcs[i].PAFCapacity )
    { dc = pcs[i].DiscoveryCode = MAC[i]; // unique 6 Byte per PCS
      // go over all currently disconnected PMEs, which can
      // pottentially be connected to PCS[i]
      FOREACH pme[j] IN ifAvailableStackTable[pcs[i]] AND
                     NOT IN ifInvStackTable[pme[j]] // unassigned
        { pme[j].RemoteDiscoveryCode = dc;      // Set if Clear
          r = pme[j].RemoteDiscoveryCode;       // Get
          IF ( r == dc AND pcs[i].NumPMEs < pcs[i].PAFCapacity)
            { // Remote CPE connected via PME[j] is/was a peer for
              // PCS[i]. Connect this PME to the PCS (there's room)
              ADD pme[j] TO ifStackTable[pcs[i]];
              pcs[i].NumPMEs = pcs[i].NumPMEs + 1;
              // Discover all other currently disconnected PMEs,
              // attached to the same CPE and connect them to the PCS
              // provided there is enough room for more PMEs.
              FOREACH pme[k] IN ifAvailableStackTable[pcs[i]] and
                                NOT IN ifInvStackTable[pme[k]]
                { r = pme[k].RemoteDiscoveryCode;       // Get
                  IF ( r == dc AND
                       pcs[i].NumPMEs < pcs[i].PAFCapacity)
                    { ADD pme[k] TO ifStackTable[pcs[i]];
                      pcs[i].NumPMEs = pcs[i].NumPMEs + 1;
                    }
                }
            }
          // Discovered all PMEs which lead to the same CPE and
          // connected them to PCS[i]. Go to the next PCS.
          BREAK;
        }
    }
}
```

The SNMP Agent builds efmCuStackTable according to the information contained in the Clause 45 PME_Available_register (see [802.3ah] 61.1.5.3 and 45.2.3.20).

Adding a PME to the ifStackTable row for a specific PCS, involves actual connection of the PME to the PCS, which can be done by modifying Clause 45 PME_Aggregate_register (see [802.3ah] 61.1.5.3 and 45.2.3.21).

Note that PCS port does not have to be operationally 'down' for the connection to succeed. In fact, a dynamic PME addition (and removal) MAY be implemented whith an available PME being initialized first (by setting its ifAdminStatus to 'up') and then added to an operationally

'up' PCS port, by modifying a respective ifStackTable entry.

It is RECOMMENDED that a removal of the last operationally 'up' PME from an operationally 'up' PCS would be rejected by the implementation, as this action would completely drop the link.

3.1.4 EFMCu ports initialization

EFMCu ports being built on top of xDSL technology, require a lengthy initialization or 'training' process, before any data can pass. During this initialization both ends of a link (peers) work cooperatively to achieve required data rate on a particular copper pair. Sometimes, when the copper line is too long or the noise environment on the line is too high, that 'training' process may fail to achieve a specific target rate with required characteristics.

The ifAdminStatus object from the IF-MIB, controls the desired state of a PCS and a PME port. Setting this object to 'up' instructs a particular PCS or PME to start initialization process, which may take tens of seconds for EFMCu ports, especially if PAF is involved. The ifOperStatus object shows the operational state of an interface (extended by efmCuPmeOperStatus defined in this MIB for PME interfaces).

A disconnected PME may be initialized by changing the ifAdminState from 'down' to 'up'. Changing the ifAdminState to 'up' on the PCS initializes all PMEs connected to that particular PCS. Note that in case of PAF some interfaces may fail to initialize while others succeed. The PCS is considered operationally 'up' if at least one PME aggregated by its PAF is operationally 'up'. When all PMEs connected to the PCS are 'down' the PCS SHALL be considered operationally 'lowerLayerDown'. The PCS SHALL be considered operationally 'notPresent' if it is not connected to any PME. The PCS/PME interface SHALL remain operationally 'down' during initialization.

The efmCuPmeOperStatus defined in this MIB expands PME's ifOperStatus value of 'down' to 'downReady', 'downNotReady' and 'init' values, indicating various EFMCu PME specific states.

3.1.5 Usage of ifTable

Both PME and PCS interfaces of the EFMCu PHY are managed using interface specific management objects defined in this MIB and generic interface objects from the ifTable of IF-MIB, with all management table entries referenced by the interface index ifIndex.

The following table summarizes EFMCu specific interpretations for

some of the ifTable objects specified by the mandatory ifGeneralInformationGroup:

IF-MIB object	EFMCu interpretation
ifIndex	Interface index. Note that each PME and each PCS in the EFMCu PHY MUST have a unique index, as there some PCS and PME specific attributes accessible only on the PCS or PME level.
ifType	ethernetCsmacd(6) for PCS, shdsl(169) for 2BASE-TL PME, vdsl(97) for 10PASS-TS PME
ifSpeed	Actual 'net' data rate as seen across MII
ifAdminStatus	Setting this object to 'up' instructs a particular PCS (with all PMEs connected to it) or PME to start initialization process
ifOperStatus	efmCuPmeOperStatus supplements the 'down' value of ifOperStatus for PMEs.

Table 1

3.2 Relation to SHDSL MIB

G.SHDSL.bis modems, similar to PME(s) comprising a 2BASE-TL port, are described in HDSL2-SHDSL-LINE-MIB [I-D.ietf-adslmib-gshdslbis]. Note that not all attributes of G.SHDSL modems reflected in HDSL2-SHDSL-LINE-MIB have adequate management objects (Clause 30 attributes and Clause 45 registers) in the EFM standard.

Because of these differences and for the purposes of simplicity, unification of attributes common to both 2BASE-TL and 10PASS-TS PMEs and name consistency (e.g. prefixing the 2BASE-TL PME related objects with 'efmCuPme2B' instead of 'hdsl2shdsl'), it was decided not to reference HDSL2-SHDSL-LINE-MIB objects, but define all the relevant objects in this MIB.

However, if some functionality, not available in this MIB, is required and supported by the PME, e.g. performance monitoring, relevant HDSL2-SHDSL-LINE-MIB groups MAY be included and aplied for

PMEs of 2BASE-TL subtype.

3.3 Relation to VDSL MIB

VDSL (DMT) modems, similar to the PME(s) comprising a 10PASS-TS port, are described in VDSL-LINE-EXT-MCM-MIB [I-D.ietf-adslmib-vdsl-ext-mcm]. Note that not all attributes of VDSL modems reflected in VDSL-LINE-EXT-MCM-MIB have adequate management objects (Clause 30 attributes and Clause 45 registers) in the EFM standard.

Because of these differences and for the purposes of simplicity, unification of attributes common to both 2BASE-TL and 10PASS-TS PMEs and name consistency, it was decided not to reference VDSL-LINE-EXT-MCM-MIB objects, but define all the relevant objects in this MIB.

However, if some functionality, not available in this MIB, is required and supported by the PME, relevant VDSL-LINE-EXT-MCM-MIB groups MAY be included and applied for PMEs of 10PASS-TS subtype.

3.4 Relation to Ethernet-Like and MAU MIBs

The implementation of EtherLike-MIB [RFC3635] and MAU-MIB [I-D.ietf-hubmib-rfc3636bis] is REQUIRED for the EFMCu interfaces.

Two new values of ifMauType (OBJECT-IDENTITIES of dot3MauType) and corresponding bit definitions of ifMauTypeListBits (IANAifMauTypeListBits) have been defined in the IANA-MAU-TC-MIB [I-D.ietf-hubmib-rfc3636bis] for the EFMCu MAUs:

- dot3MauType2BaseTL and b2BaseTL - for 2BASE-TL MAU

- dot3MauType10PassTS and b10PassTS - for 10PASS-TS MAU

As an EtherLike interface every EFMCu port (an ifEntry representing a consolidation of LLC, MAC and PCS (sub)layers) SHALL return an ifType of ethernetCsmacd(6). While most of the MAU characteristics is not applicable to the EFMCu ports (no auto-negotiation, media available, false carriers or jabber), they SHALL return an appropriate ifMauType (dot3MauType2BaseTL or dot3mauType10PassTS) in order to direct the management software to look in the EFM-CU-MIB for the desired information. For example the information on the particular EFMCu flavor that an EFMCu port is running is available from efmCuOperSubType, defined in this MIB module.

Since EFMCu PMEs are not EtherLike interfaces, they cannot be instantiated as MAU interface objects.

4. MIB Structure

4.1 Overview

The main management objects defined in this MIB are split into 2 groups:

- efmCuPort - containing objects for configuration, capabilities, status and notifications, common to all EFMCu PHYs.

- efmCuPme - containing objects for configuration, capabilities, status and notifications of EFMCu PMEs.

In addition the ifAvailableStackTable is defined at the same level.

The efmCuPme group in turn contains efmCuPme2B and efmCuPme10P groups, which define configuration profiles specific to 2BASE-TL and 10PASS-TS PMEs respectively as well as PME specific status information.

4.2 Configuration Profiles

Since a managed node can have a large number of EFMCu PHYs, provisioning every parameter on every EFMCu PHY may become burdensome. Moreover, most PMEs are provisioned identically with the same set of parameters. To simplify the provisioning process, this MIB makes use of configuration profiles, similar to HDSL2-SHDSL-LINE-MIB and VDSL-LINE-EXT-MCM-MIB. A profile is a set of parameters that can be shared by multiple PME ports using the same configuration.

The configuration profiles are defined in efmCuPme2BConfProfileTable and efmCu10PConfProfileTable for 2BASE-TL and 10PASS-TS PMEs respectively. There are 12 predefined standard profiles for 2BASE-TL and 22 standard profiles for 10PASS-TS, defined in 802.3ah and dedicated for rapid provisioning of EFMCu PHYs in most scenarios. An ability to define new configuration profiles is also provided to allow for EFMCu deployment tailored to specific copper environment and spectral regulations.

A specific configuration profile is assigned to a specific PME via efmCuPmeAdminProfile object. Alternatively, by assigning a non-empty profile to a PCS port via efmCuAdminProfile, all PMEs connected to the PCS port are made to share that profile, which comes in handy during configuration of aggregated ports.

4.3 Mapping of IEEE 802.3ah Managed Objects

This section contains the mapping between managed objects (attributes) defined in [802.3ah] Clause 30, and managed objects defined in this document and in associated MIB modules, i.e., the IF-MIB [RFC2863].

Note that majority of the objects defined in this MIB do not have direct counterparts in Clause 30 and instead refer to Clause 45 registers.

*EdNote: It would be a good idea to update Clause 30 of 802.3ah after this MIB is approved. I guess this should be done via a maintanence request. *

IEEE 802.3 Managed Object	Corresponding SNMP Object
oPAF - Basic Package	
(Mandatory)	
aPAFID	ifIndex (IF-MIB)
aPhyEnd	efmCuPhySide
aPHYCurrentStatus	efmCuStatus
aPAFSupported	efmCuPAFSupported
oPAF - PME Aggregation Package	
(Optional)	
aPAFAdminState	efmCuPAFAdminState
aLocalPAFCapacity	efmCuPAFCapacity
aLocalPMEAvailable	ifAvailableStackTable
aLocalPMEAggregate	ifStackTable (IF-MIB)
aRemotePAFSupported	efmCuRemotePAFSupported
aRemotePAFCapacity	efmCuRemotePAFCapacity
aRemotePMEAggregate	
oPME - 10P/2B Package	
(Mandatory)	
aPMEID	ifIndex (IF-MIB)
aPMEAdminState	ifAdminState (IF-MIB)
aPMEStatus	efmCuPmeStatus
aPMESNRMgn	efmCuPmeSnrMgn
aTCCodingViolations	efmCuPmeTCCodingErrors
aProfileSelect	efmCuAdminProfile,
	efmCuPmeAdminProfile
aOperatingProfile	efmCuPmeOperProfile
aPMEFECCorrectedBlocks	efmCuPme10PFECCorrectedBlocks
aPMEFECUncorrectableBlocks	efmCuPme10PFECUncorrectedBlocks

Table 2

5. Definitions

```
EFM-CU-MIB DEFINITIONS ::= BEGIN

  IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE, Integer32,
    Unsigned32, Counter32, mib-2
      FROM SNMPv2-SMI         -- [RFC2578]
    TEXTUAL-CONVENTION, TruthValue, RowStatus, PhysAddress
      FROM SNMPv2-TC          -- [RFC2579]
    MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
      FROM SNMPv2-CONF        -- [RFC2580]
    SnmpAdminString
      FROM SNMP-FRAMEWORK-MIB -- [RFC3411]
    ifIndex, ifSpeed, InterfaceIndex
      FROM IF-MIB             -- [RFC2863]
    ;

  efmCuMIB MODULE-IDENTITY
    LAST-UPDATED "200410240000Z"  -- October 24, 2004
    ORGANIZATION "IETF Ethernet Interfaces and Hub MIB Working Group"
    CONTACT-INFO
      "WG charter:
        http://www.ietf.org/html.charters/hubmib-charter.html

      Mailing Lists:
        General Discussion: hubmib@ietf.org
        To Subscribe: hubmib-request@ietf.org
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    DESCRIPTION
      "The objects in this MIB module are used to manage
```

```
        the Ethernet in the First Mile (EFM) Copper (EFMCu) Interfaces
        2BASE-TL and 10PASS-TS, defined in IEEE Draft P802.3ah/D3.3.

        The following reference is used throughout this MIB module:

        [802.3ah] refers to:
          IEEE Draft P802.3ah/D3.3: 'Draft amendment to -
          Information technology - Telecommunications and
          information exchange between systems - Local and
          metropolitan area networks - Specific requirements -
          Part 3: Carrier sense multiple access with collision
          detection (CSMA/CD) access method and physical layer
          specifications - Media Access Control Parameters, Physical
          Layers and Management Parameters for subscriber access
          networks', 19 April 2003.

        Of particular interest are Clause 61, 'Physical Coding
        Sublayer (PCS) and common specifications, type 10PASS-TS and
        type 2BASE-TL', Clause 30, 'Management', Clause 45,
        'Management Data Input/Output (MDIO) Interface', Annex 62A,
        'PMD profiles for 10PASS-TS' and Annex 63A, 'PMD profiles for
        2BASE-TL'.

        Naming Conventions:
          Atn   - Attenuation
          CO    - Central Office
          CPE   - Customer Premises Equipment
          EFM   - Ethernet in the First Mile
          EFMCu - EFM Copper
          MDIO  - Management Data Input/Output
          Mgn   - Margin
          PAF   - PME Aggregation Function
          PCS   - Physical Coding Sublayer
          PMD   - Physical Medium Dependent
          PME   - Physical Medium Entity
          PSD   - Power Spectral Density
          SNR   - Signal to Noise Ratio
          TCPAM - Trellis Coded Pulse Amplitude Modulation

        Copyright (C) The Internet Society (2004).  This version
        of this MIB module is part of RFC XXXX;  see the RFC
        itself for full legal notices."

        -- EdNote: Replace XXXX with the actual RFC number &
        -- remove this note

      REVISION    "200410240000Z"  -- October 24, 2004
      DESCRIPTION "Initial version, published as RFC XXXX."
```

```
       ::= { mib-2 YYY }

         -- EdNote: Replace YYY with a real OID once it is
         -- allocated & remove this note.

      -- Sections of the module

      efmCuObjects     OBJECT IDENTIFIER ::= { efmCuMIB 1 }

      efmCuConformance OBJECT IDENTIFIER ::= { efmCuMIB 2 }

      -- Groups in the module

      efmCuPort        OBJECT IDENTIFIER ::= { efmCuObjects 1 }

      efmCuPme         OBJECT IDENTIFIER ::= { efmCuObjects 2 }

      -- Textual Conventions

      ProfileIndex ::= TEXTUAL-CONVENTION
        DISPLAY-HINT "d"
        STATUS       current
        DESCRIPTION
          "A unique value, greater than zero, for each PME configuration
          profile in the managed EFMCu port. It is recommended that
          values are assigned contiguously starting from 1. The value
          for each profile must remain constant at least from one
          re-initialization of the entity's network management system
          to the next re-initialization."
        SYNTAX       Unsigned32 (1..255)

      ProfileIndexOrZero ::= TEXTUAL-CONVENTION
        DISPLAY-HINT "d"
        STATUS       current
        DESCRIPTION
          "This textual convention is an extension of the ProfileIndex
          convention. The latter defines a greater than zero value used
          to identify a PME profile in the managed EFMCu port. This
          extension permits the additional value of zero. The value of
          zero is object-specific and must therefore be defined as part
          of the description of any object which uses this syntax.
          Examples of the usage of zero value migh include situations
          where current operational profile is unknown."
        SYNTAX       Unsigned32 (0..255)

      ProfileIndexList ::= TEXTUAL-CONVENTION
        DISPLAY-HINT "1d:"
        STATUS       current
```

```
        DESCRIPTION
          "Represents a list of up to 6 ProfileIndex's.
          The ProfileIndex textual convention defines a greater than
          zero value used to identify a PME profile in the managed EFMCu
          port. The value of this object is a concatenation of zero or
          more (up to 6) octets, where each octet contains an 8-bit
          ProfileIndex value.
          A non-empty profile list specifies a list of alternative
          profiles any of which can be chosen for configuration of an
          PME. A zero length string value means this list has no members
          (empty). Examples of the usage of empty profile list might
          include situations where configuration profile(s) is unknown,
          or when no common profile(s) need to be referenced and
          sub-interface profile shall take precedence."
        SYNTAX       OCTET STRING (SIZE(0..6))

     -- Port Notifications Group

      efmCuPortNotifications OBJECT IDENTIFIER ::= { efmCuPort 0 }

      efmCuLowBandwidth NOTIFICATION-TYPE
        OBJECTS {
          -- ifIndex is not needed here since we are under specific PCS
          ifSpeed,
          efmCuThreshLowBandwidth
        }
        STATUS      current
        DESCRIPTION
          "This notification indicates that EFMCu port's data rate
          reached or dropped below a Low Bandwidth Threshold
          (i.e. bandwidth degradation happening in case of PAF when one
          or more PMEs drop)."
           -- EdNote: add throttling limitations here
        ::= { efmCuPortNotifications 1 }

      -- PCS Port group

      efmCuPortConfTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF EfmCuPortConfEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "Table for Configuration of EFMCu 2BASE-TL/10PASS-TS (PCS)
          Ports. Entries in this table MUST be maintained in a
          persistent manner"
        ::= { efmCuPort 1 }

      efmCuPortConfEntry OBJECT-TYPE
```

```
        SYNTAX      EfmCuPortConfEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "An entry in the EFMCu Port Configuration table.
          Each entry represents an EFMCu port indexed by the ifIndex.
          Note that an EFMCu PCS port runs on top of a single
          or multiple PME port(s), which are also indexed by ifIndex."
        INDEX  { ifIndex }
        ::= { efmCuPortConfTable 1 }

      EfmCuPortConfEntry ::=
        SEQUENCE {
          efmCuPAFAdminState              INTEGER,
          efmCuPAFDiscoveryCode           PhysAddress,
          efmCuAdminProfile               ProfileIndexList,
          efmCuTargetDataRate             Unsigned32,
          efmCuTargetSnrMgn               Unsigned32,
          efmCuThreshLowBandwidth         Unsigned32,
          efmCuLowBandwidthEnable         TruthValue
        }

      efmCuPAFAdminState  OBJECT-TYPE
        SYNTAX      INTEGER {
          enabled(1),
          disabled(2)
        }
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
          "Administrative (desired) state of the PAF of the EFMCu port
          (PCS).
          When 'disabled', PME Aggregation will not be performed by the
          PCS. No more than a single PME can be assigned to this PCS in
          this case.
          When 'enabled', PAF will be performed by the PCS when the link
          is Up, even on a single attached PME, if PAF is supported.

          PCS ports incapable of supporting PAF SHALL return a value of
          'disabled'. Attempts to 'enable' such ports SHALL be ignored.

          PAF 'enabled' port with multiple PMEs assigned cannot be
          'disabled'. Attempts to 'disable' such port SHALL be rejected,
          until at most one PME is left assigned.

          Changing PAFAdminState is a traffic disruptive operation and
          as such SHALL be done when the link is Down. Attempts to
          change this object SHALL be ignored if the link is Up or
```

```
          Initializing.

          This object maps to the Clause 30 attribute aPAFAdminState.

          If a Clause 45 MDIO Interface to the PCS is present, then this
          object maps to the PAF enable bit in the 10P/2B PCS control
          register."
        REFERENCE
          "[802.3ah] 61.2.2, 45.2.3.18.3"
        ::= { efmCuPortConfEntry 1 }

      efmCuPAFDiscoveryCode  OBJECT-TYPE
        SYNTAX      PhysAddress
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
          "PAF Discovery Code of the EFMCu port (PCS).
          A unique 6 Byte long code used by the Discovery function, when
          PAF is supported.
          PCS ports incapable of supporting PAF SHALL return a value of
          all zeroes. Attempts to change this object SHALL be ignored in
          this case.
          This object MUST be instantiated for the -O subtype PCS before
          writing operations on the efmCuPAFRemoteDiscoveryCode
          (Set_if_Clear and Clear_if_Same) are performed by PMEs
          associated with the PCS.
          The value of this object is read-only for -R port subtypes.
          The initial value of this object for -R ports after reset
          is 0. This value may be changed as a result of writing
          operation on efmCuPAFRemoteDiscoveryCode variable of remote
          PME of -O subtype, connected to one of the local PMEs
          associated with the PCS.

          Discovery MUST be performed when the link is Down.
          Attempts to change this object MUST be rejected with the error
          inconsistentValue if the link is Up or Initializing.

          The PAF Discovery code maps to the local Discovery code
          variable in PAF (note that it does not have a corresponding
          Clause 45 register)"
        REFERENCE
          "[802.3ah] 61.2.2.8.3, 61.2.2.8.4, 45.2.6.6.1"
        ::= { efmCuPortConfEntry 2 }

      efmCuAdminProfile  OBJECT-TYPE
        SYNTAX      ProfileIndexList
        MAX-ACCESS  read-write
        STATUS      current
```

```
        DESCRIPTION
          "Desired configuration profile(s), common for all PMEs in the
          EFMCu port. This object is a list of pointers to entries in
          either efmCuPme2BConfProfileTable or
          efmCuPme10PConfProfileTable, depending on the current
          operating SubType of the EFMCu port as indicated by
          efmCuPortSide.
          The value of this object is a list of up to 6 indices of
          configuration profiles. If this list consists of a single
          Profile index, then all PMEs assigned to this EFMCu port SHALL
          be configured according to the Configuration Profile
          referenced by that index. The list, consisting of more than
          one index, allows each PME in the port to be configured
          according to any configuration profile specified in the list.
          An empty list means that each PME in the port is configured
          via corresponding efmCuPmeAdminProfile object.

          This object is writable and readable for the -O subtype
          (2BaseTL-O or 10PassTS-O) EFMCu ports. It is unavailable for
          the -R  subtype (2BaseTL-R or 10PassTS-R) ports.

          Note that current operational Profile value is available via
          efmCuPmeOperProfile object.

          Modification of this object must be performed when the link is
          Down. Attempts to change this object MUST be rejected, if the
          link is Up or Initializing.
          Attempts to set this object to a non-empty list with a member
          value, that is not the value of the index for an active entry
          in the corresponding profile table, MUST be rejected."
        REFERENCE
          "[802.3ah] 30.11.2.1.6"
        ::= { efmCuPortConfEntry 3 }

      efmCuTargetDataRate  OBJECT-TYPE
        SYNTAX      Unsigned32(1..100000|999999)
        UNITS       "Kbps"
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
          "Desired EFMCu port 'net' (as seen across MII) Data Rate in
          Kbps, to be achieved during initialization, under spectral
          restrictions placed on each PME via efmCuAdminProfile or
          efmCuPmeAdminProfile, with the desired SNR Margin specified by
          efmCuTargetSnrMgn.
          In case of PAF, this object represents a sum of individual PME
          data rates, modified to compensate for fragmentation and
          64/65B framing overhead (e.g. target data rate of 10Mbps
```

```
          shall allow lossless transmission of full-duplex 10Mbps
          Ethernet frame stream with minimal inter-frame gap).

          The value is limited above by 100Mbps as this is the max
          burst rate across MII for EFMCu ports.

          The value between 1 and 100000 indicates that the total data
          rate (ifSpeed) of the EFMCu port after initialization should
          be equal to the target data rate or less, if the target data
          rate cannot be achieved under spectral restrictions specified
          by efmCuAdminProfile/efmCuPmeAdminProfile and with desired SNR
          margin. In case the copper environment allows to achieve
          higher total data rate than specified by the target, the
          excess capability SHALL be converted to additional SNR margin
          and spread evenly across all active PMEs assigned to the (PCS)
          port.

          The value of 999999 means that the target data rate is not
          fixed and should be set to the maximum attainable rate during
          initialization (Best Effort), under specified spectral
          restrictions and with desired SNR Margin.

          This object is read-write for the -O subtype EFMCu ports
          (2BaseTL-O/10PassTS-O) and not available for the -R subtypes.

          Changing of the Target Data Rate MUST be performed when the
          link is Down. Attempts to change this object MUST be rejected
          with the error inconsistentValue, if the link is Up or
          Initializing.

          Note that current Data Rate of the EFMCu port is represented
          by ifSpeed object of IF-MIB."
        ::= { efmCuPortConfEntry 4 }

      efmCuTargetSnrMgn  OBJECT-TYPE
        SYNTAX      Unsigned32(0..21)
        UNITS       "dB"
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
          "Desired EFMCu port SNR Margin to be achieved on all PMEs
          assigned to the port, during initializiation. (The SNR margin
          is the difference between the desired SNR and the actual SNR).

          Note that 802.3ah recommends using default Target SNR Margin
          of 5dB for 2BASE-TL ports and 6dB for 10PASS-TS ports in order
          to achieve mean Bit Error Rate (BER) of 10^-7 at the PMA
          service interface.
```

```
          This object is read-write for the -O subtype EFMCu ports
          (2BaseTL-O/10PassTS-O) and not available for the -R subtypes.

          Changing of the Target SNR Margin MUST be performed when the
          link is Down. Attempts to change this object MUST be rejected
          with the error inconsistentValue, if the link is Up or
          Initializing.

          Note that current SNR Margin of the PMEs comprising the EFMCu
          port is represented by efmCuPmeSnrMgn."
        REFERENCE
          "[802.3ah] 61.1.2"
        ::= { efmCuPortConfEntry 5 }

      efmCuThreshLowBandwidth  OBJECT-TYPE
        SYNTAX      Unsigned32(0..100000)
        UNITS       "Kbps"
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
          "This object configures the EFMCu port Low Bandwidth alarm
          threshold. When the current value of ifSpeed for this port
          reaches or drops below this threshold, an
          efmCuLowBandwidth notification MAY be generated if enabled by
          efmCuLowBandwidthEnable.

          The value of 0 means no efmCuLowBandwidth notifications
          SHALL ever be generated.

          This object is read-write for the -O subtype EFMCu ports
          (2BaseTL-O/10PassTS-O) and not available for the -R subtypes."
        ::= { efmCuPortConfEntry 6 }

      efmCuLowBandwidthEnable  OBJECT-TYPE
        SYNTAX      TruthValue
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
          "Indicates whether efmCuLowBandwidth notifications should be
          generated for this interface.

          Value of truth(1) indicates that efmCuLowBandwidth
          notification is enabled. Value of false(0) indicates the it is
          disabled."
        ::= { efmCuPortConfEntry 7 }


      efmCuPortCapabilityTable OBJECT-TYPE
```

```
    SYNTAX      SEQUENCE OF EfmCuPortCapabilityEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
      "Table for Capabilities of EFMCu 2BASE-TL/10PASS-TS (PCS)
      Ports. Entries in this table MUST be maintained in a
      persistent manner"
    ::= { efmCuPort 2 }

  efmCuPortCapabilityEntry OBJECT-TYPE
    SYNTAX      EfmCuPortCapabilityEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
      "An entry in the EFMCu Port Capability table.
      Each entry represents an EFMCu port indexed by the ifIndex.
      Note that an EFMCu PCS port runs on top of a single
      or multiple PME port(s), which are also indexed by ifIndex."
    INDEX  { ifIndex }
    ::= { efmCuPortCapabilityTable 1 }

  EfmCuPortCapabilityEntry ::=
    SEQUENCE {
      efmCuPAFSupported               TruthValue,
      efmCuPeerPAFSupported           TruthValue,
      efmCuPAFCapacity                Unsigned32,
      efmCuPeerPAFCapacity            Unsigned32
    }

  efmCuPAFSupported  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
      "PME Aggregation Function (PAF) Capability of the EFMCu port
      (PCS).
      This object has a value of true(1) when the PCS can perform
      PME aggregation on the available PMEs.
      Ports incapable of PAF SHALL return a value of false(2).

      This object maps to the Clause 30 attribute aPAFSupported.

      If a Clause 45 MDIO Interface to the PCS is present,
      then this object maps to the PAF available bit in the
      10P/2B capability register."
    REFERENCE
      "[802.3ah] 61.2.2, 30.11.1.1.4, 45.2.3.17.1"
    ::= { efmCuPortCapabilityEntry 1 }
```

```
      efmCuPeerPAFSupported  OBJECT-TYPE
        SYNTAX      TruthValue
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "PME Aggregation Function (PAF) Capability of the EFMCu port
          (PCS) link partner.
          This object has a value of true(1) when the remote PCS can
          perform PME aggregation on its available PMEs.
          Ports whose peers are incapable of PAF or cannot be reached
          because of the link state, SHALL return a value of false(2).

          This object maps to the Clause 30 attribute
          aRemotePAFSupported.

          If a Clause 45 MDIO Interface to the PCS is present, then
          this object maps to the Remote PAF supported bit in the
          10P/2B capability register."
        REFERENCE
          "[802.3ah] 61.2.2, 30.11.1.1.9, 45.2.3.17.2"
        ::= { efmCuPortCapabilityEntry 2 }

      efmCuPAFCapacity  OBJECT-TYPE
        SYNTAX      Unsigned32 (1..32)
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "Number of PMEs that can be aggregated by the local PAF.
          The number of PMEs currently assigned to a particular
          EFMCu port (efmCuNumPMEs) is never greater than
          efmCuPAFCapacity.

          This object maps to the Clause 30 attribute
          aLocalPAFCapacity."
        REFERENCE
          "[802.3ah] 61.2.2, 30.11.1.1.6"
        ::= { efmCuPortCapabilityEntry 3 }

      efmCuPeerPAFCapacity  OBJECT-TYPE
        SYNTAX      Unsigned32 (0|1..32)
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "Number of PMEs that can be aggregated by the PAF of the peer
          Phy (PCS port).
          Value of 0 is returned when peer PAF Capacity is unknown
          (peer cannot be reached).
```

```
          This object maps to the Clause 30 attribute
          aRemotePAFCapacity."
        REFERENCE
          "[802.3ah] 61.2.2, 30.11.1.1.10"
        ::= { efmCuPortCapabilityEntry 4 }


      efmCuPortStatusTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF EfmCuPortStatusEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "This table provides overall status information of EFMCu
          2BASE-TL/10PASS-TS ports. This table contains live data from
          the equipment. As such, it is NOT persistent."
        ::= { efmCuPort 3 }

      efmCuPortStatusEntry OBJECT-TYPE
        SYNTAX      EfmCuPortStatusEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "An entry in the EFMCu Port Status table.
          Each entry represents an EFMCu port indexed by the ifIndex.
          Note that an EFMCu PCS port runs on top of a single
          or multiple PME port(s), which are also indexed by ifIndex."
        INDEX  { ifIndex }
        ::= { efmCuPortStatusTable 1 }

      EfmCuPortStatusEntry ::=
        SEQUENCE {
          efmCuFltStatus                  BITS,
          efmCuPortSide                   INTEGER,
          efmCuNumPMEs                    Unsigned32,
          efmCuPAFInErrors                Counter32,
          efmCuPAFInSmallFragments        Counter32,
          efmCuPAFInLargeFragments        Counter32,
          efmCuPAFInBadFragments          Counter32,
          efmCuPAFInLostFragments         Counter32,
          efmCuPAFInLostStarts            Counter32,
          efmCuPAFInLostEnds              Counter32,
          efmCuPAFInOverflows             Counter32
        }

      efmCuFltStatus  OBJECT-TYPE
        SYNTAX      BITS {
          noPeer(0),               -- peer Phy cannot be reached
          pmeSubTypeMismatch(1),   -- Assigned PMEs Sub-type Mismatch
```

```
          lowBandwidth(2)          -- Low Bandwidth
        }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "EFMCu (PCS) port Fault Status. This is a bitmap of possible
          conditions. The various bit positions are:
            noPeer              - peer PHY cannot be reached (e.g.
                                  no PMEs attached, all PMEs are Down
                                  etc.) More info is available in
                                  efmCuPmeFltStatus.
            pmeSubTypeMismatch  - local PMEs in the aggregation group
                                  are not of the same sub-type, e.g.
                                  some PMEs in the local device are -O
                                  while others are -R subtype.
            lowBandwidth        - ifSpeed of the port reached or droped
                                  below efmCuThreshLowBandwidth

          This object is intended to supplement ifOperStatus object
          in IF-MIB.
          Additional information is available via efmCuPmeFltStatus
          object for each PME in the aggregation group (single PME if
          PAF is disabled)."
        REFERENCE
          "ifOperStatus in IF-MIB; efmCuPmeFltStatus"
        ::= { efmCuPortStatusEntry 1 }

      efmCuPortSide  OBJECT-TYPE
        SYNTAX      INTEGER {
          subscriber(1),  -- -R sub-type
          office(2),      -- -O sub-type
          unknown(3)      -- no PMEs assigned or PME sub-type mismatch
        }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "EFM port mode of operation (subtype).
          The value of 'subscriber' indicates the port is designated as
          '-R' subtype (all PMEs assigned to this port are of subtype
          '-R').
          The value of the 'office' indicates that the port is
          designated as '-O' subtype (all PMEs assigned to this port are
          of subtype '-O').
          The value of 'unknown' indicates that the port has no assigned
          PMEs yet or that the assigned PMEs are not of the same side
          (subTypePMEMismatch).

          This object partially maps to the Clause 30 attribute
```

```
          aPhyEnd"
        REFERENCE
           "[802.3ah] 61.1, 30.11.1.1.2"
        ::= { efmCuPortStatusEntry 2 }

      efmCuNumPMEs  OBJECT-TYPE
        SYNTAX      Unsigned32 (0..32)
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "Number of PMEs that is currently aggregated by the local PAF
          (assigned to the EFMCu port using ifStackTable).
          This number is never greater than efmCuPAFCapacity.

          This object SHALL be automatically incremented or decremented
          when a PME is added or deleted to/from the EFMCu port using
          ifStackTable."
        REFERENCE
          "[802.3ah] 61.2.2, 30.11.1.1.6"
        ::= { efmCuPortStatusEntry 3 }

      efmCuPAFInErrors OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "A number of fragments that have been received across the
          gamma interface with RxErr asserted and discarded.
          This read-only counter is inactive (not incremented) when the
          PAF is unsupported or disabled. Upon disabling the PAF, the
          counter retains its previous value.

          If a Clause 45 MDIO Interface to the PCS is present, then
          this object maps to the 10P/2B PAF RX error register."
        REFERENCE
          "[802.3ah] 45.2.3.21"
        ::= { efmCuPortStatusEntry 4 }

      efmCuPAFInSmallFragments OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "A number of fragments smaller than minFragmentSize
          (64 Bytes), that have been received across the gamma interface
          and discarded.
          This read-only counter is inactive when the PAF is
          unsupported or disabled. Upon disabling the PAF, the counter
```

```
          retains its previous value.

          If a Clause 45 MDIO Interface to the PCS is present, then
          this object maps to the 10P/2B PAF small fragments
          register."
        REFERENCE
          "[802.3ah] 45.2.3.22"
        ::= { efmCuPortStatusEntry 5 }

      efmCuPAFInLargeFragments OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "A number of fragments larger than maxFragmentSize
          (512 Bytes), that have been received across the gamma
          interface and discarded.
          This read-only counter is inactive when the PAF is
          unsupported or disabled. Upon disabling the PAF, the counter
          retains its previous value.

          If a Clause 45 MDIO Interface to the PCS is present, then
          this object maps to the 10P/2B PAF large fragments
          register."
        REFERENCE
          "[802.3ah] 45.2.3.23"
        ::= { efmCuPortStatusEntry 6 }

      efmCuPAFInBadFragments OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "A number of fragments which do not fit into the sequence
          expected by the frame assembly function, that have been
          received across the gamma interface and discarded (the
          frame buffer is flushed to the next valid frame start).
          This read-only counter is inactive when the PAF is
          unsupported or disabled. Upon disabling the PAF, the counter
          retains its previous value.

          If a Clause 45 MDIO Interface to the PCS is present, then
          this object maps to the 10P/2B PAF bad fragments
          register."
        REFERENCE
          "[802.3ah] 45.2.3.25"
        ::= { efmCuPortStatusEntry 7 }
```

```
    efmCuPAFInLostFragments OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
        "A number of gaps in the sequence of fragments, that have been
        received across the gamma interface (the frame buffer is
        flushed to the next valid frame start, when fragment/fragments
        expected by the frame assembly function is/are not received).
        This read-only counter is inactive when the PAF is
        unsupported or disabled. Upon disabling the PAF, the counter
        retains its previous value.

        If a Clause 45 MDIO Interface to the PCS is present, then
        this object maps to the 10P/2B PAF lost fragment
        register."
      REFERENCE
        "[802.3ah] 45.2.3.26"
      ::= { efmCuPortStatusEntry 8 }

    efmCuPAFInLostStarts OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
        "A number of missing StartOfPacket indicators expected by the
        frame assembly function.
        This read-only counter is inactive when the PAF is
        unsupported or disabled. Upon disabling the PAF, the counter
        retains its previous value.

        If a Clause 45 MDIO Interface to the PCS is present, then
        this object maps to the 10P/2B PAF lost start of fragment
        register."
      REFERENCE
        "[802.3ah] 45.2.3.27"
      ::= { efmCuPortStatusEntry 9 }

    efmCuPAFInLostEnds OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
        "A number of missing EndOfPacket indicators expected by the
        frame assembly function.
        This read-only counter is inactive when the PAF is
        unsupported or disabled. Upon disabling the PAF, the counter
        retains its previous value.
```

```
          If a Clause 45 MDIO Interface to the PCS is present, then
          this object maps to the 10P/2B PAF lost start of fragment
          register."
        REFERENCE
          "[802.3ah] 45.2.3.28"
        ::= { efmCuPortStatusEntry 10 }

      efmCuPAFInOverflows OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "A number of fragements, received accross the gamma interface
          and discarded, which would have caused the frame assembly
          buffer to overflow.
          This read-only counter is inactive when the PAF is
          unsupported or disabled. Upon disabling the PAF, the counter
          retains its previous value.

          If a Clause 45 MDIO Interface to the PCS is present, then
          this object maps to the 10P/2B PAF overflow register."
        REFERENCE
          "[802.3ah] 45.2.3.24"
        ::= { efmCuPortStatusEntry 11 }

      -- PME Notifications Group

      efmCuPmeNotifications OBJECT IDENTIFIER ::= { efmCuPme 0 }

      -- EdNote: Should I add more notifications here, for example
      --      efmCuPmePerfES,
      --      efmCuPmePerfSES,
      --      efmCuPmePerfCRCanomalies,
      --      efmCuPmePerfLOSWS,
      --      efmCuPmePerfUAS,
      --      efmCuPmeDeviceFault,
      --      efmCuPmeLocalPowerLoss
      -- Another option would be to reference HDSL2-SHDSL-LINE-MIB
      -- or VDSL-LINE-EXT-MCM-MIB, reusing notifications defined there.

      efmCuPmeLineAtnCrossing NOTIFICATION-TYPE
        OBJECTS {
          efmCuPmeLineAtn,
          efmCuPmeThreshLineAtn
        }
        STATUS      current
        DESCRIPTION
          "This notification indicates that the loop attenuation
```

```
          threshold (as per the efmCuPmeThreshLineAtn
          value) has been reached/exceeded for the 2BASE-TL/10PASS-TS
          PME."
          -- EdNote: add throttling limitations here
        ::= { efmCuPmeNotifications 1 }

      efmCuPmeSnrMgnCrossing NOTIFICATION-TYPE
        OBJECTS {
          efmCuPmeSnrMgn,
          efmCuPmeThreshSnrMgn
        }
        STATUS      current
        DESCRIPTION
          "This notification indicates that the SNR margin threshold
          (as per the efmCuPmeThreshSnrMgn value) has been
          reached/exceeded for the 2BASE-TL/10PASS-TS PME."
          -- EdNote: add throttling limitations here
        ::= { efmCuPmeNotifications 2 }

      efmCuPmeDeviceFault NOTIFICATION-TYPE
        OBJECTS {
          efmCuPmeFltStatus
        }
        STATUS      current
        DESCRIPTION
          "This notification indicates that a fault in the PME has been
          detected by a vendor specific diagnostic or a self-test."
          -- EdNote: add throttling limitations here
        ::= { efmCuPmeNotifications 3 }

      efmCuPmeConfigInitFailure NOTIFICATION-TYPE
        OBJECTS {
          efmCuPmeFltStatus,
          efmCuAdminProfile,
          efmCuPmeAdminProfile
        }
        STATUS      current
        DESCRIPTION
          "This notification indicates that PME initialization has
          failed, due to inability of the PME link to achieve requested
          configuration profile."
          -- EdNote: add throttling limitations here
        ::= { efmCuPmeNotifications 4 }

      efmCuPmeProtocolInitFailure NOTIFICATION-TYPE
        OBJECTS {
          efmCuPmeFltStatus,
          efmCuPmeOperSubType
```

```
        }
        STATUS     current
        DESCRIPTION
          "This notification indicates that peer PME was using
          incompatible protocol during initialization."
          -- EdNote: add throttling limitations here
        ::= { efmCuPmeNotifications 5 }

      -- The PME group

      efmCuPmeConfTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF EfmCuPmeConfEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "Table for Configuration of common aspects for EFMCu
          2BASE-TL/10PASS-TS PME ports (modems). Configuration of
          aspects specific to 2BASE-TL or 10PASS-TS PME types is
          represented in efmCuPme2BConfTable and efmCuPme10PConfTable
          respectively.

          Entries in this table MUST be maintained in a persistent
          manner."
        ::= { efmCuPme 1 }

      efmCuPmeConfEntry OBJECT-TYPE
        SYNTAX      EfmCuPmeConfEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "An entry in the EFMCu PME Configuration table.
          Each entry represents common aspects of an EFMCu PME port
          indexed by the ifIndex. Note that an EFMCu PME port can be
          stacked below a single PCS port, also indexed by ifIndex,
          possibly together with other PME ports if PAF is enabled."
        INDEX  { ifIndex }
        ::= { efmCuPmeConfTable 1 }

      EfmCuPmeConfEntry ::=
        SEQUENCE {
          efmCuPmeAdminSubType           INTEGER,
          efmCuPmeAdminProfile           ProfileIndex,
          efmCuPAFRemoteDiscoveryCode    PhysAddress,
          efmCuPmeThreshLineAtn          Integer32,
          efmCuPmeThreshSnrMgn           Integer32,
          efmCuPmeLineAtnCrossingEnable  TruthValue,
          efmCuPmeSnrMgnCrossingEnable   TruthValue,
          efmCuPmeDeviceFaultEnable      TruthValue,
```

```
          efmCuPmeConfigInitFailEnable   TruthValue,
          efmCuPmeProtocolInitFailEnable TruthValue
        }

      efmCuPmeAdminSubType  OBJECT-TYPE
        SYNTAX      INTEGER {
          ieee2BaseTLO(1),
          ieee2BaseTLR(2),
          ieee10PassTSO(3),
          ieee10PassTSR(4),
          ieee2BaseTLor10PassTSR(5),
          ieee2BaseTLor10PassTSO(6),
          ieee10PassTSor2BaseTLO(7)
        }
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
          "Administrative (desired) sub-type of the PME.
          Possible values are:
            ieee2BaseTLO           - PME shall operate as 2BaseTL-O
            ieee2BaseTLR           - PME shall operate as 2BaseTL-R
            ieee10PassTSO          - PME shall operate as 10PassTS-O
            ieee10PassTSR          - PME shall operate as 10PassTS-R
            ieee2BaseTLor10PassTSR - PME shall operate as 2BaseTL-R or
                                     10PassTS-R. Actual value will be
                                     set by -O link partner during
                                     initialization (handshake).
            ieee2BaseTLor10PassTSO - PME shall operate as 2BaseTL-O
                                     (preferred) or 10PassTS-O. Actual
                                     value will be set during
                                     initialization depending on -R
                                     link partner capability (i.e. if
                                     -R is incapable of the preferred
                                     2BaseTL mode, 10PassTS will be
                                     used).
            ieee10PassTSor2BaseTLO - PME shall operate as 10PassTS-O
                                     (preferred) or 2BaseTL-O. Actual
                                     value will be set during
                                     initialization depending on -R
                                     link partner capability (i.e. if
                                     -R is incapable of the preferred
                                     10PassTS mode, 2BaseTL will be
                                     used).

          Changing efmCuPmeAdminSubType is a traffic disruptive
          operation and as such SHALL be done when the link is Down.
          Attempts to change this object SHALL be ignored if the link
          is Up or Initializing.
```

```
          Attempts to change this object to an unsupported subtype
          (see efmCuPmeSubTypesSupported) SHALL be rejected.

          The current operational sub type is indicated by
          efmCuPmeOperSubType variable.

          If a Clause 45 MDIO Interface to the PMA/PMD is present, then
          this object combines values of the Port sub-type select
          bits and the PMA/PMD type selection bits in the 10P/2B
          PMA/PMD control register"
        REFERENCE
          "[802.3ah] 61.1, 45.2.1.11.4, 45.2.1.11.7"
        ::= { efmCuPmeConfEntry 1 }

      efmCuPmeAdminProfile  OBJECT-TYPE
        SYNTAX      ProfileIndex
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
          "Desired PME configuration profile. This object is a pointer
          to an entry in either efmCuPme2BConfProfileTable or
          efmCuPme10PConfProfileTable, depending on the current
          operating SubType of the PME. The value of this object is the
          index of the referenced profile.
          Note that if PME is assigned to a PCS port and value of
          efmCuAdminProfile for that port is not an empty list, then the
          profile(s) referenced by efmCuAdminProfile takes precedence
          over the profile referenced by efmCuPmeAdminProfile, i.e. the
          PME SHALL be configured according to efmCuAdminProfile.

          This object is writable and readable for the CO subtype PMEs
          (2BaseTL-O or 10PassTS-O). It is unavailable for the CPE
          subtype (2BaseTL-R or 10PassTS-R).

          Note that current operational Profile value is available via
          efmCuPmeOperProfile object.

          Modification of this object must be performed when the link is
          Down. Attempts to change this object MUST be rejected, if the
          link is Up or Initializing.
          Attempts to set this object to a value that is not the
          value of the index for an active entry in the corresponding
          profile table, MUST be rejected."
        REFERENCE
          "[802.3ah] 30.11.2.1.6"
        ::= { efmCuPmeConfEntry 2 }

      efmCuPAFRemoteDiscoveryCode  OBJECT-TYPE
```

```
        SYNTAX      PhysAddress
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
          "PAF Remote Discovery Code of the PME port at CO.
          A 6 Byte long Discovery Code of the peer PCS connected via
          the PME.
          Reading this object results in a Discovery Get operation.
          Writing a zero to this object results in a Discovery
          Clear_if_Same operation (the value of efmCuPAFDiscoveryCode
          at the peer PCS shall be the same as efmCuPAFDiscoveryCode of
          the local PCS associated with the PME for the operation to
          succeed).
          Writing a non-zero value to this object results in a
          Discovery Set_if_Clear operation.
          This object does not exist in CPE port subtypes. A zero length
          octet string SHALL be returned for CPE port subtypes and also
          when PAF aggregation is not enabled.

          Discovery MUST be performed when the link is Down.
          Attempts to change this object MUST be rejected with the error
          inconsistentValue, if the link is Up or Initializing.

          If a Clause 45 MDIO Interface to the PMA/PMD is present, then
          this object is a function of 10P/2B aggregation discovery
          control register, Discovery operation result bits in 10P/2B
          aggregation and discovery status register and
          10P/2B aggregation discovery code register"
        REFERENCE
          "[802.3ah] 61.2.2.8.4, 45.2.6.6-45.2.6.8"
        ::= { efmCuPmeConfEntry 3 }

      efmCuPmeThreshLineAtn  OBJECT-TYPE
        SYNTAX  Integer32(-127..128)
        UNITS       "dB"
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
          "Desired Line Attenuation Threshold for the 2B/10P PME.
          This object configures the line attenuation alarm threshold.
          When the current value of Line Attenuation reaches or
          exceeds this threshold, a efmCuPmeLineAtnCrossing
          notification MAY be generated, if enabled by
          efmCuPmeLineAtnCrossingEnable.

          This object is writable for the CO subtype PMEs (-O).
          It is read-only for the CPE subtype (-R).
```

```
          Changing of the Line Attenuation Threshold must be performed
          when the link is Down. Attempts to change this object MUST be
          rejected with the error inconsistentValue, if the link is Up
          or Initializing.

          If a Clause 45 MDIO Interface to the PME is present, then this
          object will map to the Loop attenuation threshold bits in
          the 2B PMD line quality thresholds register"
        REFERENCE
          "[802.3ah] 45.2.1.36"
        ::= { efmCuPmeConfEntry 4 }

      efmCuPmeThreshSnrMgn  OBJECT-TYPE
        SYNTAX      Integer32(-127..128)
        UNITS       "dB"
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
          "Desired SNR Margin Threshold for the 2B/10P PME.
           This object configures the SNR margin alarm threshold.
           When the current value of SNR Margin reaches
           or exceeds this threshold, a efmCuPmeSnrMgnCrossing
           notification MAY be generated, if enabled by
           efmCuPmeSnrMgnCrossingEnable.

          This object is writable for the CO subtype PMEs
          (2BaseTL-O/10PassTS-R). It is read-only for the CPE subtype
          (2BaseTL-R/10PassTS-R).

          Changing of the SNR Margin Threshold must be performed when
          the link is Down. Attempts to change this object MUST be
          rejected with the error inconsistentValue, if the link is Up
          or Initializing.

          If a Clause 45 MDIO Interface to the PME is present, then this
          object will map to the SNR margin threshold bits in the
          2B PMD line quality thresholds register"
        REFERENCE
          "[802.3ah] 45.2.1.36"
        ::= { efmCuPmeConfEntry 5 }

      efmCuPmeLineAtnCrossingEnable  OBJECT-TYPE
        SYNTAX      TruthValue
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
          "Indicates whether efmCuPmeLineAtnCrossing notifications
          should be generated for this interface.
```

```
          Value of truth(1) indicates that efmCuPmeLineAtnCrossing
          notification is enabled. Value of false(0) indicates the it is
          disabled."
        ::= { efmCuPmeConfEntry 6 }

      efmCuPmeSnrMgnCrossingEnable  OBJECT-TYPE
        SYNTAX      TruthValue
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
          "Indicates whether efmCuPmeSnrMgnCrossing notifications
          should be generated for this interface.

          Value of truth(1) indicates that efmCuPmeSnrMgnCrossing
          notification is enabled. Value of false(0) indicates the it is
          disabled."
        ::= { efmCuPmeConfEntry 7 }

      efmCuPmeDeviceFaultEnable  OBJECT-TYPE
        SYNTAX      TruthValue
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
          "Indicates whether efmCuPmeDeviceFault notifications
          should be generated for this interface.

          Value of truth(1) indicates that efmCuPmeDeviceFault
          notification is enabled. Value of false(0) indicates the it is
          disabled."
        ::= { efmCuPmeConfEntry 8 }

      efmCuPmeConfigInitFailEnable  OBJECT-TYPE
        SYNTAX      TruthValue
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
          "Indicates whether efmCuPmeConfigInitFailure notifications
          should be generated for this interface.

          Value of truth(1) indicates that efmCuPmeConfigInitFailure
          notification is enabled. Value of false(0) indicates the it is
          disabled."
        ::= { efmCuPmeConfEntry 9 }

      efmCuPmeProtocolInitFailEnable  OBJECT-TYPE
        SYNTAX      TruthValue
        MAX-ACCESS  read-write
        STATUS      current
```

```
        DESCRIPTION
          "Indicates whether efmCuPmeProtocolInitFailure notifications
          should be generated for this interface.

          Value of truth(1) indicates that efmCuPmeProtocolInitFailure
          notification is enabled. Value of false(0) indicates the it is
          disabled."
        ::= { efmCuPmeConfEntry 10 }


      efmCuPmeCapabilityTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF EfmCuPmeCapabilityEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "Table for Configuration of common aspects for EFMCu
          2BASE-TL/10PASS-TS PME ports (modems). Configuration of
          aspects specific to 2BASE-TL or 10PASS-TS PME types is
          represented in efmCuPme2BConfTable and efmCuPme10PConfTable
          respectively.

          Entries in this table MUST be maintained in a persistent
          manner."
        ::= { efmCuPme 2 }

      efmCuPmeCapabilityEntry OBJECT-TYPE
        SYNTAX      EfmCuPmeCapabilityEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "An entry in the EFMCu PME Capability table.
          Each entry represents common aspects of an EFMCu PME port
          indexed by the ifIndex. Note that an EFMCu PME port can be
          stacked below a single PCS port, also indexed by ifIndex,
          possibly together with other PME ports if PAF is enabled."
        INDEX  { ifIndex }
        ::= { efmCuPmeCapabilityTable 1 }

      EfmCuPmeCapabilityEntry ::=
        SEQUENCE {
          efmCuPmeSubTypesSupported     BITS
        }

      efmCuPmeSubTypesSupported  OBJECT-TYPE
        SYNTAX      BITS {
          ieee2BaseTLO(0),
          ieee2BaseTLR(1),
          ieee10PassTSO(2),
```

```
          ieee10PassTSR(3)
        }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "PME supported sub-types. This is a bitmap of possible
          sub-types. The various bit positions are:
            ieee2BaseTLO    - PME is capable of operating as 2BaseTL-O
            ieee2BaseTLR    - PME is capable of operating as 2BaseTL-R
            ieee10PassTSO   - PME is capable of operating as 10PassTS-O
            ieee10PassTSR   - PME is capable of operating as 10PassTS-R

          An desired mode of operation is determined by
          efmCuPmeAdminSubType, while efmCuPmeOperSubType relects the
          current operating mode.

          If a Clause 45 MDIO Interface to the PCS is present, then this
          object combines the 10PASS-TS capable and 2BASE-TL capable
          bits in the 10P/2B PMA/PMD speed ability register and the
          CO supported and CPE supported bits in the 10P/2B PMA/PMD
          status register"
        REFERENCE
          "[802.3ah] 61.1, 45.2.1.4.1, 45.2.1.4.2, 45.2.1.12.2,
          45.2.1.12.3"
        ::= { efmCuPmeCapabilityEntry 1 }


      efmCuPmeStatusTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF EfmCuPmeStatusEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "Table for Configuration of common aspects for EFMCu
          2BASE-TL/10PASS-TS PME ports (modems). Configuration of
          aspects specific to 2BASE-TL or 10PASS-TS PME types is
          represented in efmCuPme2BConfTable and efmCuPme10PConfTable
          respectively.

          Entries in this table MUST be maintained in a persistent
          manner."
        ::= { efmCuPme 3 }

      efmCuPmeStatusEntry OBJECT-TYPE
        SYNTAX      EfmCuPmeStatusEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "An entry in the EFMCu PME Status table.
```

```
        Each entry represents common aspects of an EFMCu PME port
        indexed by the ifIndex. Note that an EFMCu PME port can be
        stacked below a single PCS port, also indexed by ifIndex,
        possibly together with other PME ports if PAF is enabled."
      INDEX  { ifIndex }
      ::= { efmCuPmeStatusTable 1 }

    EfmCuPmeStatusEntry ::=
      SEQUENCE {
        efmCuPmeOperStatus            INTEGER,
        efmCuPmeFltStatus             BITS,
        efmCuPmeOperSubType           INTEGER,
        efmCuPmeOperProfile           ProfileIndexOrZero,
        efmCuPmeSnrMgn                Integer32,
        efmCuPmePeerSnrMgn            Integer32,
        efmCuPmeLineAtn               Integer32,
        efmCuPmePeerLineAtn           Integer32,
        efmCuPmeTCCodingErrors        Counter32
      }

    efmCuPmeOperStatus  OBJECT-TYPE
      SYNTAX      INTEGER {
        up(1),                  -- link is Up
        downNotReady(2),        -- link is Down and not Ready
        downReady(3),           -- link is Down and Ready
        init(4)                 -- link is Initializing
      }
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
        "Current PME link Operational Status. Possible values are:
          up(1)           - link is Up and ready to pass 64/65B
                            encoded frames or fragments.
          downNotReady(2) - link is Down and the PME does not detect
                            Handshake tones from its peer. This value
                            may indicate a possible problem with
                            the peer PME.
          downReady(3)    - link is Down and the PME detects Handshake
                            tones from its peer.
          init(4)         - link is initializing, as a result of
                            ifAdminStatus being set to 'up' for a
                            particular PME or a PCS the PME is
                            connected to.

        This object is intended to supplement Down state of
        ifOperStatus.

        This object partially maps to the Clause 30 attribute
```

```
          aPMEStatus.

          If a Clause 45 MDIO Interface to the PME is present, then this
          object partially maps to PMA/PMD link status bits in 10P/2B
          PMA/PMD status register."
        REFERENCE
          "[802.3ah] 30.11.2.1.3, 45.2.1.12.4"
        ::= { efmCuPmeStatusEntry 1 }

      efmCuPmeFltStatus  OBJECT-TYPE
        SYNTAX      BITS {
          lossOfFraming(0),      -- Loss of Framing
          snrMgnDefect(1),       -- SNR Margin dropped below Threshold
          lineAtnDefect(2),      -- Line Attenuation exceeds Threshold
          deviceFault(3),        -- Vendor-dependent diag or self-test
                                 -- fault
          configInitFailure(4),  -- Configuration Init. failure
          protocolInitFailure(5) -- Protocol Initialization failure
        }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "Current PME link Fault Status. This is a bitmap of possible
          conditions. The various bit positions are:

            lossOfFraming       - Loss of Framing for 10P or
                                  Loss of Sync word for 2B PMD or
                                  Loss of 64/65B Framing
            snrMgnDefect        - SNR Margin dropped below the Threshold
            lineAtnDefect       - Line Attenuation exceeds the Threshold
            deviceFault         - Indicates a vendor-dependent
                                  diagnostic or self-test fault
                                  has been detected.
            configInitFailure   - Configuration initialization failure,
                                  due to inability of the PME link to
                                  support configuration profile,
                                  requested during initialization.
            protocolInitFailure - Protocol initialization failure,
                                  due to incompatible protocol used by
                                  the Peer PME during init (that could
                                  happen if a peer PMD is G.SDHSL/VDSL
                                  modem for 2BASE-TL/10PASS-TS PME
                                  respectively).

          This object is intended to supplement ifOperStatus in IF-MIB.

          This object partially maps to the Clause 30 attribute
          aPMEStatus.
```

```
          If a Clause 45 MDIO Interface to the PME is present, then this
          object consolidates information from various PMA/PMD
          registers, namely: Fault bit in PMA/PMD status 1 register,
          10P/2B PMA/PMD link loss register,
          10P outgoing indicator bits status register,
          10P incoming indicator bits status register,
          2B state defects register."
        REFERENCE
          "[802.3ah] 30.11.2.1.3, 45.2.1.2.1, 45.2.1.38,
          45.2.1.39, 45.2.1.54"
        ::= { efmCuPmeStatusEntry 2 }

      efmCuPmeOperSubType  OBJECT-TYPE
        SYNTAX      INTEGER {
          ieee2BaseTLO(1),
          ieee2BaseTLR(2),
          ieee10PassTSO(3),
          ieee10PassTSR(4)
        }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "Current operational sub-type of the PME.
          Possible values are:
            ieee2BaseTLO           - PME operates as 2BaseTL-O
            ieee2BaseTLR           - PME operates as 2BaseTL-R
            ieee10PassTSO          - PME operates as 10PassTS-O
            ieee10PassTSR          - PME operates as 10PassTS-R

          The operational sub type of the PME can be configured via
          efmCuPmeAdminSubType variable.

          If a Clause 45 MDIO Interface to the PMA/PMD is present, then
          this object combines values of the Port sub-type select
          bits, the PMA/PMD type selection bits in the 10P/2B
          PMA/PMD control register and the PMA/PMD link status bits in
          the 10P/2B PMA/PMD status register."
        REFERENCE
          "[802.3ah] 61.1, 45.2.1.11.4, 45.2.1.11.7, 45.2.1.12.4"
        ::= { efmCuPmeStatusEntry 3 }

      efmCuPmeOperProfile  OBJECT-TYPE
        SYNTAX      ProfileIndexOrZero
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "PME current operating Profile. This object is a pointers to
          an entry in either efmCuPme2BConfProfileTable or
```

```
          efmCuPme10PConfProfileTable, depending on the current
          operating SubType of the PME as indicated by
          efmCuPmeOperSubType.
          The value of zero indicates that PME is down or initializing.

          This object partially maps to the aOperatingProfile
          attribute in Clause 30."
        REFERENCE
          "[802.3ah] 30.11.2.1.7"
        ::= { efmCuPmeStatusEntry 4 }

      efmCuPmeSnrMgn OBJECT-TYPE
        SYNTAX      Integer32(-127..128)
        UNITS       "dB"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "The current Signal-to-Noise Ratio (SNR) margin with respect
          to the received signal as perceived by the local PME.

          This object maps to the aPMESNRMgn attribute in Clause 30.

          If a Clause 45 MDIO Interface is present, then this
          object maps to the 10P/2B RX SNR margin register."
        REFERENCE
          "[802.3ah] 30.11.2.1.4, 45.2.1.16"
        ::= { efmCuPmeStatusEntry 5 }

      efmCuPmePeerSnrMgn OBJECT-TYPE
        SYNTAX      Integer32(-127..128)
        UNITS       "dB"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "The current SNR margin in dB with respect to the received
          signal, as perceived by the remote (link partner) PME.

          This object is not supported by -R PME subtypes.

          If a Clause 45 MDIO Interface is present, then this
          object maps to the 10P/2B link partner RX SNR margin
          register."
        REFERENCE
          "[802.3ah] 45.2.1.17"
        ::= { efmCuPmeStatusEntry 6}

      efmCuPmeLineAtn OBJECT-TYPE
        SYNTAX      Integer32(-127..128)
```

```
        UNITS       "dB"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "The current Line Attenuation in dB as perceived by the local
          PME.

          If a Clause 45 MDIO Interface is present, then this
          object maps to the Line Attenuation register"
        REFERENCE
          "[802.3ah] 45.2.1.18"
        ::= { efmCuPmeStatusEntry 7 }

      efmCuPmePeerLineAtn OBJECT-TYPE
        SYNTAX      Integer32(-127..128)
        UNITS       "dB"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "The current Line Attenuation in dB as perceived by the remote
          (link partner) PME.

          This object is not supported by CPE port subtypes.

          If a Clause 45 MDIO Interface is present, then this
          object maps to the 20P/2B link partner Line Attenuation
          register."
        REFERENCE
          "[802.3ah] 45.2.1.19"
        ::= { efmCuPmeStatusEntry 8 }

      efmCuPmeTCCodingErrors OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "A number of 64/65-octet encapsulation errors. This counter is
          incremented for each 64/65-octet encapsulation error detected
          by the 64/65-octet receive function.

          If a Clause 45 MDIO Interface to the PME TC is present, then
          this object maps to the TC coding violations register
          (see 45.2.6.12)."
        REFERENCE
          "[802.3ah] 61.3.3.1, 45.2.6.12"
        ::= { efmCuPmeStatusEntry 9 }

      -- 2BASE-TL specific PME group
```

```
      efmCuPme2B      OBJECT IDENTIFIER ::= { efmCuPme 5 }

      efmCuPme2BConfProfileTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF EfmCuPme2BConfProfileEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "This table supports definitions of configuration profiles for
          2BASE-TL PMEs.
          First 12 entries in this table SHALL always be defined as
          follows (see 802.3ah Annex 63A):
          -------+------+-----+--------+------------------
          Profile  Rate  Power  Region   Constellation
           index  (Kbps) (dBm) (G.991.2)
          -------+------+-----+--------+------------------
             1     5696  13.5   Annex A  32-TCPAM
             2     3072  13.5   Annex A  32-TCPAM
             3     2048  13.5   Annex A  16-TCPAM
             4     1024  13.5   Annex A  16-TCPAM
             5      704  13.5   Annex A  16-TCPAM
             6      512  13.5   Annex A  16-TCPAM
             7     5696  14.5   Annex B  32-TCPAM
             8     3072  14.5   Annex B  32-TCPAM
             9     2048  14.5   Annex B  16-TCPAM
            10     1024  13.5   Annex B  16-TCPAM
            11      704  13.5   Annex B  16-TCPAM
            12      512  13.5   Annex B  16-TCPAM

          These default entries SHALL be created by default and MUST
          not be deleted.

          Entries following the first 12, can be dynamically created and
          deleted, to provide custom profiles.

          This table MUST be maintained in a persistent manner."
        REFERENCE
          "[802.3ah] Annex 63A, 30.11.2.1.6"
        ::= { efmCuPme2B  2 }

      efmCuPme2BConfProfileEntry OBJECT-TYPE
        SYNTAX      EfmCuPme2BConfProfileEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "Each entry corresponds to a single 2BASE-TL PME configuration
          profile. Each profile contains a set of configuration
          parameters, which are applied to all 2BaseTL-O PMEs
          assigned to the 2BASE-TL (PCS) port, referencing that profile
```

```
          via efmCuAdminProfile object or, if efmCuAdminProfile is zero,
          all 2BaseTL-O PMEs, referencing that profile via
          efmCuPmeAdminProfile.

          Profiles may be created/deleted using the row creation/
          deletion mechanism via efmCuPme2BProfileRowStatus. If an
          active entry is referenced, the entry MUST remain 'active'
          until all references are removed.
          Default entries (first 12) MUST not be removed."
        INDEX { efmCuPme2BProfileIndex }
        ::= { efmCuPme2BConfProfileTable 1 }

      EfmCuPme2BConfProfileEntry ::=
        SEQUENCE {
          efmCuPme2BProfileIndex           ProfileIndex,
          efmCuPme2BProfileDescr           SnmpAdminString,
          efmCuPme2BRegion                 INTEGER,
          efmCuPme2BDataRate               Unsigned32,
          efmCuPme2BPower                  Unsigned32,
          efmCuPme2BConstellation          INTEGER,
          efmCuPme2BProfileRowStatus       RowStatus
        }

      efmCuPme2BProfileIndex OBJECT-TYPE
        SYNTAX      ProfileIndex
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "2BASE-TL PME Profile index.
          This object is the unique index associated with this profile.
          Entries in this table are referenced via efmCuAdminProfile
          or efmCuPmeAdminProfile objects."
        ::= { efmCuPme2BConfProfileEntry 1 }

      efmCuPme2BProfileDescr OBJECT-TYPE
        SYNTAX      SnmpAdminString (SIZE(0..255))
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
          "A textual string containing information about 2BASE-TL PME
          Profile. The string MAY include information about data rate
          and spectral limitations of this particular profile."
        ::= { efmCuPme2BConfProfileEntry 2 }

      efmCuPme2BRegion  OBJECT-TYPE
        SYNTAX      INTEGER {
          regionA(1),  -- Annex A
          regionB(2),  -- Annex B
```

```
          regionC(3)   -- Annex C
        }
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
          "Desired Power Spectral Density (PSD) Regional setting as
          specified in Regional Annex of [ITU-T G.991.2] to operate
          under.

          Possible values for this object are:
            regionA      -- Annex A
            regionB      -- Annex B
            regionC      -- Annex C

          Changing Regional Annex must be performed when the link is
          Down. Attempts to change this object MUST be rejected with
          the error inconsistentValue, if the link is Up or
          Initializing.

          If a Clause 45 MDIO Interface to the PME is present, then this
          object maps to the Region bits in the 2B general
          parameter register."
        REFERENCE
          "[802.3ah] 45.2.1.42"
        ::= { efmCuPme2BConfProfileEntry 3 }

      efmCuPme2BDataRate  OBJECT-TYPE
        SYNTAX  Unsigned32(0..5696)
        UNITS       "Kbps"
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
          "Desired 2BASE-TL PME Data Rate.
          The rate is fixed when the value of this object is n x 64Kbps,
          where n=3..60 for 16-TCPAM and n=12..89 for 32-TCPAM.
          The value of 0 means that data rate is not fixed but is
          adaptive and should be set to the maximum attainable rate
          during line probing.

          If a Clause 45 MDIO Interface to the PME is present, then this
          object maps to the Min/Max Data Rate1 bits in the 2B PMD
          parameters register."
        REFERENCE
          "[802.3ah] 45.2.1.43"
        ::= { efmCuPme2BConfProfileEntry 4 }

      efmCuPme2BPower  OBJECT-TYPE
        SYNTAX      Unsigned32(10..42)
```

```
        UNITS       "0.5 dBm"
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
          "Desired Signal Transmit Power. Multiple of 0.5dBm.

          Changing of the Signal Transmit Power must be performed when
          the link is Down. Attempts to change this object MUST be
          rejected with the error inconsistentValue, if the link is Up
          or Initializing.

          If a Clause 45 MDIO Interface to the PME is present, then this
          object will map to the Power1 bits in the 2B PMD
          parameters register"
        REFERENCE
          "[802.3ah] 45.2.1.43"
        ::= { efmCuPme2BConfProfileEntry 5 }

      efmCuPme2BConstellation  OBJECT-TYPE
        SYNTAX      INTEGER {
          tcpam16(1), -- 16-TCPAM
          tcpam32(2)  -- 32-TCPAM
        }
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
          "Desired TCPAM Constellation of the 2BASE-TL PME. The possible
          values are:
            tcpam16(1)     - 16-TCPAM
            tcpam32(2)     - 32-TCPAM

          If a Clause 45 MDIO Interface to the PME is present, then this
          object map to the Constellation1 bits in the 2B general
          parameter register."
        REFERENCE
           "[802.3ah] 45.2.1.43"
        ::= { efmCuPme2BConfProfileEntry 6 }

      efmCuPme2BProfileRowStatus OBJECT-TYPE
        SYNTAX      RowStatus
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
          "This object controls creation/deletion of the associated
          entry in efmCuPme2BConfProfileTable per the semantics of
          RowStatus.
          If an 'active' entry is referenced via efmCuAdminProfile or
          efmCuPmeAdminProfile, the entry MUST remain 'active' until all
```

```
          references are removed."
        ::= { efmCuPme2BConfProfileEntry 7 }

      -- 10PASS-TS specific PME group

       efmCuPme10P      OBJECT IDENTIFIER ::= { efmCuPme 6 }

       efmCuPme10PConfProfileTable OBJECT-TYPE
         SYNTAX      SEQUENCE OF EfmCuPme10PConfProfileEntry
         MAX-ACCESS  not-accessible
         STATUS      current
         DESCRIPTION
           "This table supports definitions of configuration profiles for
           10PassTL PMEs.
           First 22 entries in this table SHALL always be defined as
           follows (see 802.3ah Annex 62B.3):
           -------+--------+----+---------+-----+------------
           Profile Bandplan UPBO BandNotch DRate URate
            Index  PSDMask#  p#    p#        p#    p#
           -------+--------+----+---------+-----+------------
              1      1      3    2,6,10,11    20    20(default)
              2     13      5    0            20    20
              3      1      1    0            20    20
              4     16      0    0           100   100
              5     16      0    0            70    50
              6      6      0    0            50    10
              7     17      0    0            30    30
              8      8      0    0            30     5
              9      4      0    0            25    25
             10      4      0    0            15    15
             11     23      0    0            10    10
             12     23      0    0             5     5
             13     16      0    2,5,9,11    100   100
             14     16      0    2,5,9,11     70    50
             15      6      0    2,6,10,11    50    10
             16     17      0    2,5,9,11     30    30
             17      8      0    2,6,10,11    30     5
             18      4      0    2,6,10,11    25    25
             19      4      0    2,6,10,11    15    15
             20     23      0    2,5,9,11     10    10
             21     23      0    2,5,9,11      5     5
             22     30      0    0           200    50

           These default entries SHALL be created by default and MUST
           not be deleted.

           Entries following the first 22, can be dynamically created and
           deleted, to provide custom profiles.
```

```
          This table MUST be maintained in a persistent manner."
        REFERENCE
          "[802.3ah] Annex 62B.3, 30.11.2.1.6"
        ::= { efmCuPme10P  1 }

      efmCuPme10PConfProfileEntry OBJECT-TYPE
        SYNTAX      EfmCuPme10PConfProfileEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "Each entry corresponds to a single 10PASS-TS PME
          configuration profile. Each profile contains a set of
          configuration parameters, which are applied to all PMEs
          assigned to the 10PASS-TS (PCS) port, referencing that profile
          via efmCuAdminProfile object, or, if efmCuAdminProfile is
          zero, to all PMEs referencing that profile via
          efmCuPmeAdminProfile.
          Profiles may be created/deleted using the row creation/
          deletion mechanism via efmCuPme10PProfileRowStatus. If an
          'active' entry is referenced, the entry MUST remain 'active'
          until all references are removed.
          Default entries (first 22) MUST not be removed."
        INDEX { efmCuPme10PProfileIndex }
        ::= { efmCuPme10PConfProfileTable 1 }

      EfmCuPme10PConfProfileEntry ::=
        SEQUENCE {
          efmCuPme10PProfileIndex           ProfileIndex,
          efmCuPme10PProfileDescr           SnmpAdminString,
          efmCuPme10PBandplanPSDMskProfile  INTEGER,
          efmCuPme10PUPBOReferenceProfile   INTEGER,
          efmCuPme10PBandNotchProfiles      BITS,
          efmCuPme10PPayloadURateProfile    INTEGER,
          efmCuPme10PPayloadDRateProfile    INTEGER,
          efmCuPme10PProfileRowStatus       RowStatus
        }

      efmCuPme10PProfileIndex OBJECT-TYPE
        SYNTAX      ProfileIndex
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "10PASS-TS PME Profile Index.
          This object is the unique index associated with this profile.
          Entries in this table are referenced via efmCuAdminProfile or
          efmCuPmeAdminProfile."
        ::= { efmCuPme10PConfProfileEntry 1 }
```

```
      efmCuPme10PProfileDescr OBJECT-TYPE
        SYNTAX      SnmpAdminString (SIZE(0..255))
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
          "A textual string containing information about 10PASS-TS PME
          Profile. The string MAY include information about data rate
          and spectral limitations of this particular profile."
        ::= { efmCuPme10PConfProfileEntry 2 }

      efmCuPme10PBandplanPSDMskProfile  OBJECT-TYPE
        SYNTAX  INTEGER {-- PSD Mask                 Bands      Bandplan
          profile1(1),   -- T1.424/T-U P1 FTTCab.M1  x/D/U/D/U  A
          profile2(2),   -- T1.424/T-U P1 FTTEx.M1
          profile3(3),   -- T1.424/T-U P1 FTTCab.M2
          profile4(4),   -- T1.424/T-U P1 FTTEx.M2
          profile5(5),   -- T1.424/T-U P1 FTTCab.M1  D/D/U/D/U
          profile6(6),   -- T1.424/T-U P1 FTTEx.M1
          profile7(7),   -- T1.424/T-U P1 FTTCab.M2
          profile8(8),   -- T1.424/T-U P1 FTTEx.M2
          profile9(9),   -- T1.424/T-U P1 FTTCab.M1  U/D/U/D/x
          profile10(10), -- T1.424/T-U P1 FTTEx.M1
          profile11(11), -- T1.424/T-U P1 FTTCab.M2
          profile12(12), -- T1.424/T-U P1 FTTEx.M2
          profile13(13), -- TS1 101 270-1 Pcab.M1.A  x/D/U/D/U  B
          profile14(14), -- TS1 101 270-1 Pcab.M1.B
          profile15(15), -- TS1 101 270-1 Pex.P1.M1
          profile16(16), -- TS1 101 270-1 Pex.P2.M1
          profile17(17), -- TS1 101 270-1 Pcab.M2
          profile18(18), -- TS1 101 270-1 Pex.P1.M2
          profile19(19), -- TS1 101 270-1 Pex.P2.M2
          profile20(20), -- TS1 101 270-1 Pcab.M1.A  U/D/U/D/x
          profile21(21), -- TS1 101 270-1 Pcab.M1.B
          profile22(22), -- TS1 101 270-1 Pex.P1.M1
          profile23(23), -- TS1 101 270-1 Pex.P2.M1
          profile24(24), -- TS1 101 270-1 Pcab.M2
          profile25(25), -- TS1 101 270-1 Pex.P1.M2
          profile26(26), -- TS1 101 270-1 Pex.P2.M2
          profile27(27), -- G.993.1 F.1.2.1 (VDSLoPOTS) x/D/U/D/U  F
          profile28(28), -- G.993.1 F.1.2.2 (VDSLoTCM-ISDN)
          profile29(29)  -- G.993.1 F.1.2.3 (PSD reduction)
        }
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
          "10PASS-TS PME Bandplan and PSD Mask profile,
          as specified in 802.3ah Annex 62A. Possible values are:
          --------------+------------------------+-----------+---------
```

```
      Profile Name    PSD Mask                  Bands     Bandplan
      --------------+-----------------------+-----------+---------
      profile1(1)   - T1.424/T-U P1 FTTCab.M1  x/D/U/D/U  A
      profile2(2)   - T1.424/T-U P1 FTTEx.M1
      profile3(3)   - T1.424/T-U P1 FTTCab.M2
      profile4(4)   - T1.424/T-U P1 FTTEx.M2
      profile5(5)   - T1.424/T-U P1 FTTCab.M1  D/D/U/D/U
      profile6(6)   - T1.424/T-U P1 FTTEx.M1
      profile7(7)   - T1.424/T-U P1 FTTCab.M2
      profile8(8)   - T1.424/T-U P1 FTTEx.M2
      profile9(9)   - T1.424/T-U P1 FTTCab.M1  U/D/U/D/x
      profile10(10) - T1.424/T-U P1 FTTEx.M1
      profile11(11) - T1.424/T-U P1 FTTCab.M2
      profile12(12) - T1.424/T-U P1 FTTEx.M2
      profile13(13) - TS1 101 270-1 Pcab.M1.A  x/D/U/D/U  B
      profile14(14) - TS1 101 270-1 Pcab.M1.B
      profile15(15) - TS1 101 270-1 Pex.P1.M1
      profile16(16) - TS1 101 270-1 Pex.P2.M1
      profile17(17) - TS1 101 270-1 Pcab.M2
      profile18(18) - TS1 101 270-1 Pex.P1.M2
      profile19(19) - TS1 101 270-1 Pex.P2.M2
      profile20(20) - TS1 101 270-1 Pcab.M1.A  U/D/U/D/x
      profile21(21) - TS1 101 270-1 Pcab.M1.B
      profile22(22) - TS1 101 270-1 Pex.P1.M1
      profile23(23) - TS1 101 270-1 Pex.P2.M1
      profile24(24) - TS1 101 270-1 Pcab.M2
      profile25(25) - TS1 101 270-1 Pex.P1.M2
      profile26(26) - TS1 101 270-1 Pex.P2.M2
      profile27(27) - G.993.1 F.1.2.1 (VDSLoPOTS) x/D/U/D/U  F
      profile28(28) - G.993.1 F.1.2.2 (VDSLoTCM-ISDN)
      profile29(29) - G.993.1 F.1.2.3 (PSD reduction)

      This object maps to the aBandplanPSDMaskProfile attribute
      in Clause 30."
    REFERENCE
      "[802.3ah] Annex 62A, 30.5.1.1.22"
    ::= { efmCuPme10PConfProfileEntry 3 }

  efmCuPme10PUPBOReferenceProfile  OBJECT-TYPE
    SYNTAX  INTEGER {-- Reference PSD
      profile1(1),   -- T1.424/T-U         Noise A M1
      profile2(2),   -- T1.424/T-U         Noise A M2
      profile3(3),   -- T1.424/T-U         Noise F M1
      profile4(4),   -- T1.424/T-U         Noise F M2
      profile5(5),   -- ETSI TS 101 270-1  Noise A&B
      profile6(6),   -- ETSI TS 101 270-1  Noise C
      profile7(7),   -- ETSI TS 101 270-1  Noise D
      profile8(8),   -- ETSI TS 101 270-1  Noise E
```

```
          profile9(9)    -- ETSI TS 101 270-1  Noise F
        }
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
          "10PASS-TS PME Upstream Power Back-Off (UPBO) Reference PSD
          Profile, as specified in 802.3ah Annex 62A. Possible values
          are:
            profile1(1)   - T1.424/T-U         Noise A M1
            profile2(2)   - T1.424/T-U         Noise A M2
            profile3(3)   - T1.424/T-U         Noise F M1
            profile4(4)   - T1.424/T-U         Noise F M2
            profile5(5)   - ETSI TS 101 270-1  Noise A&B
            profile6(6)   - ETSI TS 101 270-1  Noise C
            profile7(7)   - ETSI TS 101 270-1  Noise D
            profile8(8)   - ETSI TS 101 270-1  Noise E
            profile9(9)   - ETSI TS 101 270-1  Noise F

          This object maps to the aUPBOReferenceProfile attribute
          in Clause 30."
        REFERENCE
          "[802.3ah] Annex 62A.3.4, 30.5.1.1.23"
        ::= { efmCuPme10PConfProfileEntry 4 }

      efmCuPme10PBandNotchProfiles  OBJECT-TYPE
        SYNTAX  BITS {  -- G.991.3  T1.424/T-U TS101 270-1 StartF EndF
                        -- Table    Table      Table       (MHz)  (MHz)
          profile0(0),  -- no profile
          profile1(1),  -- F-5 #01  -          -           1.810  1.825
          profile2(2),  -- 6-2      15-1       17          1.810  2.000
          profile3(3),  -- F-5 #02  -          -           1.907  1.912
          profile4(4),  -- F-5 #03  -          -           3.500  3.575
          profile5(5),  -- 6-2      -          17          3.500  3.800
          profile6(6),  -- -        15-1       -           3.500  4.000
          profile7(7),  -- F-5 #04  -          -           3.747  3.754
          profile8(8),  -- F-5 #05  -          -           3.791  3.805
          profile9(9),  -- 6-2      -          17          7.000  7.100
          profile10(10),-- F-5 #06  15-1       -           7.000  7.300
          profile11(11) -- 6-2      15-1       1           10.100 10.150
        }
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
          "10PASS-TS PME Egress Control Band Notch Profile bitmap,
          as specified in 802.3ah Annex 62A. Possible values are:
          --------------+---------+----------+-----------+------+-----
          Profile Name    G.991.3  T1.424/T-U TS101 270-1 StartF EndF
                          Table    Table      Table       (MHz)  (MHz)
```

```
      --------------+---------+----------+-----------+------+-----
      profile0(0)   - no profile
      profile1(1)   - F-5 #01  -          -           1.810  1.825
      profile2(2)   - 6-2      15-1       17          1.810  2.000
      profile3(3)   - F-5 #02  -          -           1.907  1.912
      profile4(4)   - F-5 #03  -          -           3.500  3.575
      profile5(5)   - 6-2      -          17          3.500  3.800
      profile6(6)   - -        15-1       -           3.500  4.000
      profile7(7)   - F-5 #04  -          -           3.747  3.754
      profile8(8)   - F-5 #05  -          -           3.791  3.805
      profile9(9)   - 6-2      -          17          7.000  7.100
      profile10(10) - F-5 #06  15-1       -           7.000  7.300
      profile11(11) - 6-2      15-1       1           10.100 10.150

      Any combination of profiles can be specified by ORing
      individual profiles, for example value of 0x0622 selects
      profiles 2,6,10 and 11.

      This object maps to the aBandNotchProfile attribute
      in Clause 30."
    REFERENCE
      "[802.3ah] Annex 62A.3.5, 30.5.1.1.19"
    ::= { efmCuPme10PConfProfileEntry 5 }

  efmCuPme10PPayloadURateProfile  OBJECT-TYPE
    SYNTAX      INTEGER {-- Upstream Payload Rate (Mbps)
      profile5(5),       -- 2.5
      profile10(10),     -- 5
      profile15(15),     -- 7.5
      profile20(20),     -- 10
      profile25(25),     -- 12.5
      profile30(30),     -- 15
      profile50(50),     -- 25
      profile70(70),     -- 35
      profile100(100)    -- 50
    }
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
      "10PASS-TS PME Upstream Payload Rate Profile,
      as specified in 802.3ah Annex 62A. Possible values are:
        profile5(5)       - 2.5 Mbps
        profile10(10)     - 5 Mbps
        profile15(15)     - 7.5 Mbps
        profile20(20)     - 10 Mbps
        profile25(25)     - 12.5 Mbps
        profile30(30)     - 15 Mbps
        profile50(50)     - 25 Mbps
```

```
            profile70(70)     - 35 Mbps
            profile100(100)   - 50 Mbps

          Each value represents a target for the PME's Upstream Payload
          Bitrate as seen at the MII. If the payload rate of the
          selected profile cannot be achieved based on the loop
          environment, bandplan and PSD mask, the PME initialization
          SHALL fail.

          This object maps to the aPayloadRateProfileUpstream
          attribute in Clause 30."
        REFERENCE
          "[802.3ah] Annex 62A.3.6, 30.5.1.1.20"
        ::= { efmCuPme10PConfProfileEntry 6 }

      efmCuPme10PPayloadDRateProfile  OBJECT-TYPE
        SYNTAX      INTEGER {-- Downstream Payload Rate (Mbps)
          profile5(5),       -- 2.5
          profile10(10),     -- 5
          profile15(15),     -- 7.5
          profile20(20),     -- 10
          profile25(25),     -- 12.5
          profile30(30),     -- 15
          profile50(50),     -- 25
          profile70(70),     -- 35
          profile100(100),   -- 50
          profile140(140),   -- 70
          profile200(200)    -- 100
        }
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
          "10PASS-TS PME Downstream Payload Rate Profile,
          as specified in 802.3ah Annex 62A. Possible values are:
            profile5(5)      - 2.5 Mbps
            profile10(10)    - 5 Mbps
            profile15(15)    - 7.5 Mbps
            profile20(20)    - 10 Mbps
            profile25(25)    - 12.5 Mbps
            profile30(30)    - 15 Mbps
            profile50(50)    - 25 Mbps
            profile70(70)    - 35 Mbps
            profile100(100)  - 50 Mbps
            profile140(140)  - 70 Mbps
            profile200(200)  - 100 Mbps

          Each value represents a target for the PME's Downstream
          Payload Bitrate as seen at the MII. If the payload rate of
```

```
          the selected profile cannot be achieved based on the loop
          environment, bandplan and PSD mask, the PME initialization
          SHALL fail.

          This object maps to the aPayloadRateProfileDownstream
          attribute in Clause 30."
        REFERENCE
          "[802.3ah] Annex 62A.3.6, 30.5.1.1.21"
        ::= { efmCuPme10PConfProfileEntry 7 }

      efmCuPme10PProfileRowStatus OBJECT-TYPE
        SYNTAX      RowStatus
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
          "This object controls creation/deletion of the associated
          entry in efmCuPme10PConfProfileTable per the semantics of
          RowStatus.
          If an active entry is referenced via efmCuAdminProfile or
          efmCuPmeAdminProfile, the entry MUST remain 'active' until
          all references are removed."
        ::= { efmCuPme10PConfProfileEntry 8 }


      efmCuPme10PStatusTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF EfmCuPme10PStatusEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "Table reflecting status of EFMCu 10PASS-TS PMEs (modems)."
        ::= { efmCuPme10P 2 }

      efmCuPme10PStatusEntry OBJECT-TYPE
        SYNTAX      EfmCuPme10PStatusEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "An entry in the EFMCu 10PASS-TS PME Status table."
        AUGMENTS { efmCuPmeStatusEntry }
        ::= { efmCuPme10PStatusTable 1 }

      EfmCuPme10PStatusEntry ::=
        SEQUENCE {
          efmCuPme10PElectricalLength       Integer32,
          efmCuPme10PFECCorrectedBlocks     Counter32,
          efmCuPme10PFECUncorrectedBlocks   Counter32
          -- EdNote: To be continued
        }
```

```
      efmCuPme10PElectricalLength  OBJECT-TYPE
        SYNTAX      Integer32(0..8192|65535)
        UNITS       "m"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "Electrical Length in meters as perceived by the 10PASS-TS PME
          after the link is established.
          The value of 65535 is returned if the link is Down or
          Initializing or the PME is unable to estimate the Electrical
          Length.

          If a Clause 45 MDIO Interface to the PME is present, then this
          object maps to the 10P Electrical Length register"
        REFERENCE
          "[802.3ah] 45.2.1.21"
        ::= { efmCuPme10PStatusEntry 1 }

      efmCuPme10PFECCorrectedBlocks  OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "A count of received and corrected FEC codewords in 10PASS-TS
          PME.

          This object maps to aPMEFECCorrectedBlocks attribute in
          clause 30.

          If a Clause 45 MDIO Interface to the PMA/PMD is present,
          then this object maps to the 10P FEC correctable errors
          register"
        REFERENCE
          "[802.3ah] 45.2.1.22"
        ::= { efmCuPme10PStatusEntry 2 }

      efmCuPme10PFECUncorrectedBlocks  OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "A count of received FEC codewords in 10PASS-TS PME, which are
          uncorrectable.

          This object maps to aPMEFECUncorrectableBlocks attribute in
          clause 30.

          If a Clause 45 MDIO Interface to the PMA/PMD is present,
```

```
          then this object maps to the 10P FEC uncorrectable errors
          register"
        REFERENCE
          "[802.3ah] 45.2.1.23"
        ::= { efmCuPme10PStatusEntry 3 }

      -- ifAvailableStackTable for use in Discovery

       ifAvailableStackTable  OBJECT-TYPE
        SYNTAX      SEQUENCE OF IfAvailableStackEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "This table, modeled after ifStackTable from [IF-MIB],
          contains information on the possible 'on-top-of'
          relationships between the multiple sub-layers of network
          interfaces (as opposed to actual relationships in
          ifStackTable).  In particular, it contains information on
          which PCS ports (sublayers) can possibly run 'on top of'
          which PMEs (sublayers), as determined by cross-connect
          capability of the EFMCu device, where each sub-layer
          corresponds to a conceptual row in the ifTable.  For example,
          when the PCS port with ifIndex value x can be connected
          to run on top of the PME with ifIndex value y, then this table
          contains:

            ifAvailableStackStatus.x.y=capable

          Note that there's always at least on PCS for each PME and at
          least one PME for each PCS in the EFMCu devices, with
          efmCuPAFCapacity and efmCuPeerPAFCapacity indicating
          maximum number of PMEs which can be aggregated by local and
          remote PCS port respectively.
          This table is read only as it describes device capability"
        REFERENCE
          "ifStackTable of RFC 2863"
        ::= { efmCuObjects 3 }

       ifAvailableStackEntry  OBJECT-TYPE
        SYNTAX      IfAvailableStackEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "Information on a particular relationship between two sub-
          layers, specifying that one sub-layer (PCS) runs on 'top' of
          the other sub-layer (PME). Each sub-layer corresponds to a
          conceptual row in the ifTable (interface index for PCS and
          PME respectively)."
```

```
        INDEX {
          ifAvailableStackHigherLayer,
          ifAvailableStackLowerLayer
        }
        ::= { ifAvailableStackTable 1 }

      IfAvailableStackEntry ::=
         SEQUENCE {
           ifAvailableStackHigherLayer  InterfaceIndex,
           ifAvailableStackLowerLayer   InterfaceIndex,
           ifAvailableStackStatus       INTEGER
         }

      ifAvailableStackHigherLayer  OBJECT-TYPE
        SYNTAX      InterfaceIndex
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "The value of ifIndex corresponding to the higher sub-layer
          of the 'cross-connect capability' relationship, i.e., the
          PCS sub-layer which MAY run on 'top' of the PME sub-layer
          identified by the corresponding instance of
          ifAvailableStackLowerLayer."
        ::= { ifAvailableStackEntry 1 }


      ifAvailableStackLowerLayer  OBJECT-TYPE
        SYNTAX      InterfaceIndex
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
          "The value of ifIndex corresponding to the lower sub-layer
          of the 'cross-connect capability' relationship, i.e., the
          PME sub-layer which MAY run 'below' the PCS sub-layer
          identified by the corresponding instance of
          ifAvailableStackHigherLayer."
        ::= { ifAvailableStackEntry 2 }

      ifAvailableStackStatus  OBJECT-TYPE
        SYNTAX      INTEGER {
          capable(1),
          outOfService(2)
        }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
          "The status of the 'cross-connect capability' relationship
          between two sub-layers. The following values are defined:
```

```
            capable(1)      - the PME sub-layer interface, identified by
                              the ifAvailableStackLowerLayer MAY be
                              connected to run 'below' the PCS sub-layer
                              interface, identified by the
                              ifAvailableStackLowerLayer.
            outOfService(2) - the PME sub-layer interface cannot be
                              connected due to unavailability of the
                              interface.

          Note that PME availability per PCS, indicated by 'capable'
          value, can be constrained by other parameters,
          for example by aggregation capacity of a PCS or by the PME in
          question being already connected to another PCS. So, in
          order to ensure that a particular PME can be connected to the
          PCS, all respective parameters (e.g. ifAvailableStackTable,
          ifStackTable and efmCuPAFCapacity) SHALL be inspected.

          This object is read only, unlike ifStackStatus, as it
          describes the device capability."
        ::= { ifAvailableStackEntry 3 }


      --
      -- Conformance Statements
      --

       efmCuGroups      OBJECT IDENTIFIER ::= { efmCuConformance 1 }

       efmCuCompliances OBJECT IDENTIFIER ::= { efmCuConformance 2 }

       -- Object Groups

       efmCuBasicGroup OBJECT-GROUP
         OBJECTS {
           efmCuPAFSupported,
           efmCuAdminProfile,
           efmCuTargetDataRate,
           efmCuTargetSnrMgn,
           efmCuPortSide,
           efmCuFltStatus
         }
         STATUS      current
         DESCRIPTION
           "A collection of objects required for all of EFMCu ports."
         ::= { efmCuGroups 1 }

       efmCuPAFGroup OBJECT-GROUP
         OBJECTS {
```

```
          efmCuPeerPAFSupported,
          efmCuPAFCapacity,
          efmCuPeerPAFCapacity,
          efmCuPAFAdminState,
          efmCuPAFDiscoveryCode,
          efmCuPAFRemoteDiscoveryCode,
          efmCuNumPMEs,
          ifAvailableStackStatus
        }
        STATUS      current
        DESCRIPTION
          "A collection of objects required for optional PME
          Aggregation Function (PAF) and PAF discovery in EFMCu ports."
        ::= { efmCuGroups 2 }

      ifStackCapabilityGroup OBJECT-GROUP
        OBJECTS {
          ifAvailableStackStatus
        }
        STATUS  current
        DESCRIPTION
          "A collection of objects providing information on
          the stacking capability of MIB-II interfaces."
        ::= { efmCuGroups 3 }

      efmCuPAFErrorsGroup OBJECT-GROUP
        OBJECTS {
          efmCuPAFInErrors,
          efmCuPAFInSmallFragments,
          efmCuPAFInLargeFragments,
          efmCuPAFInBadFragments,
          efmCuPAFInLostFragments,
          efmCuPAFInLostStarts,
          efmCuPAFInLostEnds,
          efmCuPAFInOverflows
        }
        STATUS      current
        DESCRIPTION
          "A collection of objects supporting optional error counters
          of PAF on EFMCu ports."
        ::= { efmCuGroups 4 }

      efmCuPmeGroup OBJECT-GROUP
        OBJECTS {
          efmCuPmeAdminProfile,
          efmCuPmeOperStatus,
          efmCuPmeFltStatus,
          efmCuPmeSubTypesSupported,
```

```
          efmCuPmeAdminSubType,
          efmCuPmeOperSubType,
          efmCuPAFRemoteDiscoveryCode,
          efmCuPmeOperProfile,
          efmCuPmeSnrMgn,
          efmCuPmePeerSnrMgn,
          efmCuPmeLineAtn,
          efmCuPmePeerLineAtn,
          efmCuPmeTCCodingErrors,
          efmCuPmeThreshLineAtn,
          efmCuPmeThreshSnrMgn
        }
        STATUS      current
        DESCRIPTION
          "A collection of objects providing information about
          a 2BASE-TL/10PASS-TS PME."
        ::= { efmCuGroups 5 }

      efmCuAlarmConfGroup OBJECT-GROUP
        OBJECTS {
          efmCuThreshLowBandwidth,
          efmCuLowBandwidthEnable,
          efmCuPmeThreshLineAtn,
          efmCuPmeLineAtnCrossingEnable,
          efmCuPmeThreshSnrMgn,
          efmCuPmeSnrMgnCrossingEnable,
          efmCuPmeLineAtnCrossingEnable,
          efmCuPmeDeviceFaultEnable,
          efmCuPmeConfigInitFailEnable,
          efmCuPmeProtocolInitFailEnable
    --      efmCuPmeThreshES,
    --      efmCuPmethreshSES,
    --      efmCuPmeThreshCRCanomalies,
    --      efmCuPmeThreshLOSWS,
    --      efmCuPmeThreshUAS
        }
        STATUS      current
        DESCRIPTION
          "A collection of objects required for configuration of alarm
          thresholds and notifications in EFMCu ports."
        ::= { efmCuGroups 6 }

      efmCuNotificationGroup NOTIFICATION-GROUP
        NOTIFICATIONS {
          efmCuLowBandwidth,
          efmCuPmeLineAtnCrossing,
          efmCuPmeSnrMgnCrossing,
          efmCuPmeDeviceFault,
```

```
          efmCuPmeConfigInitFailure,
          efmCuPmeProtocolInitFailure
   --       efmCuPmePerfES,
   --       efmCuPmePerfSES,
   --       efmCuPmePerfCRCanomalies,
   --       efmCuPmePerfLOSWS,
   --       efmCuPmePerfUAS,
   --       efmCuPmeDeviceFault,
   --       efmCuPmeLocalPowerLoss
        }
        STATUS      current
        DESCRIPTION
          "This group supports notifications of significant conditions
          associated with EFMCu ports."
        ::= { efmCuGroups 7 }

      efmCuPme2BProfileGroup OBJECT-GROUP
        OBJECTS {
          efmCuPme2BProfileDescr,
          efmCuPme2BRegion,
          efmCuPme2BDataRate,
          efmCuPme2BPower,
          efmCuPme2BConstellation,
          efmCuPme2BProfileRowStatus
        }
        STATUS      current
        DESCRIPTION
          "A collection of objects that constitute a configuration
          profile for configuration of 2BASE-TL ports."
        ::= { efmCuGroups 8 }

      efmCuPme10PProfileGroup OBJECT-GROUP
        OBJECTS {
          efmCuPme10PProfileDescr,
          efmCuPme10PBandplanPSDMskProfile,
          efmCuPme10PUPBOReferenceProfile,
          efmCuPme10PBandNotchProfiles,
          efmCuPme10PPayloadURateProfile,
          efmCuPme10PPayloadDRateProfile,
          efmCuPme10PProfileRowStatus
        }
        STATUS  current
        DESCRIPTION
          "A collection of objects that constitute a configuration
          profile for configuration of 10PASS-TS ports."
        ::= { efmCuGroups 9 }

      efmCuPme10PStatusGroup OBJECT-GROUP
```

```
        OBJECTS {
          efmCuPme10PElectricalLength,
          efmCuPme10PFECCorrectedBlocks,
          efmCuPme10PFECUncorrectedBlocks
        }
        STATUS  current
        DESCRIPTION
          "A collection of objects providing status information
          specific to 10PASS-TS PMEs."
        ::= { efmCuGroups 10 }

     -- Compliance Statements

      efmCuCompliance MODULE-COMPLIANCE
        STATUS      current
        DESCRIPTION
          "The compliance statement for 2BASE-TL/10PASS-TS interfaces.
          Compliance with the following external compliance statements
          is prerequisite:

          MIB Module             Compliance Statement
          ----------             --------------------
          IF-MIB                 ifCompliance3
          IF-INVERTED-STACK-MIB  ifInvCompliance
          EtherLike-MIB          dot3Compliance2
          MAU-MIB                mauModIfCompl3"

        MODULE  -- this module
          MANDATORY-GROUPS {
            efmCuBasicGroup,
            efmCuPmeGroup,
            efmCuAlarmConfGroup,
            efmCuNotificationGroup
          }

          GROUP       efmCuPme2BProfileGroup
          DESCRIPTION
            "Support for this group is only required for implementations
            supporting 2BASE-TL Phy."

          GROUP       efmCuPme10PProfileGroup
          DESCRIPTION
            "Support for this group is only required for implementations
            supporting 10PASS-TS Phy."

          GROUP       efmCuPAFGroup
          DESCRIPTION
            "Support for this group is only required for
```

```
            implementations supporting PME Aggregation Function (PAF)."

          GROUP       ifStackCapabilityGroup
          DESCRIPTION
            "Support for this group is optional for implementations
            supporting layered interfaces architecture with
            flexible cross-connect between the layers."

          GROUP       efmCuPAFErrorsGroup
          DESCRIPTION
            "Support for this group is optional for implementations
            supporting PME Aggregation Function (PAF)."

          GROUP       efmCuPme10PStatusGroup
          DESCRIPTION
            "Support for this group is optional for implementations
            supporting 10PASS-TS Phy."

          OBJECT      efmCuPmeSubTypesSupported
          SYNTAX      BITS {
            ieee2BaseTLO(0),
            ieee2BaseTLR(1),
            ieee10PassTSO(2),
            ieee10PassTSR(3)
          }
          DESCRIPTION
            "Support for all subtypes is not required. However at least
            one value SHALL be supported"

          OBJECT      efmCuPmeAdminSubType
          MIN-ACCESS  read-only
          DESCRIPTION
            "Write access is not required (needed only for PMEs
            supporting more than a single subtype, e.g.
            ieee2BaseTLO and ieee2BaseTSR or ieee2BaseTLR and
            ieee10PassTSR)"

          OBJECT      efmCuTargetSnrMgn
          MIN-ACCESS  read-only
          DESCRIPTION
            "Write access is optional. For PHYs without write access
            the target SNR margin SHALL be fixed at 5dB for 2BASE-TL
            and 6dB for 10PASS-TS."

          -- EdNote: To be Continued

        ::= { efmCuCompliances 1 }
    END
```

6. Security Considerations

There is a number of managed objects defined in this MIB module that have a MAX-ACCESS clause of read-write or read-create. Most objects are writeable only when the link is Down. Writing to these objects can have potentially disruptive effects on network operation, for example:

- Changing of efmCuPmeAdminSubType MAY lead to a potential locking of the link, as peer PMEs of the same sub-type cannot exchange handshake messages.

- Changing of efmCuPAFAdminState to enabled MAY lead to a potential locking of the link, if the peer Phy does not support PAF.

- Changing of efmCuPAFDiscoveryCode, before the discovery operation, MAY lead to a wrongful discovery, with possile multiple -O ports connecting to the same -R (both -O ports have the same Discovery register value) and similar cases.

- Changing PCS or PME configuration parameters (e.g. profile of a PCS or PME via efmCuAdminProfile or efmCuPmeAdminProfile) MAY lead to anything from link quality and rate degradation to a complete link initialization failure, as ability of an EFMCu port to support a particular configuration depends on the copper environment.

- Activation of a PME can cause a severe degradation of service for another EFMCu Phy whose PME(s) MAY be affected by the cross-talk from the newly activated PME.

- Removal of a PME from the operationally 'up' EFMCu port, aggregating several PMEs, MAY lead a link rate degradation

The user of this MIB module must therefore be aware that support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations.

The readable objects in this MIB module (i.e., those with MAX-ACCESS other than not-accessible) may be considered sensitive in some environments since, collectively, they provide information about the performance of network interfaces and can reveal some aspects of their configuration. In particular since EFMCu can be carried over Unshielded Twisted Pair (UTP) voice grade copper in a bundle with other pairs belonging to another operator/customer, it is theoretically possible to evasdrop to an EFMCu transmission simply by "listening" to a cross-talk from an EFMCu pair, especially if the parameters of the EFMCu link in question are known. In such

environments it is important to control even GET and NOTIFY access to these objects and possibly even to encrypt their values when sending them over the network via SNMP.

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPSec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB module.

It is RECOMMENDED that implementers consider the security features as provided by the SNMPv3 framework (see [RFC3410], section 8), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy).

Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

7. Acknowledgments

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