

Ethernet in the First Mile Copper (EFMCu) Interfaces MIB

Status of This Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

Abstract

This document defines Management Information Base (MIB) modules for use with network management protocols in TCP/IP-based internets. This document describes extensions to the Ethernet-like Interfaces MIB and Medium Attachment Unit (MAU) MIB modules with a set of objects for managing Ethernet in the First Mile Copper (EFMCu) interfaces 10PASS-TS and 2BASE-TL, defined in IEEE Std 802.3ah-2004 (note: IEEE Std 802.3ah-2004 has been integrated into IEEE Std 802.3-2005). In addition, a set of objects is defined, describing cross-connect capability of a managed device with multi-layer (stacked) interfaces, extending the stack management objects in the Interfaces Group MIB and the Inverted Stack Table MIB modules.

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1. Introduction

New Ethernet-like interfaces have been defined in the Institute of Electrical and Electronics Engineers (IEEE) Standard 802.3ah-2004 [802.3ah], a.k.a. Ethernet in the First Mile (EFM), which is now a part of the base IEEE Standard 802.3-2005 [802.3]. 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 EFM Copper (EFMCu), are based on Single-pair High-speed Digital Subscriber Line (SHDSL) [G.991.2] and Very High speed Digital Subscriber Line (VDSL) [G.993.1] technology, supporting optional Physical Medium Entity (PME) aggregation (a.k.a. multi-pair bonding) with variable rates.

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

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

This memo defines a Management Information Base (MIB) module for use with network management protocols in the Internet community to manage EFMCu interfaces. In addition, a MIB module is defined describing the cross-connect capability of a stacked interface.

Note that managed objects for Operation, Administration and Maintenance (OAM) and Ethernet over Passive Optical Networks (EPON) clauses of IEEE 802.3ah are defined in EFM-COMMON-MIB [RFC4878] and EFM-EPON-MIB [RFC4837], 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 MIB modules that are compliant to the SMIV2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

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 MIB Modules

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

3.1. Relation to Interfaces Group MIB Module

2BASE-TL and 10PASS-TS PHYs specified in the EFM-CU-MIB module are stacked (a.k.a. aggregated or bonded) Ethernet interfaces and as such are managed using generic interface management objects defined in the IF-MIB [RFC2863].

The stack management (i.e., actual connection of the sub-layers to the top-layer interface) is done via the ifStackTable, as defined in the IF-MIB [RFC2863], and its inverse ifInvStackTable, as defined in the IF-INVERTED-STACK-MIB [RFC2864].

The new tables ifCapStackTable and its inverse ifInvCapStackTable defined in the IF-CAP-STACK-MIB module below, extend the stack management with an ability to describe possible connections or cross-connect capability, when a flexible cross-connect matrix is present between the interface layers.

3.1.1. Layering Model

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

A generic EFMCu device can have a number of Physical Coding Sublayer (PCS) ports, each connected to a Media Access Controller (MAC) via a 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 interface 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 (e.g., for 2BaseTL PMEs it is a multiple of 64 Kbps). A zero value SHALL be returned when the PME is Initializing or Down.

The ifSpeed of the PCS is the sum of the current operating data rates of all PMEs in the aggregation group, without the 64/65-octet encapsulation overhead and PAF overhead, but accounting for the Inter-Frame Gaps (IFGs).

When using the stated definition of ifSpeed for the PCS, there would be no frame loss in the following configuration (the test-sets are configured to generate 100% of back-to-back traffic, i.e., minimal IFG, at 10 or 100 Mbps, with min and max frame sizes; the EFM interfaces are aggregated, to achieve the shown speed):

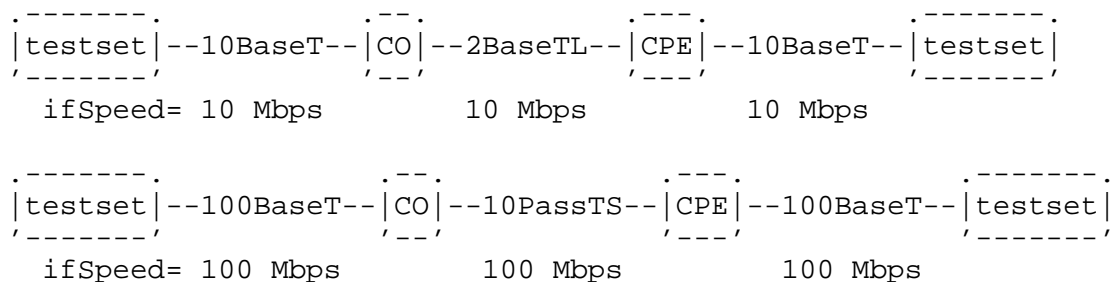
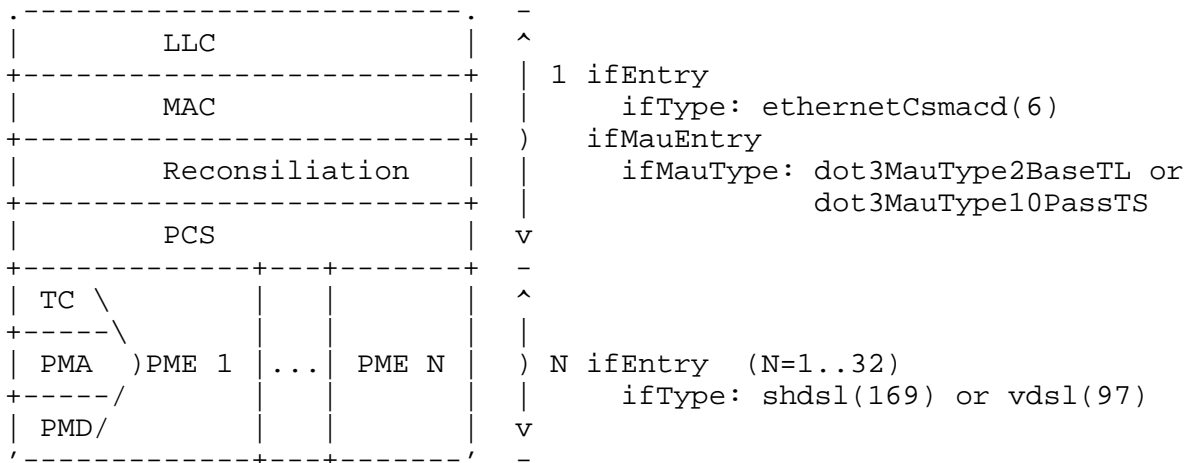


Figure 1: Example configuration with no frame loss

The following figure shows the IEEE 802.3 layering diagram and corresponding use of ifTable and ifMauTable:



LLC - Logical Link Control	PMA - Physical Medium Attachment
MAC - Media Access Control	PMD - Physical Medium Dependent
PCS - Physical Coding Sub-layer	PME - Physical Medium Entity
TC - Transmission Convergence	

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 ifCapStackTable, defined in the IF-CAP-STACK-MIB module, specifies for each higher-layer interface (e.g., PCS port) a list of lower-layer interfaces (e.g., PMEs), which can possibly be cross-connected to that higher-layer interface, determined by the cross-connect capability of the device. This table, modeled after ifStackTable, is read-only, reflecting current cross-connect capability of stacked interface, 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 ifCapStackTable, 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., ifCapStackTable, ifStackTable, and efmCuPAFCapacity) SHALL be inspected.

The ifInvCapStackTable, also defined in the IF-CAP-STACK-MIB module, describes which higher-layer interfaces (e.g., PCS ports) can possibly be connected to a particular lower-layer interface (e.g., PME), providing an inverted mapping of the ifCapStackTable. While it contains no additional information beyond that already contained in the ifCapStackTable, the ifInvCapStackTable has the ifIndex values in its INDEX clause in the reverse order, i.e., the lower-layer interface first, and the higher-layer interface second, providing an efficient means for a Network Management application to read a subset of the ifCapStackTable and thereby determine which interfaces can be connected to run on top of a particular interface.

3.1.2. PME Aggregation Function (PAF)

The PME Aggregation Function (PAF) allows a number of PMEs to be aggregated onto a PCS port, by fragmenting the Ethernet frames, transmitting the fragments over multiple PMEs, and assembling the original frames at the remote port. PAF is OPTIONAL, meaning that a device with a single PME MAY perform fragmentation and re-assembly if this function is supported by the device. Note however that the agent is REQUIRED to report on the PAF capability for all EFMCu ports (2BASE-TL and 10PASS-TS).

The EFM-CU-MIB module allows a Network Management application to query the PAF capability and enable/disable it if supported. Note that enabling PAF effectively turns on fragmentation and re-assembly, even on a single-PME port.

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 misconnections or for an automatic assignment of the local PMEs into aggregation groups instead of a fixed pre-configuration.

The MIB modules defined in this document allow a Network Management application to control the 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 the EFM Discovery mechanism: ifStackTable and ifCapStackTable. The following pseudo-code gives an example of the Discovery and automatic PME assignment for a generic PAF-enabled multi-PCS EFMCu device, located at Central Office (CO), using objects defined in these MIB modules and in the IF-MIB (Note that automatic PME assignment is only shown here for the purposes of the example. Fixed PME pre-assignment, manual assignment, or auto-assignment using an alternative internal algorithm may be chosen by a particular implementation):

```
// Go over all PCS ports in the CO device
FOREACH pcs[i] IN CO_device
{ // Perform discovery and auto-assignment only on PAF enabled ports
  // with room for more PMEs
  IF ( pcs[i].PAFSupported AND pcs[i].NumPMEs < pcs[i].PAFCapacity )
  { // Assign a unique 6-octet local discovery code to the PCS
    // e.g., MAC address
    dc = pcs[i].DiscoveryCode = MAC[i];
    // Go over all disconnected PMEs, which can
    // potentially be connected to the PCS
    FOREACH pme[j] IN ifCapStackTable[pcs[i]] AND
                        NOT IN ifStackTable[pcs[i]] // not connected
    { // Try to grab the remote RT_device, by writing the value
      // of the local 6-octet discovery code to the remote
      // discovery code register (via handshake mechanism).
      // This operation is atomic Set-if-Clear action, i.e., it
      // would succeed only if the remote discovery register was
      // zero. Read the remote discovery code register via Get
      // operation to see if the RT_device, attached via the PME
      // is indeed marked as being the CO_device peer.
      pme[j].RemoteDiscoveryCode = dc; // Set-if-Clear
      r = pme[j].RemoteDiscoveryCode; // Get
      IF ( r == dc AND pcs[i].NumPMEs < pcs[i].PAFCapacity )
      { // Remote RT_device connected via PME[j] is/was a peer
        // for PCS[i] and there is room for another PME in the
        // PCS[i] aggregation group (max. PAF capacity is not
        // reached yet).
        // Connect this PME to the PCS (via ifStackTable,
        // ifInvStackTable being inverse of ifStackTable is
        // updated automatically, i.e., pcs[i] is auto-added
        // to ifInvStackTable[pme[j]])
        ADD pme[j] TO ifStackTable[pcs[i]];
        pcs[i].NumPMEs = pcs[i].NumPMEs + 1;
        // Discover all other disconnected PMEs,
        // attached to the same RT_device and connect them to
        // the PCS provided there is enough room for more PMEs.
        FOREACH pme[k] IN ifCapStackTable[pcs[i]] AND
                        NOT IN ifStackTable[pcs[i]]
```



```

    { // Get Remote Discovery Code from the PME to see if
      // it belongs to a connected RT_device "grabbed" by
      // the CO_device.
      r = pme[k].RemoteDiscoveryCode;
      IF ( r == dc AND pcs[i].NumPMEs < pcs[i].PAFCapacity)
      { // Physically connect the PME to the PCS
        // (pcs[i] is auto-added TO ifInvStackTable[pme[k]])
        ADD pme[k] TO ifStackTable[pcs[i]];
        pcs[i].NumPMEs = pcs[i].NumPMEs + 1;
      }
    }
  }
  // At this point we have discovered all local PMEs which
  // are physically connected to the same remote RT_device
  // and connected them to PCS[i]. Go to the next PCS.
  BREAK;
}
}
}

```

An SNMP Agent for an EFMCu device builds the ifCapStackTable and its inverse ifInvCapStackTable 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 the 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 with 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 (and respective ifInvStackTable) 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 the required data rate on a particular

copper pair. Sometimes, when the copper line is too long or the noise 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 with all the PMEs connected to it or of an individual PME port. Setting this object to 'up' instructs a particular PCS or PME to start the 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 the ifMauMediaAvailable object from MAU-MIB for PCS and efmCuPmeOperStatus defined in the EFM-CU-MIB module 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 the EFM-CU-MIB module 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 the EFM-CU-MIB module 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 in 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 are 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	Operating data rate for the PME. For the PCS, it is the sum of the current operating data rates of all PMEs in the aggregation group, without the 64/65-octet encapsulation overhead and PAF overhead, but accounting for the Inter-Frame Gaps (IFGs).
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: EFMCu interpretation of IF-MIB objects

3.2. Relation to SHDSL MIB Module

G.SHDSL.bis modems, similar to PMEs comprising a 2BASE-TL port, are described in the HDSL2-SHDSL-LINE-MIB module [RFC4319]. Note that not all attributes of G.SHDSL modems reflected in the HDSL2-SHDSL-LINE-MIB module 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 'hds12shdsl'), it was decided not to reference HDSL2-SHDSL-LINE-MIB objects, but define all the relevant objects in the EFM-CU-MIB module.

However, if some functionality not available in the EFM-CU-MIB module is required and supported by the PME, e.g., performance monitoring, relevant HDSL2-SHDSL-LINE-MIB groups MAY be included and applied for PMEs of 2BASE-TL subtype.

3.3. Relation to VDSL MIB Module

VDSL modems, similar to the PME(s) comprising a 10PASS-TS port, are described in the VDSL-LINE-EXT-MCM-MIB module [RFC4070]. Note that not all attributes of VDSL modems reflected in the VDSL-LINE-EXT-MCM-MIB module 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 the EFM-CU-MIB module.

However, if some functionality not available in the EFM-CU-MIB module 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 MIB Modules

The implementation of the EtherLike-MIB [RFC3635] and MAU-MIB [RFC4836] modules is REQUIRED for 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-MIB module [RFC4836] for EFMCu MAUs:

- o dot3MauType2BaseTL and b2BaseTL - for 2BASE-TL MAU
- o dot3MauType10PassTS and b10PassTS - for 10PASS-TS MAU

Additionally, the IANA-MAU-MIB module defines two new values of ifMauMediaAvailable, specifically for EFMCu ports: availableReduced and ready (in textual convention IANAifMauMediaAvailable). Due to the PME aggregation, the EFMCu interpretation of some possible ifMauMediaAvailable values differs from other MAUs as follows:

- o unknown - the EFMCu interface (PCS with connected PMEs) is Initializing
- o ready - the interface is Down, at least one PME in the aggregation group (all PMEs connected to the PCS) is ready for handshake
- o available - the interface is Up, all PMEs in the aggregation group are up

- o notAvailable - the interface is Down, all PMEs in the aggregation group are Down, no handshake tones are detected by any PME
- o availableReduced - the interface is Up, a link fault is detected at the receive direction by one or more PMEs in the aggregation group, but at least one PME is Up
- o pmdLinkFault - a link fault is detected at the receive direction by all PMEs in the aggregation group

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 are not applicable to the EFMCu ports (no auto-negotiation, 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 module 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 the EFM-CU-MIB module.

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

4. MIB Structure

4.1. EFM Copper MIB Overview

The main management objects defined in the EFM-CU-MIB module are split into 2 groups:

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

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

4.2. Interface Stack Capability MIB Overview

The IF-CAP-STACK-MIB module contains 2 tables:

- o ifCapStackTable - containing objects that define possible relationships among the sub-layers of an interface with flexible cross-connect (cross-connect capability).

- o ifInvCapStackTable - an inverse of the ifCapstackTable.

4.3. PME 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, the EFM-CU-MIB module makes use of configuration profiles, similar to the HDSL2-SHDSL-LINE-MIB and VDSL-LINE-EXT-MCM-MIB modules. A profile is a set of parameters, used either for configuration or representation of a PME. The same profile can be shared by multiple PME ports using the same configuration.

The PME profiles are defined in the efmCuPme2BProfileTable and efmCuPme10PProfileTable 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. In addition, the EFM-CU-MIB defines two additional predefined profiles for "best-effort" provisioning of 2BASE-TL PMEs. An ability to define new configuration profiles is also provided to allow for EFMCu deployment tailored to specific copper environments and spectral regulations.

A specific configuration or administrative profile is assigned to a specific PME via the efmCuPmeAdminProfile object. If efmCuPmeAdminProfile is zero, then the efmCuAdminProfile object of the PCS port connected to the PME determines the configuration profile (or a list of possible profiles) for that PME. This mechanism allows specifying a common profile for all PMEs connected to the PCS port, with an ability to change individual PME profiles by setting efmCuPmeAdminProfile object, which overwrites the profile set by efmCuAdminProfile.

A current operating PME profile is pointed to by the efmCuPmeOperProfile object. Note that this profile entry can be created automatically to reflect achieved parameters in adaptive (not fixed) initialization.

4.4. Mapping of IEEE 802.3ah Managed Objects

This section contains the mapping between relevant 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 the majority of the objects defined in the EFM-CU-MIB module do not have direct counterparts in Clause 30 and instead refer to Clause 45 registers.

IEEE 802.3 Managed Object	Corresponding SNMP Object
oMAU - Basic Package (Mandatory)	
aMAUType	ifMauType (MAU-MIB)
aMAUTypeList	ifMauTypeListBits (MAU-MIB)
aMediaAvailable	ifMediaAvailable (MAU-MIB)
oPAF - Basic Package (Mandatory)	
aPAFID	ifIndex (IF-MIB)
aPhyEnd	efmCuPhySide
aPHYCurrentStatus	efmCuStatus
aPAFSupported	efmCuPAFSupported
oPAF - PME Aggregation Package (Optional)	
aPAFAdminState	efmCuPAFAdminState
aLocalPAFCapacity	efmCuPAFCapacity
aLocalPMEAvailable	ifCapStackTable
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	
aTCCRCErrors	efmCuPmeTCCrcErrors	
aProfileSelect	efmCuAdminProfile,	
	efmCuPmeAdminProfile	
aOperatingProfile	efmCuPmeOperProfile	
aPMEFECCorrectedBlocks	efmCuPme10PFECCorrectedBlocks	
aPMEFECCUncorrectableBlocks	efmCuPme10PFECUncorrectedBlocks	

Table 2: Mapping of IEEE 802.3 Managed Objects

5. Interface Stack Capability MIB Definitions

```
IF-CAP-STACK-MIB DEFINITIONS ::= BEGIN
```

IMPORTS

```
MODULE-IDENTITY, OBJECT-TYPE, mib-2
```

```
FROM SNMPv2-SMI -- [RFC2578]
```

```
TruthValue
```

```
FROM SNMPv2-TC -- [RFC2579]
```

```
MODULE-COMPLIANCE, OBJECT-GROUP
```

```
FROM SNMPv2-CONF -- [RFC2580]
```

```
ifStackGroup2, ifStackHigherLayer, ifStackLowerLayer
```

```
FROM IF-MIB -- [RFC2863]
```

```
ifInvStackGroup
```

```
FROM IF-INVERTED-STACK-MIB -- [RFC2864]
```

```
;
```

```
ifCapStackMIB MODULE-IDENTITY
```

```
LAST-UPDATED "200711070000Z" -- November 07, 2007
```

```
ORGANIZATION "IETF Ethernet Interfaces and Hub MIB Working Group"
```

```
CONTACT-INFO
```

```
"WG charter:
```

```
http://www.ietf.org/html.charters/OLD/hubmib-charter.html
```

```
Mailing Lists:
```

```
General Discussion: hubmib@ietf.org
```


To Subscribe: hubmib-request@ietf.org
In Body: subscribe your_email_address

Chair: Bert Wijnen
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DESCRIPTION

"The objects in this MIB module are used to describe cross-connect capabilities of stacked (layered) interfaces, complementing ifStackTable and ifInvStackTable defined in IF-MIB and IF-INVERTED-STACK-MIB, respectively.

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REVISION "200711070000Z" -- November 07, 2007

DESCRIPTION "Initial version, published as RFC 5066."

::= { mib-2 166 }

-- Sections of the module
-- Structured as recommended by [RFC4181], see
-- Appendix D: Suggested OID Layout

ifCapStackObjects OBJECT IDENTIFIER ::= { ifCapStackMIB 1 }

ifCapStackConformance OBJECT IDENTIFIER ::= { ifCapStackMIB 2 }

-- Groups in the module

--
-- ifCapStackTable group
--

ifCapStackTable OBJECT-TYPE

SYNTAX SEQUENCE OF IfCapStackEntry

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 described in ifStackTable). In particular, it contains information on which sub-layers MAY possibly run 'on top of' which other sub-layers, as determined by cross-connect capability of the device, where each sub-layer corresponds to a conceptual row in the ifTable. For example, when the sub-layer with ifIndex value x can be connected to run on top of the sub-layer with ifIndex value y, then this table contains:

```
ifCapStackStatus.x.y=true
```

The ifCapStackStatus.x.y row does not exist if it is impossible to connect between the sub-layers x and y.

Note that for most stacked interfaces (e.g., 2BASE-TL) there's always at least one higher-level interface (e.g., PCS port) for each lower-level interface (e.g., PME) and at least one lower-level interface for each higher-level interface, that is, there is at least a single row with a 'true' status for any such existing value of x or y.

This table is read-only as it describes device capabilities."

REFERENCE

"IF-MIB, ifStackTable"

```
::= { ifCapStackObjects 1 }
```

ifCapStackEntry OBJECT-TYPE

SYNTAX IfCapStackEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"Information on a particular relationship between two sub-layers, specifying that one sub-layer MAY possibly run on 'top' of the other sub-layer. Each sub-layer corresponds to a conceptual row in the ifTable (interface index for lower and higher layer, respectively)."

INDEX {

```
ifStackHigherLayer,
```

```
ifStackLowerLayer
```

```
}
```

```

 ::= { ifCapStackTable 1 }

IfCapStackEntry ::= SEQUENCE {
    ifCapStackStatus      TruthValue
}

ifCapStackStatus OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The status of the 'cross-connect capability' relationship
        between two sub-layers. The following values can be returned:
            true(1)      - indicates that the sub-layer interface,
                           identified by the ifStackLowerLayer MAY
                           be connected to run 'below' the sub-layer
                           interface, identified by the
                           ifStackHigherLayer index.
            false(2)     - the sub-layer interfaces cannot be
                           connected temporarily due to
                           unavailability of the interface(s), e.g.,
                           one of the interfaces is located on an
                           absent pluggable module."

Note that lower-layer interface availability per higher-layer,
indicated by the value of 'true', can be constrained by
other parameters, for example, by the aggregation capacity of
a higher-layer interface or by the lower-layer interface in
question being already connected to another higher-layer
interface. In order to ensure that a particular sub-layer can
be connected to another sub-layer, all respective objects
(e.g., ifCapStackTable, ifStackTable, and efmCuPAFCapacity for
EFMCu interfaces) SHALL be inspected.

This object is read-only, unlike ifStackStatus, as it
describes a cross-connect capability."
 ::= { ifCapStackEntry 1 }

ifInvCapStackTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF IfInvCapStackEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
        "A table containing information on the possible relationships
        between the multiple sub-layers of network interfaces. This
        table, modeled after ifInvStackTable from
        IF-INVERTED-STACK-MIB, is an inverse of the ifCapStackTable
        defined in this MIB module."

```

In particular, this table contains information on which sub-layers MAY run 'underneath' which other sub-layers, where each sub-layer corresponds to a conceptual row in the ifTable. For example, when the sub-layer with ifIndex value x MAY be connected to run underneath the sub-layer with ifIndex value y, then this table contains:

```
ifInvCapStackStatus.x.y=true
```

This table contains exactly the same number of rows as the ifCapStackTable, but the rows appear in a different order.

This table is read-only as it describes a cross-connect capability."

REFERENCE

"IF-INVERTED-STACK-MIB, ifInvStackTable"
 ::= { ifCapStackObjects 2 }

ifInvCapStackEntry OBJECT-TYPE

SYNTAX IfInvCapStackEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"Information on a particular relationship between two sub-layers, specifying that one sub-layer MAY run underneath the other sub-layer. Each sub-layer corresponds to a conceptual row in the ifTable."

INDEX { ifStackLowerLayer, ifStackHigherLayer }

::= { ifInvCapStackTable 1 }

```
IfInvCapStackEntry ::= SEQUENCE {
    ifInvCapStackStatus      TruthValue
}
```

ifInvCapStackStatus OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The status of the possible 'cross-connect capability' relationship between two sub-layers.

An instance of this object exists for each instance of the ifCapStackStatus object, and vice versa. For example, if the variable ifCapStackStatus.H.L exists, then the variable ifInvCapStackStatus.L.H must also exist, and vice versa. In addition, the two variables always have the same value.

The ifInvCapStackStatus object is read-only, as it describes a cross-connect capability."

REFERENCE

"ifCapStackStatus"

::= { ifInvCapStackEntry 1 }

--

-- Conformance Statements

--

ifCapStackGroups OBJECT IDENTIFIER ::=

{ ifCapStackConformance 1 }

ifCapStackCompliances OBJECT IDENTIFIER ::=

{ ifCapStackConformance 2 }

-- Units of Conformance

ifCapStackGroup OBJECT-GROUP

OBJECTS {

ifCapStackStatus,

ifInvCapStackStatus

}

STATUS current

DESCRIPTION

"A collection of objects providing information on the cross-connect capability of multi-layer (stacked) network interfaces."

::= { ifCapStackGroups 1 }

-- Compliance Statements

ifCapStackCompliance MODULE-COMPLIANCE

STATUS current

DESCRIPTION

"The compliance statement for SNMP entities, which provide information on the cross-connect capability of multi-layer (stacked) network interfaces, with flexible cross-connect between the sub-layers."

MODULE -- this module

MANDATORY-GROUPS {

ifCapStackGroup

}

OBJECT ifCapStackStatus

```

SYNTAX      TruthValue { true(1) }
DESCRIPTION
    "Support for the false(2) value is OPTIONAL for
    implementations supporting pluggable interfaces."

OBJECT      ifInvCapStackStatus
SYNTAX      TruthValue { true(1) }
DESCRIPTION
    "Support for the false(2) value is OPTIONAL for
    implementations supporting pluggable interfaces."

MODULE IF-MIB
    MANDATORY-GROUPS {
        ifStackGroup2
    }

MODULE IF-INVERTED-STACK-MIB
    MANDATORY-GROUPS {
        ifInvStackGroup
    }

    ::= { ifCapStackCompliances 1 }
END

6. EFM Copper MIB 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
    FROM IF-MIB             -- [RFC2863]
    ;

efmCuMIB MODULE-IDENTITY
    LAST-UPDATED "200711140000Z" -- November 14, 2007
    ORGANIZATION "IETF Ethernet Interfaces and Hub MIB Working Group"
    CONTACT-INFO
        "WG charter:
        http://www.ietf.org/html.charters/OLD/hubmib-charter.html

```

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To Subscribe: hubmib-request@ietf.org
In Body: subscribe your_email_address

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Email: edward.beili@actelis.com"

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 Std. 802.3ah-2004, which is now a part of IEEE Std. 802.3-2005.

The following references are used throughout this MIB module:

[802.3ah] refers to:

IEEE Std 802.3ah-2004: 'IEEE Standard for 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 -
Amendment: Media Access Control Parameters, Physical Layers and Management Parameters for Subscriber Access Networks', 07 September 2004.

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'.

[G.991.2] refers to:

ITU-T Recommendation G.991.2: 'Single-pair High-speed Digital Subscriber Line (SHDSL) transceivers', December 2003.

[ANFP] refers to:

NICC Document ND1602:2005/08: 'Specification of the Access Network Frequency Plan (ANFP) applicable to transmission systems used on the BT Access Network,' August 2005.

The following normative documents are quoted by the DESCRIPTION clauses in this MIB module:

[G.993.1] refers to:

ITU-T Recommendation G.993.1: 'Very High speed Digital Subscriber Line transceivers', June 2004.

[T1.424] refers to:

ANSI T1.424-2004: 'Interface Between Networks and Customer Installation Very-high-bit-rate Digital Subscriber Lines (VDSL) Metallic Interface (DMT Based)', June 2004.

[TS 101 270-1] refers to:

ETSI TS 101 270-1: 'Transmission and Multiplexing (TM); Access transmission systems on metallic access cables; Very high speed Digital Subscriber Line (VDSL); Part 1: Functional requirements', October 2005.

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
PBO - Power Back-Off
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

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```
REVISION      "200711140000Z"  -- November 14, 2007
DESCRIPTION   "Initial version, published as RFC 5066."

 ::= { mib-2 167 }

-- 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

EfmProfileIndex ::= 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)

EfmProfileIndexOrZero ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS      current
    DESCRIPTION
        "This textual convention is an extension of the
        EfmProfileIndex 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 that uses
        this syntax.
        Examples of the usage of zero value might include situations
        where the current operational profile is unknown."
    SYNTAX      Unsigned32 (0..255)

EfmProfileIndexList ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "ld:"
```

STATUS current

DESCRIPTION

"This textual convention represents a list of up to 6 EfmProfileIndex values, any of which can be chosen for configuration of a PME in a managed EFMCu port.

The EfmProfileIndex textual convention defines a greater than zero value used to identify a PME profile.

The value of this object is a concatenation of zero or more (up to 6) octets, where each octet contains an 8-bit EfmProfileIndex value.

A zero-length octet string is object-specific and MUST therefore be defined as part of the description of any object that uses this syntax. Examples of the usage of a zero-length value might include situations where an object using this textual convention is irrelevant for a specific EFMCu port type."

SYNTAX OCTET STRING (SIZE(0..6))

EfmTruthValueOrUnknown ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"This textual convention is an extension of the TruthValue convention. The latter defines a boolean value with possible values of true(1) and false(2). This extension permits the additional value of unknown(0), which can be returned as the result of a GET operation when an exact true or false value of the object cannot be determined."

SYNTAX INTEGER { unknown(0), true(1), false(2) }

-- Port Notifications Group

efmCuPortNotifications OBJECT IDENTIFIER ::= { efmCuPort 0 }

efmCuLowRateCrossing NOTIFICATION-TYPE

OBJECTS {
 ifSpeed,
 efmCuThreshLowRate
}

STATUS current

DESCRIPTION

"This notification indicates that the EFMCu port's data rate has reached/dropped below or exceeded the low rate threshold, specified by efmCuThreshLowRate.

This notification MAY be sent for the -O subtype ports (2BaseTL-O/10PassTS-O) while the port is Up, on the crossing event in both directions: from normal (rate is above the threshold) to low (rate equals the threshold or below it) and

from low to normal. This notification is not applicable to the -R subtypes.

It is RECOMMENDED that a small debouncing period of 2.5 sec, between the detection of the condition and the notification, is implemented to prevent simultaneous LinkUp/LinkDown and efmCuLowRateCrossing notifications to be sent.

The adaptive nature of the EFMCu technology allows the port to adapt itself to the changes in the copper environment, e.g., an impulse noise, alien crosstalk, or a micro-interruption may temporarily drop one or more PMEs in the aggregation group, causing a rate degradation of the aggregated EFMCu link. The dropped PMEs would then try to re-initialize, possibly at a lower rate than before, adjusting the rate to provide required target SNR margin.

Generation of this notification is controlled by the efmCuLowRateCrossingEnable object."

```
::= { 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	EfmProfileIndexList,
efmCuTargetDataRate	Unsigned32,
efmCuTargetSnrMgn	Unsigned32,
efmCuAdaptiveSpectra	TruthValue,
efmCuThreshLowRate	Unsigned32,
efmCuLowRateCrossingEnable	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 rejected.

A 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 rejected 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.

This object MUST be maintained in a persistent manner."

REFERENCE

"[802.3ah] 61.2.2, 45.2.3.18.3"

::= { efmCuPortConfEntry 1 }

efmCuPAFDiscoveryCode OBJECT-TYPE

SYNTAX PhysAddress (SIZE(0|6))

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"PAF Discovery Code of the EFMCu port (PCS).

A unique 6-octet code used by the Discovery function, when PAF is supported.

PCS ports incapable of supporting PAF SHALL return a zero-length octet string on an attempt to read this object.

An attempt to write to this object SHALL be rejected for such ports.

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 initial value of this object for -R subtype ports after reset is all zeroes. For -R subtype ports, the value of this object cannot be changed directly. This value may be changed as a result of writing operation on the efmCuPAFRemoteDiscoveryCode object 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 (in case of SNMP 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, 45.2.6.8, 61A.2"

::= { efmCuPortConfEntry 2 }

efmCuAdminProfile OBJECT-TYPE

SYNTAX EfmProfileIndexList

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 efmCuPme2BProfileTable or efmCuPme10PProfileTable, 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 profiles. If this list consists of a single profile index, then all PMEs assigned to this EFMCu port SHALL be configured according to the profile referenced by that index, unless it is overwritten by a corresponding non-zero efmCuPmeAdminProfile instance, which takes precedence over efmCuAdminProfile.

A list consisting of more than one index allows each PME in the port to be configured according to any profile specified in the list.

By default, this object has a value of 0x01, referencing the 1st entry in efmCuPme2BProfileTable or efmCuPme10PProfileTable.

This object is writable and readable for the -O subtype (2BaseTL-O or 10PasSTS-O) EFMCu ports. It is irrelevant for the -R subtype (2BaseTL-R or 10PasSTS-R) ports -- a zero-length octet string SHALL be returned on an attempt to read this object and an attempt to change this object MUST be rejected in this case.

Note that the current operational profile value is available via the efmCuPmeOperProfile object.

Any 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 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.

This object maps to the Clause 30 attribute aProfileSelect.

This object MUST be maintained in a persistent manner."

REFERENCE

"[802.3ah] 30.11.2.1.6"

DEFVAL { '01'H }

::= { 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 64/65-octet encapsulation overhead (e.g., target data rate of 10 Mbps SHALL allow lossless transmission of a full-duplex 10 Mbps Ethernet frame stream with minimal inter-frame gap).

The value is limited above by 100 Mbps 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 SHALL 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 the desired SNR margin. In case the copper environment allows a higher total data rate to be achieved than that specified by the target, the excess capability SHALL be either converted to additional SNR margin or reclaimed by minimizing transmit power as controlled by efmCuAdaptiveSpectra.

The value of 999999 means that the target data rate is not fixed and SHALL be set to the maximum attainable rate during initialization (Best Effort), under specified spectral restrictions and with the 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 (in case of SNMP with the error inconsistentValue), if the link is Up or Initializing.

Note that the current Data Rate of the EFMCu port is represented by the ifSpeed object of IF-MIB.

This object MUST be maintained in a persistent manner."
 ::= { 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 initialization. (The SNR margin is the difference between the desired SNR and the actual SNR).

Note that 802.3ah recommends using a default target SNR margin of 5 dB for 2BASE-TL ports and 6 dB for 10PASS-TS ports in order to achieve a 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 (in case of SNMP with the error inconsistentValue), if the link is Up or Initializing.

Note that the current SNR margin of the PMEs comprising the EFMCu port is represented by efmCuPmeSnrMgn.

This object MUST be maintained in a persistent manner."

REFERENCE

"[802.3ah] 61.1.2"
 ::= { efmCuPortConfEntry 5 }

efmCuAdaptiveSpectra OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"Indicates how to utilize excess capacity when the copper environment allows a higher total data rate to be achieved than that specified by the efmCuTargetDataRate.

A value of true(1) indicates that the excess capability SHALL be reclaimed by minimizing transmit power, e.g., using higher constellations and Power Back-Off, in order to reduce interference to other copper pairs in the binder and the adverse impact to link/system performance.

A value of false(2) indicates that the excess capability SHALL be converted to additional SNR margin and spread evenly across all active PMEs assigned to the (PCS) port, to increase link robustness.

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

Changing of this object MUST be performed when the link is

Down. Attempts to change this object MUST be rejected (in case of SNMP with the error inconsistentValue), if the link is Up or Initializing.

This object MUST be maintained in a persistent manner."
 ::= { efmCuPortConfEntry 6 }

efmCuThreshLowRate OBJECT-TYPE

SYNTAX Unsigned32(1..100000)

UNITS "Kbps"

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"This object configures the EFMCu port low-rate crossing alarm threshold. When the current value of ifSpeed for this port reaches/drops below or exceeds this threshold, an efmCuLowRateCrossing notification MAY be generated if enabled by efmCuLowRateCrossingEnable.

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

This object MUST be maintained in a persistent manner."
 ::= { efmCuPortConfEntry 7 }

efmCuLowRateCrossingEnable OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"Indicates whether efmCuLowRateCrossing notifications should be generated for this interface.

A value of true(1) indicates that efmCuLowRateCrossing notification is enabled. A value of false(2) indicates that the notification is disabled.

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

This object MUST be maintained in a persistent manner."
 ::= { efmCuPortConfEntry 8 }

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

EfmTruthValueOrUnknown,

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 EfmTruthValueOrUnknown

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 SHALL return a value of false(2).

Ports whose peers cannot be reached because of the link state SHALL return a value of unknown(0).

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).

A 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, complementing the generic status
information from the ifTable of IF-MIB and ifMauTable of
MAU-MIB. Additional status information about connected PMEs
is available from the efmCuPmeStatusTable.

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),
    peerPowerLoss(1),
    pmeSubTypeMismatch(2),
    lowRate(3)
}
```

```
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 | - the peer PHY cannot be reached (e.g., no PME's attached, all PME's are Down, etc.). More info is available in efmCuPmeFltStatus. |
| peerPowerLoss | - the peer PHY has indicated impending unit failure due to loss of local power ('Dying Gasp'). |
| pmeSubTypeMismatch | - local PME's in the aggregation group are not of the same subtype, e.g., some PME's in the local device are -O while others are -R subtype. |
| lowRate | - ifSpeed of the port reached or dropped below efmCuThreshLowRate. |

This object is intended to supplement the ifOperStatus object in IF-MIB and ifMauMediaAvailable in MAU-MIB.

Additional information is available via the efmCuPmeFltStatus object for each PME in the aggregation group (single PME if PAF is disabled)."

REFERENCE

"IF-MIB, ifOperStatus; MAU-MIB, ifMauMediaAvailable;
efmCuPmeFltStatus"

```
::= { efmCuPortStatusEntry 1 }
```

efmCuPortSide OBJECT-TYPE

```
SYNTAX      INTEGER {
    subscriber(1),
    office(2),
    unknown(3)
}
```

```
MAX-ACCESS  read-only
```

```
STATUS      current
```

DESCRIPTION

"EFM port mode of operation (subtype).

The value of 'subscriber' indicates that 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

"The number of PMEs that is currently aggregated by the local PAF (assigned to the EFMCu port using the 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 the 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

"The 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.

Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of ifCounterDiscontinuityTime,

defined in IF-MIB."
REFERENCE
"[802.3ah] 45.2.3.21"
::= { efmCuPortStatusEntry 4 }

efmCuPAFInSmallFragments OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"The 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.

Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of ifCounterDiscontinuityTime, defined in IF-MIB."

REFERENCE
"[802.3ah] 45.2.3.22"
::= { efmCuPortStatusEntry 5 }

efmCuPAFInLargeFragments OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"The 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.

Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of ifCounterDiscontinuityTime, defined in IF-MIB."

REFERENCE

```
"[802.3ah] 45.2.3.23"  
 ::= { efmCuPortStatusEntry 6 }
```

efmCuPAFInBadFragments OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of fragments that do not fit into the sequence expected by the frame assembly function and 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.

Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of ifCounterDiscontinuityTime, defined in IF-MIB."

REFERENCE

```
"[802.3ah] 45.2.3.25"  
 ::= { efmCuPortStatusEntry 7 }
```

efmCuPAFInLostFragments OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The 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.

Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of ifCounterDiscontinuityTime, defined in IF-MIB."

REFERENCE


```
"[802.3ah] 45.2.3.26"  
 ::= { efmCuPortStatusEntry 8 }
```

efmCuPAFInLostStarts OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The 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.

Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of ifCounterDiscontinuityTime, defined in IF-MIB."

REFERENCE

```
"[802.3ah] 45.2.3.27"  
 ::= { efmCuPortStatusEntry 9 }
```

efmCuPAFInLostEnds OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The 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.

Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of ifCounterDiscontinuityTime, defined in IF-MIB."

REFERENCE

```
"[802.3ah] 45.2.3.28"  
 ::= { efmCuPortStatusEntry 10 }
```

efmCuPAFInOverflows OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of fragments, received across 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.

Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of ifCounterDiscontinuityTime, defined in IF-MIB."

REFERENCE

"[802.3ah] 45.2.3.24"

::= { efmCuPortStatusEntry 11 }

-- PME Notifications Group

efmCuPmeNotifications OBJECT IDENTIFIER ::= { efmCuPme 0 }

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. This notification MAY be sent on the crossing event in both directions: from normal to exceeded and from exceeded to normal.

It is RECOMMENDED that a small debouncing period of 2.5 sec, between the detection of the condition and the notification, is implemented to prevent intermittent notifications from being sent.

Generation of this notification is controlled by the efmCuPmeLineAtnCrossingEnable object."

```
::= { 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. This notification MAY be sent on the crossing event in both directions: from normal to exceeded and from exceeded to normal.

It is RECOMMENDED that a small debouncing period of 2.5 sec, between the detection of the condition and the notification, is implemented to prevent intermittent notifications from being sent.

Generation of this notification is controlled by the efmCuPmeSnrMgnCrossingEnable object."

```
::= { 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.

Generation of this notification is controlled by the efmCuPmeDeviceFaultEnable object."

```
::= { 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 the

requested configuration profile.

Generation of this notification is controlled by the
efmCuPmeConfigInitFailEnable object."

::= { efmCuPmeNotifications 4 }

efmCuPmeProtocolInitFailure NOTIFICATION-TYPE

OBJECTS {
 efmCuPmeFltStatus,
 efmCuPmeOperSubType
}

STATUS current

DESCRIPTION

"This notification indicates that the peer PME was using
an incompatible protocol during initialization.

Generation of this notification is controlled by the
efmCuPmeProtocolInitFailEnable object."

::= { 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          EfmProfileIndexOrZero,
    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) subtype 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. The actual value will be set by the -O link partner during initialization (handshake).
- ieee2BaseTLor10PassTSO - PME SHALL operate as 2BaseTL-O (preferred) or 10PassTS-O. The actual value will be set during initialization depending on the -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. The actual value will be set during initialization depending on the -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 rejected if the link is Up or Initializing. Attempts to change this object to an unsupported subtype (see efmCuPmeSubTypesSupported) SHALL be rejected.

The current operational subtype is indicated by the efmCuPmeOperSubType variable.

If a Clause 45 MDIO Interface to the PMA/PMD is present, then this object combines values of the Port subtype 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 EfmProfileIndexOrZero

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"Desired PME configuration profile. This object is a pointer to an entry in either the efmCuPme2BProfileTable or the efmCuPme10PProfileTable, depending on the current operating SubType of the PME. The value of this object is the index of the referenced profile.

The value of zero (default) indicates that the PME is configured via the efmCuAdminProfile object for the PCS port to which this PME is assigned. That is, the profile referenced by efmCuPmeAdminProfile takes precedence over the profile(s) referenced by efmCuAdminProfile.

This object is writable and readable for the CO subtype PMEs (2BaseTL-O or 10PassTS-O). It is irrelevant for the CPE subtype (2BaseTL-R or 10PassTS-R) -- a zero value SHALL be returned on an attempt to read this object and any attempt to change this object MUST be rejected in this case.

Note that the current operational profile value is available via efmCuPmeOperProfile object.

Any 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.

This object maps to the Clause 30 attribute aProfileSelect.

This object MUST be maintained in a persistent manner."

REFERENCE

"[802.3ah] 30.11.2.1.6"

DEFVAL { 0 }

::= { efmCuPmeConfEntry 2 }

efmCuPAFRemoteDiscoveryCode OBJECT-TYPE

SYNTAX PhysAddress (SIZE(0|6))

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"PAF Remote Discovery Code of the PME port at the CO.
The 6-octet Discovery Code of the peer PCS connected via the PME.

Reading this object results in a Discovery Get operation. Setting this object to all zeroes 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.

A zero-length octet string SHALL be returned on an attempt to read this object when PAF aggregation is not enabled.

This object is irrelevant in CPE port (-R) subtypes: in this case, a zero-length octet string SHALL be returned on an attempt to read this object; writing to this object SHALL be rejected.

Discovery MUST be performed when the link is Down.

Attempts to change this object MUST be rejected (in case of SNMP 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, an 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 (in case of SNMP 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 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, an efmCuPmeSnrMgnCrossing notification MAY be generated, if enabled by efmCuPmeSnrMgnCrossingEnable.

This object is writable for the CO subtype PMEs (2BaseTL-O/10PassTS-O). 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 (in case of SNMP 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 SNR margin threshold bits in the 2B PMD line quality thresholds register."

REFERENCE

"[802.3ah] 45.2.1.36"
 ::= { efmCuPmeConfEntry 5 }

efmCuPmeLineAtnCrossoverEnable OBJECT-TYPE

SYNTAX TruthValue
 MAX-ACCESS read-write
 STATUS current

DESCRIPTION

"Indicates whether efmCuPmeLineAtnCrossover notifications should be generated for this interface.

A value of true(1) indicates that efmCuPmeLineAtnCrossover notification is enabled. A value of false(2) indicates that the notification is disabled."

::= { efmCuPmeConfEntry 6 }

efmCuPmeSnrMgnCrossoverEnable OBJECT-TYPE

SYNTAX TruthValue
 MAX-ACCESS read-write
 STATUS current

DESCRIPTION

"Indicates whether efmCuPmeSnrMgnCrossover notifications should be generated for this interface.

A value of true(1) indicates that efmCuPmeSnrMgnCrossover notification is enabled. A value of false(2) indicates that the notification 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.

A value of true(1) indicates that efmCuPmeDeviceFault notification is enabled. A value of false(2) indicates that the notification 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.

A value of true(1) indicates that efmCuPmeConfigInitFailure notification is enabled. A value of false(2) indicates that the notification 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.

A value of true(1) indicates that efmCuPmeProtocolInitFailure notification is enabled. A value of false(2) indicates that the notification is disabled."

::= { efmCuPmeConfEntry 10 }

efmCuPmeCapabilityTable OBJECT-TYPE

SYNTAX SEQUENCE OF EfmCuPmeCapabilityEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"Table for the configuration of common aspects for EFMCu 2BASE-TL/10PASS-TS PME ports (modems). The configuration of aspects specific to 2BASE-TL or 10PASS-TS PME types is represented in the efmCuPme2BConfTable and the 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 subtypes. This is a bitmap of possible subtypes. 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

The desired mode of operation is determined by efmCuPmeAdminSubType, while efmCuPmeOperSubType reflects 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

"This table provides common status information of EFMcu 2BASE-TL/10PASS-TS PME ports. Status information specific to 10PASS-TS PME is represented in efmCuPme10PStatusTable.

This table contains live data from the equipment. As such, it is NOT persistent."

::= { 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        EfmProfileIndexOrZero,
    efmCuPmeSnrMgn             Integer32,
    efmCuPmePeerSnrMgn         Integer32,
    efmCuPmeLineAtn            Integer32,
    efmCuPmePeerLineAtn        Integer32,
    efmCuPmeEquivalentLength   Unsigned32,
    efmCuPmeTCCodingErrors     Counter32,
    efmCuPmeTCCrcErrors        Counter32
}
```

efmCuPmeOperStatus OBJECT-TYPE

SYNTAX INTEGER {

up(1),

downNotReady(2),

downReady(3),

init(4)

}

MAX-ACCESS read-only
 STATUS current
 DESCRIPTION

"Current PME link Operational Status. Possible values are:
 up(1) - The link is Up and ready to pass
 64/65-octet encoded frames or fragments.
 downNotReady(2) - The 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) - The link is Down and the PME detects
 Handshake tones from its peer.
 init(4) - The link is Initializing, as a result of
 ifAdminStatus being set to 'up' for a
 particular PME or a PCS to which the PME
 is connected.

This object is intended to supplement the Down(2) 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),
 snrMgnDefect(1),
 lineAtnDefect(2),
 deviceFault(3),
 configInitFailure(4),
 protocolInitFailure(5)
 }

MAX-ACCESS read-only
 STATUS current
 DESCRIPTION

"Current/Last 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 64/65-octet 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 the configuration profile, requested during initialization.
- protocolInitFailure - Protocol initialization failure, due to an incompatible protocol used by the peer PME during init (that could happen if a peer PMD is a regular G.SDHSL/VDSL modem instead of a 2BASE-TL/10PASS-TS PME).

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

This object holds information about the last fault. efmCuPmeFltStatus is cleared by the device restart. In addition, lossOfFraming, configInitFailure, and protocolInitFailure are cleared by PME init; deviceFault is cleared by successful diagnostics/test; snrMgnDefect and lineAtnDefect are cleared by SNR margin and Line attenuation, respectively, returning to norm and by PME init.

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 subtype 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 desired operational subtype of the PME can be configured via the efmCuPmeAdminSubType variable.

If a Clause 45 MDIO Interface to the PMA/PMD is present, then this object combines values of the Port subtype 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        EfmProfileIndexOrZero
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION

```

"PME current operating profile. This object is a pointer to an entry in either the efmCuPme2BProfileTable or the efmCuPme10PProfileTable, depending on the current operating SubType of the PME as indicated by efmCuPmeOperSubType. Note that a profile entry to which efmCuPmeOperProfile is pointing can be created automatically to reflect achieved parameters in adaptive (not fixed) initialization, i.e., values of efmCuPmeOperProfile and efmCuAdminProfile or efmCuPmeAdminProfile may differ. The value of zero indicates that the 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|65535)

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. The value of 65535 is returned when the PME is Down or Initializing.

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|65535)

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. The value of 65535 is returned when the PME is Down or Initializing.

This object is irrelevant for the -R PME subtypes. The value of 65535 SHALL be returned in this case.

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|65535)

UNITS "dB"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The current Line Attenuation in dB as perceived by the local PME.

The value of 65535 is returned when the PME is Down or Initializing.

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|65535)

UNITS "dB"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The current Line Attenuation in dB as perceived by the remote (link partner) PME.

The value of 65535 is returned when the PME is Down or Initializing.

This object is irrelevant for the -R PME subtypes. The value of 65535 SHALL be returned in this case.

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 }

efmCuPmeEquivalentLength OBJECT-TYPE

SYNTAX Unsigned32(0..8192|65535)

UNITS "m"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"An estimate of the equivalent loop's physical length in meters, as perceived by the PME after the link is established. An equivalent loop is a hypothetical 26AWG (0.4mm) loop with a perfect square root attenuation characteristic, without any bridged taps.

The value of 65535 is returned if the link is Down or Initializing or the PME is unable to estimate the equivalent length.

For a 10BASE-TL PME, 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"
 ::= { efmCuPmeStatusEntry 9 }

efmCuPmeTCCodingErrors OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The 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.

This object maps to aTCCodingViolations attribute in Clause 30.

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).

Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of ifCounterDiscontinuityTime, defined in IF-MIB."

REFERENCE

"[802.3ah] 61.3.3.1, 30.11.2.1.5, 45.2.6.12"
 ::= { efmCuPmeStatusEntry 10 }

efmCuPmeTCCrcErrors OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of TC-CRC errors. This counter is incremented for each TC-CRC error detected by the 64/65-octet receive function (see 61.3.3.3 and Figure 61-19).

This object maps to aTCCRCErrors attribute in Clause 30.

If a Clause 45 MDIO Interface to the PME TC is present, then this object maps to the TC CRC error register (see 45.2.6.11).

Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of ifCounterDiscontinuityTime, defined in IF-MIB."

REFERENCE

"[802.3ah] 61.3.3.3, 30.11.2.1.10, 45.2.6.11"
 ::= { efmCuPmeStatusEntry 11 }

-- 2BASE-TL specific PME group

efmCuPme2B OBJECT IDENTIFIER ::= { efmCuPme 5 }

efmCuPme2BProfileTable OBJECT-TYPE

SYNTAX SEQUENCE OF EfmCuPme2BProfileEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table supports definitions of administrative and operating profiles for 2BASE-TL PMEs.

The first 14 entries in this table SHALL always be defined as follows (see 802.3ah Annex 63A):

Profile index	MinRate (Kbps)	MaxRate (Kbps)	Power (dBm)	Region	Constellation	Comment
1	5696	5696	13.5	1	32-TCPAM	default
2	3072	3072	13.5	1	32-TCPAM	
3	2048	2048	13.5	1	16-TCPAM	
4	1024	1024	13.5	1	16-TCPAM	
5	704	704	13.5	1	16-TCPAM	
6	512	512	13.5	1	16-TCPAM	
7	5696	5696	14.5	2	32-TCPAM	
8	3072	3072	14.5	2	32-TCPAM	
9	2048	2048	14.5	2	16-TCPAM	
10	1024	1024	13.5	2	16-TCPAM	
11	704	704	13.5	2	16-TCPAM	
12	512	512	13.5	2	16-TCPAM	
13	192	5696	0	1	0	best effort
14	192	5696	0	2	0	best effort

These default entries SHALL be created during agent initialization and MUST NOT be deleted.

Entries following the first 14 can be dynamically created and deleted to provide custom administrative (configuration) profiles and automatic operating profiles.

This table MUST be maintained in a persistent manner."

REFERENCE

"[802.3ah] Annex 63A, 30.11.2.1.6"
 ::= { efmCuPme2B 2 }

efmCuPme2BProfileEntry OBJECT-TYPE

SYNTAX EfmCuPme2BProfileEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"Each entry corresponds to a single 2BASE-TL PME profile.

Each profile contains a set of parameters, used either for configuration or representation of a 2BASE-TL PME.

In case a particular profile is referenced via the efmCuPmeAdminProfile object (or efmCuAdminProfile if efmCuPmeAdminProfile is zero), it represents the desired parameters for the 2BaseTL-O PME initialization.

If a profile is referenced via an efmCuPmeOperProfile object, it represents the current operating parameters of an operational PME.

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 MUST NOT be removed."

INDEX { efmCuPme2BProfileIndex }

::= { efmCuPme2BProfileTable 1 }

EfmCuPme2BProfileEntry ::=

SEQUENCE {

efmCuPme2BProfileIndex	EfmProfileIndex,
efmCuPme2BProfileDescr	SnmpAdminString,
efmCuPme2BRegion	INTEGER,
efmCuPme2BsMode	EfmProfileIndexOrZero,
efmCuPme2BMinDataRate	Unsigned32,
efmCuPme2BMaxDataRate	Unsigned32,
efmCuPme2BPower	Unsigned32,
efmCuPme2BConstellation	INTEGER,
efmCuPme2BProfileRowStatus	RowStatus

}

efmCuPme2BProfileIndex OBJECT-TYPE

SYNTAX EfmProfileIndex

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."

::= { efmCuPme2BProfileEntry 1 }

efmCuPme2BProfileDescr OBJECT-TYPE

SYNTAX SnmpAdminString

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"A textual string containing information about a 2BASE-TL PME profile. The string may include information about the data rate and spectral limitations of this particular profile."

::= { efmCuPme2BProfileEntry 2 }

efmCuPme2BRegion OBJECT-TYPE

SYNTAX INTEGER {

region1(1),

region2(2)

}

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"Regional settings for a 2BASE-TL PME, as specified in the relevant Regional Annex of [G.991.2]. Regional settings specify the Power Spectral Density (PSD) mask and the Power Back-Off (PBO) values, and place limitations on the max allowed data rate, power, and constellation.

Possible values for this object are:

region1 - Annexes A and F (e.g., North America)

region2 - Annexes B and G (e.g., Europe)

Annex A/B specify regional settings for data rates 192-2304 Kbps using 16-TCPAM encoding.

Annex F/G specify regional settings for rates 2320-3840 Kbps using 16-TCPAM encoding and 768-5696 Kbps using 32-TCPAM encoding.

If a Clause 45 MDIO Interface to the PME is present, then this object partially maps to the Region bits in the 2B general parameter register."

REFERENCE

"[802.3ah] 45.2.1.42; [G.991.2] Annexes A, B, F and G"

::= { efmCuPme2BProfileEntry 3 }

efmCuPme2BsMode OBJECT-TYPE

SYNTAX EfmProfileIndexOrZero

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"Desired custom Spectral Mode for a 2BASE-TL PME. This object

is a pointer to an entry in efmCuPme2BsModeTable and a block of entries in efmCuPme2BRateReachTable, which together define (country-specific) reach-dependent rate limitations in addition to those defined by efmCuPme2BRegion.

The value of this object is the index of the referenced spectral mode.

The value of zero (default) indicates that no specific spectral mode is applicable.

Attempts to set this object to a value that is not the value of the index for an active entry in the corresponding spectral mode table MUST be rejected."

REFERENCE

"efmCuPme2BsModeTable, efmCuPme2BRateReachTable"

DEFVAL { 0 }

::= { efmCuPme2BProfileEntry 4 }

efmCuPme2BMinDataRate OBJECT-TYPE

SYNTAX Unsigned32(192..5696)

UNITS "Kbps"

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"Minimum Data Rate for the 2BASE-TL PME.

This object can take values of (n x 64)Kbps, where n=3..60 for 16-TCPAM and n=12..89 for 32-TCPAM encoding.

The data rate of the 2BASE-TL PME is considered 'fixed' when the value of this object equals that of efmCuPme2BMaxDataRate. If efmCuPme2BMinDataRate is less than efmCuPme2BMaxDataRate in the administrative profile, the data rate is considered 'adaptive', and SHALL be set to the maximum attainable rate not exceeding efmCuPme2BMaxDataRate, under the spectral limitations placed by the efmCuPme2BRegion and efmCuPme2BsMode.

Note that the current operational data rate of the PME is represented by the ifSpeed object of IF-MIB.

If a Clause 45 MDIO Interface to the PME is present, then this object maps to the Min Data Rate1 bits in the 2B PMD parameters register.

This object MUST be maintained in a persistent manner."

REFERENCE

"[802.3ah] 45.2.1.43"

::= { efmCuPme2BProfileEntry 5 }

efmCuPme2BMaxDataRate OBJECT-TYPE

SYNTAX Unsigned32(192..5696)

UNITS "Kbps"

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"Maximum Data Rate for the 2BASE-TL PME.

This object can take values of (n x 64)Kbps, where n=3..60 for 16-TCPAM and n=12..89 for 32-TCPAM encoding.

The data rate of the 2BASE-TL PME is considered 'fixed' when the value of this object equals that of efmCuPme2BMinDataRate. If efmCuPme2BMinDataRate is less than efmCuPme2BMaxDataRate in the administrative profile, the data rate is considered 'adaptive', and SHALL be set to the maximum attainable rate not exceeding efmCuPme2BMaxDataRate, under the spectral limitations placed by the efmCuPme2BRegion and efmCuPme2BsMode.

Note that the current operational data rate of the PME is represented by the ifSpeed object of IF-MIB.

If a Clause 45 MDIO Interface to the PME is present, then this object maps to the Max Data Rate1 bits in the 2B PMD parameters register.

This object MUST be maintained in a persistent manner."

REFERENCE

"[802.3ah] 45.2.1.43"

::= { efmCuPme2BProfileEntry 6 }

efmCuPme2BPower OBJECT-TYPE

SYNTAX Unsigned32(0|10..42)

UNITS "0.5 dBm"

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"Signal Transmit Power. Multiple of 0.5 dBm.

The value of 0 in the administrative profile means that the signal transmit power is not fixed and SHALL be set to maximize the attainable rate, under the spectral limitations placed by the efmCuPme2BRegion and efmCuPme2BsMode.

If a Clause 45 MDIO Interface to the PME is present, then this object maps to the Power1 bits in the 2B PMD parameters register."

REFERENCE

"[802.3ah] 45.2.1.43"

```
::= { efmCuPme2BProfileEntry 7 }
```

```
efmCuPme2BConstellation OBJECT-TYPE
```

```
SYNTAX      INTEGER {
```

```
    adaptive(0),
```

```
    tcpam16(1),
```

```
    tcpam32(2)
```

```
}
```

```
MAX-ACCESS  read-create
```

```
STATUS      current
```

```
DESCRIPTION
```

```
"TCPAM Constellation of the 2BASE-TL PME.
```

```
The possible values are:
```

```
    adaptive(0)      - either 16- or 32-TCPAM
```

```
    tcpam16(1)       - 16-TCPAM
```

```
    tcpam32(2)       - 32-TCPAM
```

The value of adaptive(0) in the administrative profile means that the constellation is not fixed and SHALL be set to maximize the attainable rate, under the spectral limitations placed by the efmCuPme2BRegion and efmCuPme2BsMode.

If a Clause 45 MDIO Interface to the PME is present, then this object maps to the Constellation1 bits in the 2B general parameter register."

```
REFERENCE
```

```
"[802.3ah] 45.2.1.43"
```

```
::= { efmCuPme2BProfileEntry 8 }
```

```
efmCuPme2BProfileRowStatus OBJECT-TYPE
```

```
SYNTAX      RowStatus
```

```
MAX-ACCESS  read-create
```

```
STATUS      current
```

```
DESCRIPTION
```

```
"This object controls the creation, modification, or deletion of the associated entry in the efmCuPme2BProfileTable per the semantics of RowStatus.
```

If an 'active' entry is referenced via efmCuAdminProfile or efmCuPmeAdminProfile instance(s), the entry MUST remain 'active'.

An 'active' entry SHALL NOT be modified. In order to modify an existing entry, it MUST be taken out of service (by setting this object to 'notInService'), modified, and set 'active' again."

```
::= { efmCuPme2BProfileEntry 9 }
```


efmCuPme2BsModeTable OBJECT-TYPE

SYNTAX SEQUENCE OF EfmCuPme2BsModeEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table, together with efmCu2BReachRateTable, supports definition of administrative custom spectral modes for 2BASE-TL PMEs, describing spectral limitations in addition to those specified by efmCuPme2BRegion.

In some countries, spectral regulations (e.g., UK ANFP) limit the length of the loops for certain data rates. This table allows these country-specific limitations to be specified.

Entries in this table referenced by the efmCuPme2BsMode MUST NOT be deleted until all the active references are removed.

This table MUST be maintained in a persistent manner."

REFERENCE

"efmCu2BReachRateTable"

::= { efmCuPme2B 3 }

efmCuPme2BsModeEntry OBJECT-TYPE

SYNTAX EfmCuPme2BsModeEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"Each entry specifies a spectral mode description and its index, which is used to reference corresponding entries in the efmCu2BReachRateTable.

Entries may be created/deleted using the row creation/deletion mechanism via efmCuPme2BsModeRowStatus."

INDEX { efmCuPme2BsModeIndex }

::= { efmCuPme2BsModeTable 1 }

EfmCuPme2BsModeEntry ::=

```
SEQUENCE {
    efmCuPme2BsModeIndex          EfmProfileIndex,
    efmCuPme2BsModeDescr          SnmpAdminString,
    efmCuPme2BsModeRowStatus      RowStatus
}
```

efmCuPme2BsModeIndex OBJECT-TYPE

SYNTAX EfmProfileIndex

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"2BASE-TL PME Spectral Mode index.

This object is the unique index associated with this spectral mode.

Entries in this table are referenced via the efmCuPme2BsMode object."

::= { efmCuPme2BsModeEntry 1 }

efmCuPme2BsModeDescr OBJECT-TYPE

SYNTAX SnmpAdminString

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"A textual string containing information about a 2BASE-TL PME spectral mode. The string may include information about corresponding (country-specific) spectral regulations and rate/reach limitations of this particular spectral mode."

::= { efmCuPme2BsModeEntry 2 }

efmCuPme2BsModeRowStatus OBJECT-TYPE

SYNTAX RowStatus

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This object controls creation, modification, or deletion of the associated entry in efmCuPme2BsModeTable per the semantics of RowStatus.

If an 'active' entry is referenced via efmCuPme2BsMode instance(s), the entry MUST remain 'active'.

An 'active' entry SHALL NOT be modified. In order to modify an existing entry, it MUST be taken out of service (by setting this object to 'notInService'), modified, and set 'active' again."

::= { efmCuPme2BsModeEntry 3 }

efmCuPme2BReachRateTable OBJECT-TYPE

SYNTAX SEQUENCE OF EfmCuPme2BReachRateEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table supports the definition of administrative custom spectral modes for 2BASE-TL PMEs, providing spectral limitations in addition to those specified by efmCuPme2BRegion.

The spectral regulations in some countries (e.g., UK ANFP) limit the length of the loops for certain data rates. This table allows these country-specific limitations to be specified.

Below is an example of this table for [ANFP]:

Equivalent Length (m)	MaxRate PAM16 (Kbps)	MaxRate PAM32 (Kbps)
975	2304	5696
1125	2304	5504
1275	2304	5120
1350	2304	4864
1425	2304	4544
1500	2304	4288
1575	2304	3968
1650	2304	3776
1725	2304	3520
1800	2304	3264
1875	2304	3072
1950	2048	2688
2100	1792	2368
2250	1536	0
2400	1408	0
2550	1280	0
2775	1152	0
2925	1152	0
3150	1088	0
3375	1024	0

Entries in this table referenced by an efmCuPme2BsMode instance MUST NOT be deleted.

This table MUST be maintained in a persistent manner."

REFERENCE

"[ANFP]"

::= { efmCuPme2B 4 }

efmCuPme2BReachRateEntry OBJECT-TYPE

SYNTAX EfmCuPme2BReachRateEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"Each entry specifies maximum 2BASE-TL PME data rates allowed for a certain equivalent loop length, when using

16-TCPAM or 32-TCPAM encoding.

When a 2BASE-TL PME is initialized, its data rate MUST NOT exceed one of the following limitations:

- the value of efmCuPme2BMaxDataRate
- maximum data rate allowed by efmCuPme2BRegion and efmCuPme2BPower
- maximum data rate for a given encoding specified in the efmCuPme2BsModeEntry, corresponding to the equivalent loop length, estimated by the PME

It is RECOMMENDED that the efmCuPme2BEquivalentLength values are assigned in increasing order, starting from the minimum value.

Entries may be created/deleted using the row creation/deletion mechanism via efmCuPme2ReachRateRowStatus."

```
INDEX { efmCuPme2BsModeIndex, efmCuPme2BReachRateIndex }
 ::= { efmCuPme2BReachRateTable 1 }
```

```
EfmCuPme2BReachRateEntry ::=
```

```
SEQUENCE {
    efmCuPme2BReachRateIndex          EfmProfileIndex,
    efmCuPme2BEquivalentLength        Unsigned32,
    efmCuPme2BMaxDataRatePam16        Unsigned32,
    efmCuPme2BMaxDataRatePam32        Unsigned32,
    efmCuPme2BReachRateRowStatus      RowStatus
}
```

```
efmCuPme2BReachRateIndex OBJECT-TYPE
```

```
SYNTAX      EfmProfileIndex
```

```
MAX-ACCESS  not-accessible
```

```
STATUS      current
```

```
DESCRIPTION
```

"2BASE-TL custom spectral mode Reach-Rate table index.

This object is the unique index associated with each entry."

```
 ::= { efmCuPme2BReachRateEntry 1 }
```

```
efmCuPme2BEquivalentLength OBJECT-TYPE
```

```
SYNTAX      Unsigned32(0..8192)
```

```
UNITS       "m"
```

```
MAX-ACCESS  read-create
```

```
STATUS      current
```

```
DESCRIPTION
```

"Maximum allowed equivalent loop's physical length in meters for the specified data rates.

An equivalent loop is a hypothetical 26AWG (0.4mm) loop with a perfect square root attenuation characteristic, without any

```

        bridged taps."
 ::= { efmCuPme2BReachRateEntry 2 }

efmCuPme2BMaxDataRatePam16 OBJECT-TYPE
    SYNTAX      Unsigned32(0|192..5696)
    UNITS       "Kbps"
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "Maximum data rate for a 2BASE-TL PME at the specified
        equivalent loop's length using TC-PAM16 encoding.
        The value of zero means that TC-PAM16 encoding should not be
        used at this distance."
 ::= { efmCuPme2BReachRateEntry 3 }

efmCuPme2BMaxDataRatePam32 OBJECT-TYPE
    SYNTAX      Unsigned32(0|192..5696)
    UNITS       "Kbps"
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "Maximum data rate for a 2BASE-TL PME at the specified
        equivalent loop's length using TC-PAM32 encoding.
        The value of zero means that TC-PAM32 encoding should not be
        used at this distance."
 ::= { efmCuPme2BReachRateEntry 4 }

efmCuPme2BReachRateRowStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This object controls the creation, modification, or deletion
        of the associated entry in the efmCuPme2BReachRateTable per
        the semantics of RowStatus.

        If an 'active' entry is referenced via efmCuPme2BsMode
        instance(s), the entry MUST remain 'active'.

        An 'active' entry SHALL NOT be modified.  In order to modify
        an existing entry, it MUST be taken out of service (by setting
        this object to 'notInService'), modified, and set 'active'
        again."
 ::= { efmCuPme2BReachRateEntry 5 }

-- 10PASS-TS specific PME group

```

efmCuPme10P OBJECT IDENTIFIER ::= { efmCuPme 6 }

efmCuPme10PProfileTable OBJECT-TYPE

SYNTAX SEQUENCE OF EfmCuPme10PProfileEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table supports definitions of configuration profiles for 10PASS-TS PMEs.

The first 22 entries in this table SHALL always be defined as follows (see 802.3ah Annex 62B.3, table 62B-1):

Profile Index	Bandplan PSDMask#	UPBO p#	BandNotch p#	DRate p#	URate p#	Comment
1	1	3	2,6,10,11	20	20	default profile
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 during agent initialization and MUST NOT be deleted.

Entries following the first 22 can be dynamically created and deleted to provide custom administrative (configuration) profiles and automatic operating profiles.

This table MUST be maintained in a persistent manner."

REFERENCE

"[802.3ah] Annex 62B.3, 30.11.2.1.6"
 ::= { efmCuPme10P 1 }

efmCuPme10PProfileEntry OBJECT-TYPE

SYNTAX EfmCuPme10PProfileEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"Each entry corresponds to a single 10PASS-TS PME profile.

Each profile contains a set of parameters, used either for configuration or representation of a 10PASS-TS PME.

In case a particular profile is referenced via the efmCuPmeAdminProfile object (or efmCuAdminProfile if efmCuPmeAdminProfile is zero), it represents the desired parameters for the 10PassTS-O PME initialization.

If a profile is referenced via an efmCuPmeOperProfile object, it represents the current operating parameters of the PME.

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 MUST NOT be removed."

INDEX { efmCuPme10PProfileIndex }

::= { efmCuPme10PProfileTable 1 }

EfmCuPme10PProfileEntry ::=

```
SEQUENCE {
    efmCuPme10PProfileIndex          EfmProfileIndex,
    efmCuPme10PProfileDescr          SnmpAdminString,
    efmCuPme10PBandplanPSDMskProfile INTEGER,
    efmCuPme10PUPBOReferenceProfile  INTEGER,
    efmCuPme10PBandNotchProfiles     BITS,
    efmCuPme10PPayloadDRateProfile    INTEGER,
    efmCuPme10PPayloadURateProfile    INTEGER,
    efmCuPme10PProfileRowStatus       RowStatus
}
```

efmCuPme10PProfileIndex OBJECT-TYPE

SYNTAX EfmProfileIndex

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."

```
::= { efmCuPme10PProfileEntry 1 }

efmCuPme10PProfileDescr OBJECT-TYPE
    SYNTAX      SnmpAdminString
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
        "A textual string containing information about a 10PASS-TS PME
        profile. The string may include information about data rate
        and spectral limitations of this particular profile."
    ::= { efmCuPme10PProfileEntry 2 }

efmCuPme10PBandplanPSDMskProfile OBJECT-TYPE
    SYNTAX  INTEGER {
        profile1(1),
        profile2(2),
        profile3(3),
        profile4(4),
        profile5(5),
        profile6(6),
        profile7(7),
        profile8(8),
        profile9(9),
        profile10(10),
        profile11(11),
        profile12(12),
        profile13(13),
        profile14(14),
        profile15(15),
        profile16(16),
        profile17(17),
        profile18(18),
        profile19(19),
        profile20(20),
        profile21(21),
        profile22(22),
        profile23(23),
        profile24(24),
        profile25(25),
        profile26(26),
        profile27(27),
        profile28(28),
        profile29(29),
        profile30(30)
    }
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
```


"The 10PASS-TS PME Bandplan and PSD Mask Profile, as specified in 802.3ah Annex 62A, table 62A-1. Possible values are:

Profile Name	PSD Mask	Bands 0/1/2/3/4/5	G.993.1 Bandplan
profile1(1)	T1.424 FTTCab.M1	x/D/U/D/U	A
profile2(2)	T1.424 FTTEEx.M1	x/D/U/D/U	A
profile3(3)	T1.424 FTTCab.M2	x/D/U/D/U	A
profile4(4)	T1.424 FTTEEx.M2	x/D/U/D/U	A
profile5(5)	T1.424 FTTCab.M1	D/D/U/D/U	A
profile6(6)	T1.424 FTTEEx.M1	D/D/U/D/U	A
profile7(7)	T1.424 FTTCab.M2	D/D/U/D/U	A
profile8(8)	T1.424 FTTEEx.M2	D/D/U/D/U	A
profile9(9)	T1.424 FTTCab.M1	U/D/U/D/x	A
profile10(10)	T1.424 FTTEEx.M1	U/D/U/D/x	A
profile11(11)	T1.424 FTTCab.M2	U/D/U/D/x	A
profile12(12)	T1.424 FTTEEx.M2	U/D/U/D/x	A
profile13(13)	TS 101 270-1 Pcab.M1.A	x/D/U/D/U	B
profile14(14)	TS 101 270-1 Pcab.M1.B	x/D/U/D/U	B
profile15(15)	TS 101 270-1 Pex.P1.M1	x/D/U/D/U	B
profile16(16)	TS 101 270-1 Pex.P2.M1	x/D/U/D/U	B
profile17(17)	TS 101 270-1 Pcab.M2	x/D/U/D/U	B
profile18(18)	TS 101 270-1 Pex.P1.M2	x/D/U/D/U	B
profile19(19)	TS 101 270-1 Pex.P2.M2	x/D/U/D/U	B
profile20(20)	TS 101 270-1 Pcab.M1.A	U/D/U/D/x	B
profile21(21)	TS 101 270-1 Pcab.M1.B	U/D/U/D/x	B
profile22(22)	TS 101 270-1 Pex.P1.M1	U/D/U/D/x	B
profile23(23)	TS 101 270-1 Pex.P2.M1	U/D/U/D/x	B
profile24(24)	TS 101 270-1 Pcab.M2	U/D/U/D/x	B
profile25(25)	TS 101 270-1 Pex.P1.M2	U/D/U/D/x	B
profile26(26)	TS 101 270-1 Pex.P2.M2	U/D/U/D/x	B
profile27(27)	G.993.1 F.1.2.1	x/D/U/D/U	Annex F
profile28(28)	G.993.1 F.1.2.2	x/D/U/D/U	Annex F
profile29(29)	G.993.1 F.1.2.3	x/D/U/D/U	Annex F
profile30(30)	T1.424 FTTCab.M1 (ext.)	x/D/U/D/U/D	Annex A

"

REFERENCE

"[802.3ah] Annex 62A"

::= { efmCuPme10PProfileEntry 3 }

efmCuPme10PUPBReferenceProfile OBJECT-TYPE

```
SYNTAX INTEGER {
    profile0(0),
    profile1(1),
    profile2(2),
    profile3(3),
```

```

    profile4(4),
    profile5(5),
    profile6(6),
    profile7(7),
    profile8(8),
    profile9(9)
}
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
    "The 10PASS-TS PME Upstream Power Back-Off (UPBO) Reference
    PSD Profile, as specified in 802.3 Annex 62A, table 62A-3.
    Possible values are:
    -----+-----
    Profile Name      Reference PSD
    -----+-----
    profile0(0)      no profile
    profile1(1)      T1.424          Noise A      M1
    profile2(2)      T1.424          Noise A      M2
    profile3(3)      T1.424          Noise F      M1
    profile4(4)      T1.424          Noise F      M2
    profile5(5)      TS 101 270-1    Noise A&B
    profile6(6)      TS 101 270-1    Noise C
    profile7(7)      TS 101 270-1    Noise D
    profile8(8)      TS 101 270-1    Noise E
    profile9(9)      TS 101 270-1    Noise F
    -----+-----
    "
REFERENCE
    "[802.3ah] Annex 62A.3.5"
 ::= { efmCuPme10PProfileEntry 4 }

```

efmCuPme10PBandNotchProfiles OBJECT-TYPE

```

SYNTAX BITS {
    profile0(0),
    profile1(1),
    profile2(2),
    profile3(3),
    profile4(4),
    profile5(5),
    profile6(6),
    profile7(7),
    profile8(8),
    profile9(9),
    profile10(10),
    profile11(11)
}
MAX-ACCESS    read-create

```

STATUS current

DESCRIPTION

"The 10PASS-TS PME Egress Control Band Notch Profile bitmap, as specified in 802.3 Annex 62A, table 62A-4. Possible values are:

Profile Name	G.991.3 table	T1.424 table	TS 101 table	270-1	StartF (MHz)	EndF (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, a value of 0x2230 selects profiles 2, 6, 10, and 11."

REFERENCE

"[802.3ah] Annex 62A.3.5"

::= { efmCuPme10PPProfileEntry 5 }

efmCuPme10PPayloadDRateProfile OBJECT-TYPE

SYNTAX INTEGER {

profile5(5),
profile10(10),
profile15(15),
profile20(20),
profile25(25),
profile30(30),
profile50(50),
profile70(70),
profile100(100),
profile140(140),
profile200(200)

}

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The 10PASS-TS PME Downstream Payload Rate Profile, as

specified in 802.3 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."

REFERENCE

"[802.3ah] Annex 62A.3.6"

::= { efmCuPme10PPProfileEntry 6 }

efmCuPme10PPayloadURateProfile OBJECT-TYPE

SYNTAX INTEGER {

```

profile5(5),
profile10(10),
profile15(15),
profile20(20),
profile25(25),
profile30(30),
profile50(50),
profile70(70),
profile100(100)

```

}

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The 10PASS-TS PME Upstream Payload Rate Profile, as specified in 802.3 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."

REFERENCE

"[802.3ah] Annex 62A.3.6"

::= { efmCuPme10PProfileEntry 7 }

efmCuPme10PProfileRowStatus OBJECT-TYPE

SYNTAX RowStatus

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This object controls creation, modification, or deletion of the associated entry in efmCuPme10PProfileTable 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.

An 'active' entry SHALL NOT be modified. In order to modify an existing entry, it MUST be taken out of service (by setting this object to 'notInService'), modified, and set 'active' again."

::= { efmCuPme10PProfileEntry 8 }

efmCuPme10PStatusTable OBJECT-TYPE

SYNTAX SEQUENCE OF EfmCuPme10PStatusEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table provides status information of EFMCu 10PASS-TS PMEs (modems).

This table contains live data from the equipment. As such, it is NOT persistent."

::= { efmCuPme10P 2 }

efmCuPme10PStatusEntry OBJECT-TYPE

SYNTAX EfmCuPme10PStatusEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry in the EFMCu 10PASS-TS PME Status table."

INDEX { ifIndex }

```
::= { efmCuPme10PStatusTable 1 }
```

```
EfmCuPme10PStatusEntry ::=
```

```
SEQUENCE {
    efmCuPme10PFECCorrectedBlocks      Counter32,
    efmCuPme10PFECUncorrectedBlocks    Counter32
}
```

```
efmCuPme10PFECCorrectedBlocks OBJECT-TYPE
```

```
SYNTAX Counter32
```

```
MAX-ACCESS read-only
```

```
STATUS current
```

```
DESCRIPTION
```

"The number of received and corrected Forward Error Correction (FEC) codewords in this 10PASS-TS PME.

This object maps to the 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.

Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of ifCounterDiscontinuityTime, defined in IF-MIB."

```
REFERENCE
```

"[802.3ah] 45.2.1.22, 30.11.2.1.8"

```
::= { efmCuPme10PStatusEntry 1 }
```

```
efmCuPme10PFECUncorrectedBlocks OBJECT-TYPE
```

```
SYNTAX Counter32
```

```
MAX-ACCESS read-only
```

```
STATUS current
```

```
DESCRIPTION
```

"The number of received uncorrectable FEC codewords in this 10PASS-TS PME.

This object maps to the 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.

Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times

```

        as indicated by the value of ifCounterDiscontinuityTime,
        defined in IF-MIB."
REFERENCE
    "[802.3ah] 45.2.1.23, 30.11.2.1.9"
    ::= { efmCuPme10PStatusEntry 2 }

--
-- Conformance Statements
--

efmCuGroups          OBJECT IDENTIFIER ::= { efmCuConformance 1 }

efmCuCompliances OBJECT IDENTIFIER ::= { efmCuConformance 2 }

-- Object Groups

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

efmCuPAFGroup OBJECT-GROUP
    OBJECTS {
        efmCuPeerPAFSupported,
        efmCuPAFCapacity,
        efmCuPeerPAFCapacity,
        efmCuPAFAdminState,
        efmCuPAFDiscoveryCode,
        efmCuPAFRemoteDiscoveryCode,
        efmCuNumPMEs
    }
    STATUS      current
    DESCRIPTION
        "A collection of objects supporting OPTIONAL PME
        Aggregation Function (PAF) and PAF discovery in EFMCu ports."
    ::= { efmCuGroups 2 }

```

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 3 }

efmCuPmeGroup OBJECT-GROUP

OBJECTS {

efmCuPmeAdminProfile,
efmCuPmeOperStatus,
efmCuPmeFltStatus,
efmCuPmeSubTypesSupported,
efmCuPmeAdminSubType,
efmCuPmeOperSubType,
efmCuPAFRemoteDiscoveryCode,
efmCuPmeOperProfile,
efmCuPmeSnrMgn,
efmCuPmePeerSnrMgn,
efmCuPmeLineAtn,
efmCuPmePeerLineAtn,
efmCuPmeEquivalentLength,
efmCuPmeTCCodingErrors,
efmCuPmeTCCrcErrors,
efmCuPmeThreshLineAtn,
efmCuPmeThreshSnrMgn

}

STATUS current

DESCRIPTION

"A collection of objects providing information about
a 2BASE-TL/10PASS-TS PME."

::= { efmCuGroups 4 }

efmCuAlarmConfGroup OBJECT-GROUP

OBJECTS {

efmCuThreshLowRate,
efmCuLowRateCrossingEnable,
efmCuPmeThreshLineAtn,


```

    efmCuPmeLineAtnCrossingEnable,
    efmCuPmeThreshSnrMgn,
    efmCuPmeSnrMgnCrossingEnable,
    efmCuPmeDeviceFaultEnable,
    efmCuPmeConfigInitFailEnable,
    efmCuPmeProtocolInitFailEnable
}
STATUS          current
DESCRIPTION
    "A collection of objects supporting configuration of alarm
    thresholds and notifications in EFMCu ports."
::= { efmCuGroups 5 }

```

```

efmCuNotificationGroup NOTIFICATION-GROUP
NOTIFICATIONS {
    efmCuLowRateCrossing,
    efmCuPmeLineAtnCrossing,
    efmCuPmeSnrMgnCrossing,
    efmCuPmeDeviceFault,
    efmCuPmeConfigInitFailure,
    efmCuPmeProtocolInitFailure
}
STATUS          current
DESCRIPTION
    "This group supports notifications of significant conditions
    associated with EFMCu ports."
::= { efmCuGroups 6 }

```

```

efmCuPme2BProfileGroup OBJECT-GROUP
OBJECTS {
    efmCuPme2BProfileDescr,
    efmCuPme2BRegion,
    efmCuPme2BsMode,
    efmCuPme2BMinDataRate,
    efmCuPme2BMaxDataRate,
    efmCuPme2BPower,
    efmCuPme2BConstellation,
    efmCuPme2BProfileRowStatus,
    efmCuPme2BsModeDescr,
    efmCuPme2BsModeRowStatus,
    efmCuPme2BEquivalentLength,
    efmCuPme2BMaxDataRatePam16,
    efmCuPme2BMaxDataRatePam32,
    efmCuPme2BReachRateRowStatus
}
STATUS          current
DESCRIPTION
    "A collection of objects that constitute a configuration

```

```

    profile for configuration of 2BASE-TL ports."
    ::= { efmCuGroups 7}

```

efmCuPme10PProfileGroup OBJECT-GROUP

```

    OBJECTS {
        efmCuPme10PProfileDescr,
        efmCuPme10PBandplanPSDMskProfile,
        efmCuPme10PUPBORreferenceProfile,
        efmCuPme10PBandNotchProfiles,
        efmCuPme10PPayloadDRateProfile,
        efmCuPme10PPayloadURateProfile,
        efmCuPme10PProfileRowStatus
    }
    STATUS      current
    DESCRIPTION
        "A collection of objects that constitute a configuration
        profile for configuration of 10PASS-TS ports."
    ::= { efmCuGroups 8 }

```

efmCuPme10PStatusGroup OBJECT-GROUP

```

    OBJECTS {
        efmCuPme10PFECCorrectedBlocks,
        efmCuPme10PFECUncorrectedBlocks
    }
    STATUS      current
    DESCRIPTION
        "A collection of objects providing status information
        specific to 10PASS-TS PMEs."
    ::= { efmCuGroups 9 }

```

-- 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 REQUIRED:

```

MIB Module	Compliance Statement
-----	-----
IF-MIB	ifCompliance3
EtherLike-MIB	dot3Compliance2
MAU-MIB	mauModIfCompl3

```

    Compliance with the following external compliance statements
    is OPTIONAL for implementations supporting PME Aggregation
    Function (PAF) with flexible cross-connect between the PCS

```

and PME ports:

MIB Module	Compliance Statement
-----	-----
IF-INVERTED-STACK-MIB	ifInvCompliance
IF-CAP-STACK-MIB	ifCapStackCompliance"

```
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          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 ieee2BaseTLR or ieee10PassTSO 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."

OBJECT efmCuAdaptiveSpectra

MIN-ACCESS read-only

DESCRIPTION

"Write access is OPTIONAL. For PHYs without write access, the default value SHOULD be false."

::= { efmCuCompliances 1 }

END

7. Security Considerations

There is a number of managed objects defined in the EFM-CU-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:

- o Changing of efmCuPmeAdminSubType may lead to a potential locking of the link, as peer PMEs of the same subtype cannot exchange handshake messages.
- o Changing of efmCuPAFAdminState to enabled may lead to a potential locking of the link, if the peer PHY does not support PAF.
- o Changing of efmCuPAFDiscoveryCode, before the discovery operation, may lead to a wrongful discovery, for example, when two -O ports are connected to the same multi-PME -R port and both -O ports have the same Discovery register value.

- o 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.
- o 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.
- o Removal of a PME from an operationally 'up' EFMCu port, aggregating several PMEs, may cause port's rate degradation.

The user of the EFM-CU-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 the EFM-CU-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 eavesdrop to an EFMCu transmission simply by "listening" to a cross-talk from the EFMCu pairs, especially if the parameters of the EFMCu link in question are known.

In such environments, it is important to control also 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 these MIB modules.

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 these MIB modules 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.

8. IANA Considerations

Object identifiers for the efmCuMIB MODULE-IDENTITY and ifCapStackMIB MODULE-IDENTITY have been allocated by IANA in the MIB-2 sub-tree.

9. Acknowledgments

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