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



## Copyright Notice



## Abstract

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

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## 1. Introduction

New Ethernet like interfaces have been defined in the Institute of Electrical and Electronics Engineers (IEEE) 802.3ah project a.k.a. Ethernet in the First Mile (EFM) [802.3ah]. In particular 2Base-TL and 10Pass-TS physical interfaces (PHYs), defined over voice-grade copper pairs, have been specified for the long and short reach respectively. These interfaces, collectively called EFMCu, support variable rates and optional Physical Medium Instance (PMI) aggregation (multi-pair bonding).

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

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

## 2. The Internet-Standard Management Framework

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

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

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

## 3. Relation to Interfaces Group MIB

This section specifies how the ifStackTable, as defined in the IF-MIB [RFC2863] and ifInvStackTable, as defined in the IF-INVERTED-STACK-MIB [RFC2864] are used for the EFMCu application.

### 3.1 Layering Model

An EFMCu interface can aggregate up to 32 Physical Medium Instance (PMI) sublayer devices (modems), using so called PMI Aggregation Function (PAF).

*EdNote: Change all occurrences of PMI to PME after 802.3ah/D3.1 is out as per resolution of comment 160.*

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

Each PMI comprising an aggregated EFMCu port is represented in the Interface table as a separate port with ifType of shdsl(169) for 2Base-TL or vdsl(97) for 10Pass-TS. The ifType values are defined in IANAifType-MIB. ifSpeed for each PMI shall return an actual bitrate of the active PMI or a configured bitrate for pre-activated modems (note that unassigned PMI has its default bitrate).

The ifStackTable is indexed by the ifIndex values of the aggregated EFMCu port (PCS) and the PMIs connected to it. ifStackTable allows a Network Management application to determine which PMIs 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 PMI.

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

*EdNote: An alternative would be to use ifStackTable to describe cross-connect capability and efmCuAvailableStackTable to describe actual connections, so that the cross-connect action would be done in the EFM-CU-MIB by modifying the efmCuAvailableStackTable (and not in IF-MIB).*

### 3.2 PMI Aggregation Function (PAF)

The PMI Aggregation Function (PAF) is optional and may not be supported. Note however that it is mandatory for the agent to report on the PAF capability for all EFMCu ports (2BASE-TL and 10PASS-TS).

*EdNote: Add more info.*

### 3.3 Discovery Operation

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

Two tables are used by Discovery mechanism: ifStackTable and efmCuAvailableStackTable defined. The following pseudo-code defines an example of Discovery for a generic PAF enabled multi-PCS EFMCu device, located at Central Office (CO):

```
foreach PCS[i] in Device
{ if ( PCS[i].PAFSupported ) // Discover only on ports supporting  PAF
    { dc = PCS[i].DiscoveryCode = MAC[i]; // unique 6 byte code per PCS
      // go over all currently disconnected PMIs, which can
      // pottentially be connected to PCS[i]
      foreach PMI[j] in efmCuAvailableStackTable[PCS[i]] and
                     not in ifStackTable[PCS[i]]
        { PMI[j].RemoteDiscoveryCode = dc;   // Set if Clear
          r = PMI[j].RemoteDiscoveryCode;    // Get
          if ( r == dc )
            { // Remote CPE connected via PMI[j] is/was a peer for
              // PCS[i]. Connect this PMI to the PCS
              Add PMI[j] to ifStackTable[PCS[i]];
              // Discover all other currently disconnected PMIs,
              // attached to the same CPE and connect them to the PCS
              foreach PMI[k] in efmCuAvailableStackTable[PCS[i]] and
                             not in ifStackTable[PCS[i]]
                { r = PMI[k].RemoteDiscoveryCode;    // Get
                  if ( r == dc )
                    Add PMI[k] to ifStackTable[PCS[i]];
                }
            }
          // Discovered all PMIs which lead to the same CPE and
          // connected them to PCS[i]. Go to the next PCS.
          break;
        }
    }
}
```

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

Adding a PMI to the ifStackTable row for a specific PCS, involves actual connection of the PMI to the PCS, which can be done by

modifying Clause 45 PMI_Aggregate_register (see [802.3ah] 61.1.5.3 and 45.2.3.21).

### 3.4 Relation to SHDSL MIB

SHDSL modems, similar to PMI(s) comprising a 2BaseTL port are described in HDSL2-SHDSL-LINE-MIB [RFC3276]. While HDSL2-SHDSL-LINE-MIB describes standard G.SHDSL modems according to ITU-T G.991.2, IEEE 802.3ah uses soon to be approved G.SHDSL.bis spec, extended to support higher constellations and rates. In addition not all attributes of G.SHDSL modems reflected in HDSL2-SHDSL-LINE-MIB have adequate management objects in the EFM standards.

Because of these differences and for the purposes of simplicity and name consistency it was decided not to reference HDSL2-SHDSL-LINE-MIB objects, but define all the relevant objects in this MIB.

### 3.5 Relation to VDSL MIB

PMI(s) comprising a 10PassTS port are described in VDSL-LINE-MIB [I-D.ietf-adslmib-vdsl]. In cases where VDSL-LINE-MIB and 802.3ah differ, the definitions in 802.3ah take precedence.

Because of these differences and for the purposes of simplicity and name consistency it was decided not to reference VDSL-LINE-MIB objects, but define all the relevant objects in this MIB.

### 3.6 Relation to Ethernet-Like and MAU MIBs

The implementation of EtherLike-MIB [RFC3635] and MAU-MIB [RFC3636] is REQUIRED for the EFMCu interfaces. As such EFMCu interfaces 2Base-TL/10Pass-TS SHALL return an ifType of ethernetCsmacd(6). Information on the particular flavor of EFMCu that an interface is running is available from ifSpeed in the IF-MIB [RFC2863], and ifMauType in the MAU-MIB.

The MAU-MIB shall be augmented to include the following new values for ifMauType (instances of dot2MauType):

- dot3MauType2BaseTL - voice grade UTP Phy specified in Clause 61 and 63
- dot3MauType10PassTS - voice grade UTP Phy specified in Clause 61 and 62
- *EdNote: Should we also include -O/-R subtypes?*

### 3.7 Mapping of IEEE 802.3ah Managed Objects

This section contains the mapping between managed objects defined in [802.3ah] Clause 30, and managed objects defined in this document and in associated MIB modules, i.e., the IF-MIB [RFC2863] and the MAU-MIB [RFC3636].

IEEE 802.3 Managed Object Corresponding SNMP Object

*EdNote: Add the table here.*

## 4. Definitions

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

  IMPORTS
      MODULE-IDENTITY, OBJECT-TYPE,
      Gauge32, Integer32, transmission
          FROM SNMPv2-SMI
      TruthValue, RowStatus, PhysAddress
          FROM SNMPv2-TC
      ifIndex, InterfaceIndexOrZero
          FROM IF-MIB
      MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
          FROM SNMPv2-CONF
      ;

   efmCuMIB MODULE-IDENTITY
       LAST-UPDATED "200401130000Z"  -- January 13, 2004
           ORGANIZATION "IETF Ethernet Interfaces and Hub MIB
                         Working Group"
           CONTACT-INFO
              "WG charter:
                 http://www.ietf.org/html.charters/hubmib-charter.html

               Mailing Lists:
                 General Discussion: hubmib@ietf.org
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DESCRIPTION

"The objects in this MIB module are used to manage the Ethernet in the First Mile (EFM) Copper (EFMCu) Interfaces 2BASE-TL and 10PASS-TS, defined in IEEE Draft P802.3ah/D3.0.

The following reference is used throughout this MIB module:

[802.3ah] refers to:
IEEE Draft P802.3ah/D3.0: 'Draft amendment to - Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications - Media Access Control Parameters, Physical Layers and Management Parameters for subscriber access networks', 05 December 2003.

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

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 - PMI Aggregation Function
PCS - Physical Coding Sublayer
PMD - Physical Medium Dependent
PMI - Physical Medium Instance
PSD - Power Spectral Density
SNR - Signal to Noise Ratio

```
            itself for full legal notices."

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

        REVISION    "200401130000Z"  -- January 13, 2004
        DESCRIPTION "Initial version, published as RFC XXXX."

        ::= { mib-2 YYY }

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

    -- Sections of the module

    efmCuObjects     OBJECT IDENTIFIER ::= { efmCuMIB 1 }

    efmCuConformance OBJECT IDENTIFIER ::= { efmCuMIB 2 }

    -- Groups in the module

    efmCuPort        OBJECT IDENTIFIER ::= { efmCuObjects 1 }

    efmCuPmi         OBJECT IDENTIFIER ::= { efmCuObjects 2 }

    -- PCS Port group

    efmCuPortTable OBJECT-TYPE
        SYNTAX  SEQUENCE OF EfmCuPortEntry
        MAX-ACCESS  not-accessible
        STATUS  current
        DESCRIPTION
           "Table for EFMCu 2BaseTL/10PassTS (PCS) Ports."
         ::= { efmCuPort 1 }

    efmCuPortEntry OBJECT-TYPE
        SYNTAX  EfmCuPortEntry
        MAX-ACCESS  not-accessible
        STATUS  current
        DESCRIPTION
           "An entry in the EFMCu Port table."
        INDEX  { ifIndex }
         ::= { efmCuPortTable 1 }

    EfmCuPortEntry ::=
        SEQUENCE {
            efmCuStatus                     BITS,
            efmCuPortSidesSupported         INTEGER,
```

```
            efmCuPortSide                   INTEGER,
            efmCuPAFSupported               TruthValue,
            efmCuRemotePAFSupported         TruthValue,
            efmCuPAFAdminState              INTEGER,
            efmCuPAFDiscoveryCode           PhysAddress
        }

    efmCuStatus  OBJECT-TYPE
        SYNTAX  BITS {
             noPmi(0),               -- no PMI has been assigned to the PCS
             noRemotePMI(1),         -- no peer PMI present
             lossOfSignal(2),        -- Loss of Signal
             lossOfPower (3),        -- Loss of Power
             lossOfFraming(4),       -- Loss of Framing
             lossOfRemoteFraming(5), -- Remote Loss of Framing
             snrMgnDefect(6),        -- SNR Margin Violation
             snrMgnRemoteDefect(7),  -- Remote SNR Margin Violation
             lineAtnDefect(8),       -- Loop Attenuation Violation
             lineAtnRemoteDefect(9), -- Remote Loop Attenuation Violation
             deviceFault(10),        -- vendor-dependent diag fault
             configInitFailure(11),  -- configuration initialization failure
             protocolInitFailure(12), -- protocol initialization failure
             pafDefect(13)           -- PAF related defect
            }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
           "EFMCu (PCS) port Status. This is a bitmap of possible conditions.
           The various bit positions are:
             noPmi               - no PMI has been assigned to the PCS
                                   (in case of PAF)
             noRemotePMI           - one or more PMIs in the aggregation
group
                                   indicate no peer PMI present
             lossOfSignal        - one or more PMIs in the aggregation group
                                   indicate Loss of Signal
             lossOfPower         - one or more PMIs in the aggregation group
                                   indicate Loss of Power
             lossOfFraming       - one or more PMIs in the aggregation group
                                   indicate Loss of Framing
             lossOfRemoteFraming - one or more PMIs in the aggregation group
                                   indicate Remote Loss of Framing
             snrMgnDefect        - one or more PMIs in the aggregation group
                                   indicate SNR Margin Violation
             snrMgnRemoteDefect  - one or more PMIs in the aggregation group
                                   indicate Remote SNR Margin Violation
             lineAtnDefect       - one or more PMIs in the aggregation group
                                   indicate Loop Attenuation Violation
```

lineAtnRemoteDefect - one or more PMIs in the aggregation group

```
                                  indicate Remote Loop Attenuation Violation
               deviceFault        - one or more PMIs in the aggregation group
                                  indicate vendor-dependent diag fault.
               configInitFailure  - one or more PMIs in the aggregation group
                                  indicate configuration initialization
failure.
                                  (e.g. the Peer PMI could not support
                                  configuration requested during init).
               protocolInitFailure - one or more PMIs in the aggregation group
                                  indicate protocol initialization failure.
               pafDefect          - PAF related defect
                                  -- EdNote: Do we need that? When do we
clear
                                  -- this bit?

            This is intended to supplement ifOperStatus.

            If a Clause 45 MDIO Interface to the PMI is present, then this
            attribute will consolidate various PMA/PMD registers, namely
            TBD"
            -- EdNote: Add relevant registers to Clauses 45,30. Reference them
            -- instead of TBD.
         REFERENCE
            "[802.3ah] "
         ::= { efmCuPortEntry 1 }

      efmCuPortSidesSupported  OBJECT-TYPE
         SYNTAX  INTEGER {
                  subscriber(1),
                  office(2),
                  both(3)
         }
         MAX-ACCESS  read-only
         STATUS      current
         DESCRIPTION
            "EFM port supported mode of operation (subtype).
            The value of 'subscriber' indicates that the port supports
            'CPE' or '-R' subtype.
            The value of 'office' indicates that the port supports
            'CO' or '-O' subtype.
            The value of 'both' indicates that the port supports both
            'CO' and 'CPE' subtypes.
            An actual mode of operation is determined by ifPhySide.

            If a Clause 45 MDIO Interface to the PCS is present, then this
            attribute will map to the CO supported and CPE supported
            bits in the 10P/2B capability register"
         REFERENCE
```

```
            "[802.3ah] 61.1, 45.2.3.17.2, 45.2.3.17.3"
          ::= { efmCuPortEntry 2 }
```

```
      efmCuPortSide  OBJECT-TYPE
          SYNTAX  INTEGER {
                   subscriber(1),
                   office(2)
                }
          MAX-ACCESS  read-write
          STATUS      current
          DESCRIPTION
             "EFM port mode of operation (subtype).
             The value of 'subscriber' indicates the port is designated as
             the 'CPE' or '-R' subtype.
             The value of the 'office' indicates that the port is
             designated as the 'CO' or '-O' subtype.

             Changing efmCuPortSide is a traffic disruptive operation and
             as such shall be done when the link is Down. Attempts to
             change this object shall be ignored if the link is Up or
             Initializing.
             Attempts to change this object to an unsupported subtype shall
             be ignored.

             If a Clause 45 MDIO Interface to the PCS is present, then this
             attribute will map to the Port sub-type select bit in the
             10P/2B capability register"
          REFERENCE
             "[802.3ah] 61.1, 45.2.3.17.1"
          ::= { efmCuPortEntry 3 }

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

             If a Clause 45 MDIO Interface to the PCS is present,
             then this attribute will map to the PAF available bit in the
             10P/2B capability register."
          REFERENCE
             "[802.3ah] 61.2.2, 45.2.3.17.4"
          ::= { efmCuPortEntry 4 }

      efmCuRemotePAFSupported  OBJECT-TYPE
          SYNTAX      TruthValue
```

```
          MAX-ACCESS  read-only
          STATUS      current
          DESCRIPTION
             "PMI 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
             PMI aggregation on the available PMIs.
             Ports incapable of PAF shall return a value of false(2).

             If a Clause 45 MDIO Interface to the PCS is present,
             then this attribute will map to the Remote PAF supported bit in
the
             10P/2B capability register."
          REFERENCE
             "[802.3ah] 61.2.2, 45.2.3.17.5"
          ::= { efmCuPortEntry 5 }

      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', PMI Aggregation will not be performed by the
             PCS.
             When 'enabled', PAF will be performed by the PCS when the link
             is Up, even on a single PMI, if PAF is supported.
             PCS ports incapable of supporting PAF shall return a value of
             'disabled'. Attempts to 'enable' such port shall be ignored.

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

             If a Clause 45 MDIO Interface to the PCS is present, then this
             attribute will map to the PAF enable bit in the 10P/2B
             capability register"
          REFERENCE
             "[802.3ah] 61.2.2, 45.2.3.17.6"
          ::= { efmCuPortEntry 6 }

      efmCuPAFDiscoveryCode  OBJECT-TYPE
          SYNTAX      PhysAddress
```

```
          MAX-ACCESS  read-write
```

```
        STATUS      current
        DESCRIPTION
           "PAF Discovery Code of the EFMCu port (PCS).
           A unique 6 Byte long code used by the Discovery function.
           This object must be instantiated for the CO subtype PCS before
           writing operations on the PAFRemoteDiscoveryCode
           (Set_if_Clear and Clear_if_Same) are performed by PMIs
           associated with the PCS.
           The value of this object is read-only for CPE port subtypes.
           (The initial value of this object for CPE ports after reset
           is 0).

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

           If a Clause 45 MDIO Interface to the PCS is present, then this
           attribute will map to the Aggregaion Discovery Code registers"
        REFERENCE
           "[802.3ah] 61.2.2.8.3, 45.2.1.13"
        ::= { efmCuPortEntry 7 }


    -- The PMI group

    efmCuPmiTable OBJECT-TYPE
        SYNTAX  SEQUENCE OF EfmCuPmiEntry
        MAX-ACCESS  not-accessible
        STATUS  current
        DESCRIPTION
           "Table for EFMCu 2BaseTL/10PassTS PMIs (modems). Common part"
         ::= { efmCuPmi 1 }

    efmCuPmiEntry OBJECT-TYPE
        SYNTAX  EfmCuPmiEntry
        MAX-ACCESS  not-accessible
        STATUS  current
        DESCRIPTION
           "An entry in the EFMCu PMI Common table."
        INDEX  { ifIndex }
         ::= { efmCuPmiTable 1 }

    EfmCuPmiEntry ::=
      SEQUENCE {
        efmCuPmiStatus                BITS,
        efmCuPAFRemoteDiscoveryCode   PhysAddress,
        efmCuPmiSnrMgn                Integer32,
        efmCuPmiRemoteSnrMgn          Integer32,
```

```
          efmCuPmiLineAtn              Integer32,
          efmCuPmiRemoteLineAtn        Integer32,
          efmCuPmiThreshLineAtn        Integer32,
          efmCuPmiThreshSnrMgn         Integer32
        }

      efmCuPmiStatus  OBJECT-TYPE
          SYNTAX  BITS {
              unassigned(0),          -- detached from PCS in case of PAF
              noRemotePmi(1),         -- no peer PMI present
              lossOfSignal(2),        -- Loss of Signal
              lossOfPower(3),         -- Loss of Power
              lossOfFraming(4),       -- Loss of Framing
              lossOfRemoteFraming(5), -- Loss of Framing at peer PMD
              snrMgnDefect(6),        -- SNR Margin dropped below Threshold
              snrMgnRemoteDefect(7),  -- Peer SNR Margin dropped below
Threshold
                                      -- at the peer PMI
              lineAtnDefect(8),       -- Line Attenuation exceeds Threshold
              lineAtnRemoteDefect(9), -- Remote Line Attenuation exceeds
Threshold
              deviceFault(10),        -- Vendor-dependent diag or self-test
fault
              configInitFailure(11),  -- configuration initialization failure
              protocolInitFailure(12) -- protocol initialization failure
          }
          MAX-ACCESS  read-only
          STATUS      current
          DESCRIPTION
             "Current PMI link Status. This is a bitmap of possible conditions.
             The various bit positions are:
               unassigned            - disconnected from PCS in case of PAF
               noRemotePmi          - no peer PMI present, the PMI didn't
                                      detect Handshake tones from its peer
                                      during initialization.
               lossOfSignal          - Loss of Signal
               lossOfPower           - Loss of Power
               lossOfFraming         - Loss of Framing for 10P or
                                      Loss of Sync word for 2B PMD or
                                      Loss of 64/65B Framing
               lossOfRemoteFraming   - Loss of Synchronization word at the peer
PMD
               snrMgnDefect          - SNR Margin dropped below the Threshold
               snrMgnRemoteDefect    - SNR Margin dropped below the Threshold
                                      at the peer PMI
               lineAtnDefect         - Line Attenuation exceeds the Threshold
               lineAtnRemoteDefect   - Line Attenuation exceeds the Threshold
                                      at the peer PMI
```

```
deviceFault           - Indicates a vendor-dependent
                        diagnostic or self-test fault
                        has been detected.
configInitFailure     - configuration initialization failure.
```

```
                                    the Peer PMI could not support
                                    configuration requested during init.
                protocolInitFailure - protocol initialization failure.
                                    due to incompatible protocol used by
                                    the Peer PMI during init (that could
happen
                                    if a peer PMD is G.SDHSL/VDSL modem for
                                    2BaseTL/10PassTS PMI respectivelly).

              This is intended to supplement ifOperStatus.  Note that there
              is a 1-1 relationship between the status bits defined in this
              object and the notification thresholds defined elsewhere in
              this MIB.

              If a Clause 45 MDIO Interface to the PMI is present, then this
              attribute will consolidate various PMA/PMD registers, namely
              PMA/PMD status 1 register, 10P incoming indicator bits status
              register, 2B state defects register"
              -- EdNote: Add relevant registers to Clause 45/30. Reference them.
          REFERENCE
              "[802.3ah] 45.2.1.2, 45.2.1.33, 45.2.1.42"
          ::= { efmCuPmiEntry 1 }

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

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

              If a Clause 45 MDIO Interface to the PCS is present, then this
```

attribute is a function of Aggregation Discovery Operation,

```
            Code and Operation result registers"
        REFERENCE
            "[802.3ah] 61.2.2.8.3, 45.2.1.12.1"
        ::= { efmCuPmiEntry 2 }

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

            If a Clause 45 MDIO Interface is present, then this
            attribute will map to the Rx SNR Margin register"
        REFERENCE
            "[802.3ah] 45.2.1.18"
        ::= { efmCuPmiEntry 3 }

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

            This object is not supported by CPE port subtypes.

            If a Clause 45 MDIO Interface is present, then this
            attribute will map to the Rx SNR Margin register for link partner"
        REFERENCE
            "[802.3ah] 45.2.1.18"
        ::= { efmCuPmiEntry 4 }

    efmCuPmiLineAtn OBJECT-TYPE
        SYNTAX      Integer32(-127..128)
        UNITS       "dB"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The current Line Attenuation in dB as perceived by the local PMI.

            If a Clause 45 MDIO Interface is present, then this
            attribute will map to the Line Attenuation register"
        REFERENCE
```

```
            "[802.3ah] 45.2.1.21"
          ::= { efmCuPmiEntry 5 }

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

             This object is not supported by CPE port subtypes.

             If a Clause 45 MDIO Interface is present, then this
             attribute will map to the Line Attenuation register for link
partner"
          REFERENCE
             "[802.3ah] 45.2.1.21"
          ::= { efmCuPmiEntry 6 }

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

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

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

             If a Clause 45 MDIO Interface to the PMI is present, then this
             attribute will map to the Loop attenuation threshold bits in the
             2B PMD line quality thresholds register"
          REFERENCE
             "[802.3ah] 45.2.1.36"
          ::= { efmCuPmiEntry 7 }
```

```
      efmCuPmiThreshSnrMgn  OBJECT-TYPE
```

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

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

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

             If a Clause 45 MDIO Interface to the PMI is present, then this
             attribute will map to the SNR margin threshold bits in the
             2B PMD line quality thresholds register"
          REFERENCE
             "[802.3ah] 45.2.1.36"
          ::= { efmCuPmiEntry 8 }

       -- PMI Notifications Group

      efmCuPmiNotifications OBJECT IDENTIFIER ::= { efmCuPmi 2 }

      -- EdNote: Add more notificatoins here, for example
      --      efmCuPmiPerfES,
      --      efmCuPmiPerfSES,
      --      efmCuPmiPerfCRCanomalies,
      --      efmCuPmiPerfLOSWS,
      --      efmCuPmiPerfUAS,
      --      efmCuPmiDeviceFault,
      --      efmCuPmiLocalPowerLoss

      efmCuPmiLinkDefect NOTIFICATION-TYPE
        OBJECTS {
          -- ifINdex is not needed here since we are under specific PMI
          efmCuPmiStatus
          -- EdNote: should I add anything else here
        }
        STATUS     current
        DESCRIPTION
```

```
          "This notification indicates that a link defect has been detected
           by the PMI, preventing it from been operational.
           Note that in case of PAF, PMI link defect may not cause
           the whole PHY to go down, it will just cause bandwidth degradation.
           -- EdNote: add throttling limitations here"
        ::= { efmCuPmiNotifications 1 }

      efmCuPmiLineAtnCrossing NOTIFICATION-TYPE
        OBJECTS {
          efmCuPmiLineAtn,
          efmCuPmiThreshLineAtn
        }
        STATUS     current
        DESCRIPTION
          "This notification indicates that the loop attenuation
           threshold (as per the efmCuPmiThreshLineAtn
           value) has been reached/exceeded for the 2Base-TL/10Pass-TS
           PMI.
           -- EdNote: add throttling limitations here"
        ::= { efmCuPmiNotifications 2 }

      efmCuPmiRemoteLineAtnCrossing NOTIFICATION-TYPE
        OBJECTS {
          efmCuPmiRemoteLineAtn,
          efmCuPmiThreshLineAtn
        }
        STATUS     current
        DESCRIPTION
          "This notification indicates that the loop attenuation
           threshold (as per the efmCuPmiThreshLineAtn
           value) has been reached/exceeded for the 2Base-TL/10Pass-TS
           PMI link partner.
           -- EdNote: add throttling limitations here"
        ::= { efmCuPmiNotifications 3 }

      efmCuPmiSnrMgnCrossing NOTIFICATION-TYPE
        OBJECTS {
          efmCuPmiSnrMgn,
          efmCuPmiThreshSnrMgn
        }
        STATUS     current
        DESCRIPTION
          "This notification indicates that the SNR margin threshold (as
           per the efmCuPmiThreshSnrMgn value) has been
           reached/exceeded for the 2Base-TL/10Pass-TS PMI.
           -- EdNote: add throttling limitations here"
        ::= { efmCuPmiNotifications 4 }
```

```
      efmCuPmiRemoteSnrMgnCrossing NOTIFICATION-TYPE
        OBJECTS {
          efmCuPmiRemoteSnrMgn,
          efmCuPmiThreshSnrMgn
        }
        STATUS     current
        DESCRIPTION
          "This notification indicates that the SNR margin threshold (as
           per the efmCuPmiThreshSnrMgn value) has been
           reached/exceeded for the 2Base-TL/10Pass-TS PMI link partner.
           -- EdNote: add throttling limitations here"
        ::= { efmCuPmiNotifications 5 }

     -- 2BaseTL specific PMI group

      efmCuPmi2BTable OBJECT-TYPE
          SYNTAX  SEQUENCE OF EfmCuPmi2BEntry
          MAX-ACCESS  not-accessible
          STATUS  current
          DESCRIPTION
             "Table for EFMCu 2BaseTL PMIs (modems)."
           ::= { efmCuPmi 3 }

      efmCuPmi2BEntry OBJECT-TYPE
          SYNTAX  EfmCuPmi2BEntry
          MAX-ACCESS  not-accessible
          STATUS  current
          DESCRIPTION
             "An entry in the EFMCu 2BaseTL PMI table."
          AUGMENTS { efmCuPmiEntry }
           ::= { efmCuPmi2BTable 1 }

      EfmCuPmi2BEntry ::=
          SEQUENCE {
              efmCuPmi2BProfile               INTEGER,
              efmCuPmi2BRegion                INTEGER,
              efmCuPmi2BPower                 Integer32,
              efmCuPmi2BDataRate              Integer32,
              efmCuPmi2BConstellation         INTEGER
            }

      efmCuPmi2BProfile  OBJECT-TYPE
          SYNTAX  INTEGER { -- Rate    Power  Region   Constellation
                            -- (Kbps)  (dBm)
              profile0(0),  -- Undefined (individual PMI params are used)
              profile1(1),  -- 3072    13.5   Annex A  32-TCPAM
              profile2(2),  -- 2048    13.5   Annex A  16-TCPAM
              profile3(3),  -- 1024    13.5   Annex A  16-TCPAM
```

```
              profile4(4),  -- 704     13.5   Annex A  16-TCPAM
              profile5(5),  -- 512     13.5   Annex A  16-TCPAM
              profile6(6),  -- 3072    14.5   Annex B  32-TCPAM
              profile7(7),  -- 2048    14.5   Annex B  16-TCPAM
              profile8(8),  -- 1024    13.5   Annex B  16-TCPAM
              profile9(9),  -- 704     13.5   Annex B  16-TCPAM
              profile10(10) -- 512     13.5   Annex B  16-TCPAM
            }
          MAX-ACCESS  read-write
          STATUS      current
          DESCRIPTION
             "2BaseTL PMI complete Profile, instantiating
             individual PMI parameters: efmCuPmi2BRegion, efmCuPmi2BPower,
             efmCuPmi2BDataRate and efmCuPmi2BConstellation as specified in
             802.3ah Annex 63A.
             The value of profile0 is returned, when any of the individual
             PMI parameters are modidifed directly by modifying a corresponding
             variable.
             This object is writable for the CO subtype PMIs (2BaseTL-O).
             It is read-only for the CPE subtype (2BaseTL-R).

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

             This attribute maps to the aProfileSelect variable in Clause 30."
          REFERENCE
             "[802.3ah] Annex 63A, 30.5.1.1.8"
          ::= { efmCuPmi2BEntry 1 }

      efmCuPmi2BRegion  OBJECT-TYPE
          SYNTAX  INTEGER {
              regionA(1),  -- Annex A
              regionB(2),  -- Annex B
              regionC(3)   -- Annex C
            }
          MAX-ACCESS  read-write
          STATUS      current
          DESCRIPTION
             "Desired Power Spectral Density (PSD) Regional setting as
specified
             in Regional Annex of [ITU-T G.991.2] to operate under.
             This object is writable for the CO subtype PMIs (2BaseTL-O).
             It is read-only for the CPE subtype (2BaseTL-R).

             Changing Regional Annex must be performed when the link is
             Down. Attempts to change this object MUST be rejected with
```

the error inconsistentValue, if the link is Up or

```
            Initializing.

            If a Clause 45 MDIO Interface to the PMI is present, then this
            attribute will map to the Region bits in the 2B general
            parameter register"
        REFERENCE
            "[802.3ah] 45.2.1.34"
        ::= { efmCuPmi2BEntry 2 }

    efmCuPmi2BPower  OBJECT-TYPE
        SYNTAX  Integer32(0..15)
        UNITS       "dBm"
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
            "Desired Signal Transmit Power. Multiple of 0.5dBm.
            This object is writable for the CO subtype PMIs (2BaseTL-O).
            It is read-only for the CPE subtype (2BaseTL-R).

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

            If a Clause 45 MDIO Interface to the PMI is present, then this
            attribute will map to the Power bits in the 2B PMD
            parameters register"
        REFERENCE
            "[802.3ah] 45.2.1.35"
        ::= { efmCuPmi2BEntry 3 }

    efmCuPmi2BDataRate  OBJECT-TYPE
        SYNTAX  Integer32(0..5696)
        UNITS       "Kbps"
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
            "Desired 2BaseTL PMI Data Rate.
            The rate is fixed when the value is n x 64Kbps, where n=3..60 for
            16-TCPAM and n=12..89 for 32-TCPAM. The value of 0 means
            that data rate is not fixed but is adaptive and should be set to
            the maximum attainable rate during line probing.
            This object is writable for the CO subtype PMIs (2BaseTL-O).
            It is read-only for the CPE subtype (2BaseTL-R).

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

```
            Initializing.

            If a Clause 45 MDIO Interface to the PMI is present, then this
            attribute will map to the Data Rate bits in the 2B PMD
            parameters register"
        REFERENCE
            "[802.3ah] 45.2.1.35"
        ::= { efmCuPmi2BEntry 4 }

    efmCuPmi2BConstellation  OBJECT-TYPE
        SYNTAX  INTEGER {
            tcpam16(1), -- 16-TCPAM
            tcpam32(2)  -- 32-TCPAM
          }
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
            "Desired TCPAM Constellation of the 2BaseTL PMI.
            This object is writable for the CO subtype PMIs (2BaseTL-O).
            It is read-only for the CPE subtype (2BaseTL-R).

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

            If a Clause 45 MDIO Interface to the PMI is present, then this
            attribute will map to the Constellation bits in the 2B general
            parameter register"
        REFERENCE
            "[802.3ah] 45.2.1.34"
        ::= { efmCuPmi2BEntry 5 }

    -- 10PassTS specific PMI group

    efmCuPmi10PTable OBJECT-TYPE
        SYNTAX  SEQUENCE OF EfmCuPmi10PEntry
        MAX-ACCESS  not-accessible
        STATUS  current
        DESCRIPTION
            "Table for EFMCu 10PassTS PMIs (modems)."
         ::= { efmCuPmi 4 }

    efmCuPmi10PEntry OBJECT-TYPE
        SYNTAX  EfmCuPmi10PEntry
        MAX-ACCESS  not-accessible
        STATUS  current
        DESCRIPTION
```

```
            "An entry in the EFMCu 10PassTS PMI table."
        AUGMENTS { efmCuPmiEntry }
         ::= { efmCuPmi10PTable 1 }

    EfmCuPmi10PEntry ::=
        SEQUENCE {
            efmCuPmi10PProfile                INTEGER,
            efmCuPmi10PBandplanPSDMaskProfile INTEGER,
            efmCuPmi10PUPBOReferenceProfile   INTEGER,
            efmCuPmi10PBandNotchProfiles      BITS,
            efmCuPmi10PPayloadURateProfile    INTEGER,
            efmCuPmi10PPayloadDRateProfile    INTEGER,
            efmCuPmi10PElectricalLength       Integer32
            -- EdNote: To be continued
          }

    efmCuPmi10PProfile  OBJECT-TYPE
        SYNTAX  INTEGER { -- BandplanPSDMask UPBO BandNotch   URate DRate
            profile0(0),  -- Undefined (individual PMI Params are used)
            profile1(1),  -- p1              p3   p2,6,10,11  p20   p20
                          -- default profile
            profile2(2),  -- TBD
            profile3(3),  -- TBD
            profile4(4),  -- TBD
            profile5(5),  -- TBD
            profile6(6),  -- TBD
            profile7(7),  -- TBD
            profile8(8),  -- TBD
            profile9(9),  -- TBD
            profile10(10) -- TBD
            profile10(11) -- TBD
            profile10(12) -- TBD
            profile10(13) -- TBD
            profile10(14) -- TBD
            profile10(15) -- TBD
            profile10(16) -- TBD
            profile10(17) -- TBD
            profile10(18) -- TBD
            profile10(19) -- TBD
            profile10(20) -- TBD
            profile10(21) -- TBD
          }
        -- EdNote: replace TBD with values from table 62B-1 after 802.3ah/
D3.1
        -- is released, as per comment resolution #160.
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
```

"10PassTS PMI complete profile, instantiating

```
            individual PMI parameters: efmCuPmi10PBandplanPSDMaskProfile,
            efmCuPmi10PUPBOReferenceProfile, efmCuPmi10PBandNotchProfile,
            efmCuPmi10PUDataRateProfile and efmCuPmi10PDRateProfile as
follows:
            -- EdNote: put a table here.
            The value of profile0 is returned, when any of the individual
            PMI parameters are modidifed directly by modifying a corresponding
            variable.
            This object is writable for the CO subtype PMIs (10PassTS-O).
            It is read-only for the CPE subtype (10PassTS-R).

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

            This attribute maps to the XXX variable in Clause 30."
            -- EdNote: Define a variable in Clause 30 with relevant profiles
            -- defined. Put a reference to it.
         REFERENCE
            "[802.3ah] TBD"
         ::= { efmCuPmi10PEntry 1 }

      efmCuPmi10PBandplanPSDMaskProfile  OBJECT-TYPE
          SYNTAX  INTEGER {  -- PSD Mask                        Bands
Bandplan
              profile1(1),   -- T1.424/Trial-Use P1 FTTCab.M1  x/D/U/D/U  A
              profile2(2),   -- T1.424/Trial-Use P1 FTTEx.M1
              profile3(3),   -- T1.424/Trial-Use P1 FTTCab.M2
              profile4(4),   -- T1.424/Trial-Use P1 FTTEx.M2
              profile5(5),   -- T1.424/Trial-Use P1 FTTCab.M1  D/D/U/D/U
              profile6(6),   -- T1.424/Trial-Use P1 FTTEx.M1
              profile7(7),   -- T1.424/Trial-Use P1 FTTCab.M2
              profile8(8),   -- T1.424/Trial-Use P1 FTTEx.M2
              profile9(9),   -- T1.424/Trial-Use P1 FTTCab.M1  U/D/U/D/x
              profile10(10)  -- T1.424/Trial-Use P1 FTTEx.M1
              profile11(11), -- T1.424/Trial-Use P1 FTTCab.M2
              profile12(12), -- T1.424/Trial-Use P1 FTTEx.M2
              profile13(13), -- TS1 101 270-1       Pcab.M1.A  x/D/U/D/U  B
              profile14(14), -- TS1 101 270-1       Pcab.M1.B
              profile15(15), -- TS1 101 270-1       Pex.P1.M1
              profile16(16), -- TS1 101 270-1       Pex.P2.M1
              profile17(17), -- TS1 101 270-1       Pcab.M2
              profile18(18), -- TS1 101 270-1       Pex.P1.M2
              profile19(19), -- TS1 101 270-1       Pex.P2.M2
              profile20(20)  -- TS1 101 270-1       Pcab.M1.A  U/D/U/D/x
              profile21(21), -- TS1 101 270-1       Pcab.M1.B
              profile22(22), -- TS1 101 270-1       Pex.P1.M1
```

```
            profile23(23), -- TS1 101 270-1       Pex.P2.M1
            profile24(24), -- TS1 101 270-1       Pcab.M2
```

```
              profile25(25), -- TS1 101 270-1       Pex.P1.M2
              profile26(26), -- TS1 101 270-1       Pex.P2.M2
              profile27(27), -- G.993.1 F.1.2.1 (VDSLoPOTS)    x/D/U/D/U  F
              profile28(28), -- G.993.1 F.1.2.2 (VDSLoTCM-ISDN)
              profile29(29)  -- G.993.1 F.1.2.3 (PSD reduction)
            }
          MAX-ACCESS  read-write
          STATUS      current
          DESCRIPTION
             "10PassTS PMI Bandplan and PSD Mask profile,
             as specified in 802.3ah Annex 62A.
             This object is writable for the CO subtype PMIs (10PassTS-O).
             It is read-only for the CPE subtype (10PassTS-R).

             Changing PMI Bandplan and PSD MAsk profile must be performed
             when the link is Down. Attempts to change this object MUST be
             rejected with the error inconsistentValue, if the link is Up or
             Initializing.

             This attribute maps to the aBandplanPSDMaskProfile variable
             in Clause 30."
          REFERENCE
             "[802.3ah] Annex 62A, 30.5.1.1.22"
          ::= { efmCuPmi10PEntry 2 }

      efmCuPmi10PUPBOReferenceProfile  OBJECT-TYPE
          SYNTAX  INTEGER {  -- Reference PSD
              profile1(1),   -- T1.424/Trial-Use   Noise A M1
              profile2(2),   -- T1.424/Trial-Use   Noise A M2
              profile3(3),   -- T1.424/Trial-Use   Noise F M1
              profile4(4),   -- T1.424/Trial-Use   Noise F M2
              profile5(5),   -- ETSI TS 101 270-1  Noise A&B
              profile6(6),   -- ETSI TS 101 270-1  Noise C
              profile7(7),   -- ETSI TS 101 270-1  Noise D
              profile8(8),   -- ETSI TS 101 270-1  Noise E
              profile9(9)    -- ETSI TS 101 270-1  Noise F
            }
          MAX-ACCESS  read-write
          STATUS      current
          DESCRIPTION
             "10PassTS PMI Upstream Power Back-Off (UPBO) Reference PSD
Profile,
             as specified in 802.3ah Annex 62A.
             This object is writable for the CO subtype PMIs (10PassTS-O).
             It is read-only for the CPE subtype (10PassTS-R).

             Changing UPBO Reference profile must be performed
             when the link is Down. Attempts to change this object MUST be
```

rejected with the error inconsistentValue, if the link is Up or

```
            Initializing.

            This attribute maps to the aUPBOReferenceProfile variable
            in Clause 30."
        REFERENCE
            "[802.3ah] Annex 62A.3.4, 30.5.1.1.23"
        ::= { efmCuPmi10PEntry 3 }

    efmCuPmi10PBandNotchProfiles  OBJECT-TYPE
        SYNTAX  BITS {     -- G.991.3  T1.424/T-U TS 101 270-1  StartF EndF
                           -- Table    Table      Table         (MHz)  (MHz)
            profile0(0),   -- no profile
            profile1(1),   -- F-5 #01  -          -             1.810  1.825
            profile2(2),   -- 6-2      15-1       17            1.810  2.000
            profile3(3),   -- F-5 #02  -          -             1.907  1.912
            profile4(4),   -- F-5 #03  -          -             3.500  3.575
            profile5(5),   -- 6-2      -          17            3.500  3.800
            profile6(6),   -- -        15-1       -             3.500  4.000
            profile7(7),   -- F-5 #04  -          -             3.747  3.754
            profile8(8),   -- F-5 #05  -          -             3.791  3.805
            profile9(9),   -- 6-2      -          17            7.000  7.100
            profile10(10), -- F-5 #06  15-1       -             7.000  7.300
            profile11(11)  -- 6-2      15-1       17            10.100 10.150
          }
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
            "10PassTS PMI Egress Control Band Notch Profile bitmap,
            as specified in 802.3ah Annex 62A.
            This object is writable for the CO subtype PMIs (10PassTS-O).
            It is read-only for the CPE subtype (10PassTS-R).
            Any combination of profiles can be specified by ORing individual
            profiles, for example value of 0x0622 selects profiles
            2,6,10 and 11.

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

            This attribute maps to the aBandNotchProfile variable
            in Clause 30."
        REFERENCE
            "[802.3ah] Annex 62A.3.5, 30.5.1.1.19"
        ::= { efmCuPmi10PEntry 4 }

    efmCuPmi10PPayloadURateProfile  OBJECT-TYPE
        SYNTAX  INTEGER {    -- Upstream Payload Rate (Mbps)
```

```
            profile100(100), -- 50
            profile70(70),   -- 35
            profile50(50),   -- 25
            profile30(30),   -- 15
            profile25(25),   -- 12.5
            profile20(20),   -- 10
            profile15(15),   -- 7.5
            profile10(10),   -- 5
            profile5(5)      -- 2.5
          }
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
           "10PassTS PMI Upstream Payload Rate Profile,
           as specified in 802.3ah Annex 62A.
           This object is writable for the CO subtype PMIs (10PassTS-O).
           It is read-only for the CPE subtype (10PassTS-R).

           The SET operation sets a target for the PHY'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 PHY shall drop the link.

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

           This attribute maps to the aPayloadRateProfileUpstream variable
           in Clause 30."
        REFERENCE
           "[802.3ah] Annex 62A.3.6, 30.5.1.1.20"
        ::= { efmCuPmi10PEntry 5 }

    efmCuPmi10PPayloadDRateProfile  OBJECT-TYPE
        SYNTAX  INTEGER {    -- Downstream Payload Rate (Mbps)
            profile200(200), -- 100
            profile140(140), -- 70
            profile100(100), -- 50
            profile70(70),   -- 35
            profile50(50),   -- 25
            profile30(30),   -- 15
            profile25(25),   -- 12.5
            profile20(20),   -- 10
            profile15(15),   -- 7.5
            profile10(10),   -- 5
            profile5(5)      -- 2.5
          }
```

```
          MAX-ACCESS  read-write
          STATUS      current
          DESCRIPTION
             "10PassTS PMI Downstream Payload Rate Profile,
             as specified in 802.3ah Annex 62A.
             This object is writable for the CO subtype PMIs (10PassTS-O).
             It is read-only for the CPE subtype (10PassTS-R).

             The SET operation sets a target for the PHY'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 PHY shall drop the link.

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

             This attribute maps to the aPayloadRateProfileDownstream variable
             in Clause 30."
          REFERENCE
             "[802.3ah] Annex 62A.3.6, 30.5.1.1.21"
          ::= { efmCuPmi10PEntry 6 }

      efmCuPmi10PElectricalLength  OBJECT-TYPE
          SYNTAX  Integer32(0..8192,65535)
          UNITS       "m"
          MAX-ACCESS  read-only
          STATUS      current
          DESCRIPTION
             "Electrical Length in meters as perceived by the 10PassTS PMI
             after the link is established.
             The value of 65535 is returned if the link is Down or Initializing
             or the PMI is unable to estimate the Electrical Length.

             If a Clause 45 MDIO Interface to the PMI is present, then this
             attribute will map to the 10P Electrical Length register"
          REFERENCE
             "[802.3ah] 45.2.1.21"
          ::= { efmCuPmi10PEntry 7 }


      -- efmCuAvailableStackTable for use in Discovery

      efmCuAvailableStackTable  OBJECT-TYPE
          SYNTAX        SEQUENCE OF EfmCuAvailableStackEntry
          MAX-ACCESS    not-accessible
          STATUS        current
```

```
        DESCRIPTION
           "This table, modeled after ifStackTable from [IF-MIB],
           contains information on the possible 'on-top-of'
           relationships between the multiple sub-layers of network
           interfaces (as opposed to actual relationships in
           ifStackTable).  In particular, it contains information on
           which PCS ports (sub-layers) can possible run 'on top of'
           which PMIs (sublayers), as determined by cross-connect
           capability of the EFMCu device, where each sub-layer
           corresponds to a conceptual row in the ifTable.  For example,
           when the PCS port with ifIndex value x can be connected
           to run on top of the PMI with ifIndex value y, then this table
           contains:

             efmCuAvailableStackStatus.x.y=active

           For each ifIndex value, I, which identifies a PCS or PMI
           interface, there are always at least two instantiated rows
           in this table associated with I.  For one of these rows, I
           is the value of efmCuAvailableStackHigherLayer; for the other,
           I is the value of efmCuAvailableStackLowerLayer.
           Note that there's always at least on PCS for each PMI and at
           least one PMI for each PCS in the EFMCu devices.
           This table is ready only as it describes device capability"
        REFERENCE
           "ifStackTable of RFC 2863"
        ::= { efmCuObjects 3 }

    efmCuAvailableStackEntry  OBJECT-TYPE
        SYNTAX        EfmCuAvailableStackEntry
        MAX-ACCESS    not-accessible
        STATUS        current
        DESCRIPTION
           "Information on a particular relationship between two sub-
           layers, specifying that one sub-layer runs on 'top' of the
           other sub-layer.  Each sub-layer corresponds to a conceptual
           row in the ifTable."
        INDEX {
           efmCuAvailableStackHigherLayer,
           efmCuAvailableStackLowerLayer
        }
        ::= { efmCuAvailableStackTable 1 }

    EfmCuAvailableStackEntry ::=
          SEQUENCE {
              efmCuAvailableStackHigherLayer  InterfaceIndexOrZero,
              efmCuAvailableStackLowerLayer   InterfaceIndexOrZero,
              efmCuAvailableStackStatus       RowStatus
```

```
      }

    efmCuAvailableStackHigherLayer  OBJECT-TYPE
        SYNTAX        InterfaceIndexOrZero
        MAX-ACCESS    not-accessible
        STATUS        current
        DESCRIPTION
           "The value of ifIndex corresponding to the higher sub-layer
           of the relationship, i.e., the sub-layer which runs on 'top'
           of the sub-layer identified by the corresponding instance of
           ifStackLowerLayer.  If there is no higher sub-layer (below
           the internetwork layer), then this object has the value 0."
        ::= { efmCuAvailableStackEntry 1 }


    efmCuAvailableStackLowerLayer  OBJECT-TYPE
        SYNTAX        InterfaceIndexOrZero
        MAX-ACCESS    not-accessible
        STATUS        current
        DESCRIPTION
           "The value of ifIndex corresponding to the lower sub-layer
           of the relationship, i.e., the sub-layer which runs 'below'
           the sub-layer identified by the corresponding instance of
           ifStackHigherLayer.  If there is no lower sub-layer, then
           this object has the value 0."
        ::= { efmCuAvailableStackEntry 2 }

    efmCuAvailableStackStatus  OBJECT-TYPE
        SYNTAX         RowStatus
        MAX-ACCESS     read-only
        STATUS         current
        DESCRIPTION
           "The status of the relationship between two sub-layers.

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


    --
    --     Conformance Statements
    --

    efmCuGroups      OBJECT IDENTIFIER ::= { efmCuConformance 1 }

    efmCuCompliances OBJECT IDENTIFIER ::= { efmCuConformance 2 }

    --     Object Groups
```

```
      efmCuPortBasicGroup OBJECT-GROUP
          OBJECTS {
              efmCuPortSidesSupported,
              efmCuPortSide,
              efmCuPAFSupported
          }
          STATUS  current
          DESCRIPTION
             "A collection of objects required for all EFMCu ports."
           ::= { efmCuGroups 1 }

      efmCuPAFGroup OBJECT-GROUP
          OBJECTS {
              efmCuPAFAdminState,
              efmCuPAFDiscoveryCode,
              efmCuPAFRemoteDiscoveryCode,
              efmCuAvailableStackTable
          }
          STATUS  current
          DESCRIPTION
             "A collection of objects that support
             optional Aggregation features on EFMCu ports."
           ::= { efmCuGroups 2 }

      efmCuPmiGroup OBJECT-GROUP
          OBJECTS {
              efmCuPmiSnrMgn,
              efmCuPmiRemoteSnrMgn,
              efmCuPmiLineAtn,
              efmCuPmiRemoteLineAtn
          }
          STATUS  current
          DESCRIPTION
             "A collection of objects that provide
             required information about a 2BaseTL/10PassTS PMI."
           ::= { efmCuGroups 3 }

      efmCuPmiAlarmConfGroup OBJECT-GROUP
          OBJECTS {
              efmCuPmiThreshLineAtn,
              efmCuPmiThreshSnrMgn
   --         efmCuPmiThreshES,
   --         efmCuPmithreshSES,
   --         efmCuPmiThreshCRCanomalies,
   --         efmCuPmiThreshLOSWS,
   --         efmCuPmiThreshUAS
          }
          STATUS      current
```

```
          DESCRIPTION
              "This group supports objects that allow configuration of alarm
              thresholds for various performance parameters for 2B/10P PMI."
          ::= { efmCuGroups 4 }

      efmCuPmiNotificationGroup NOTIFICATION-GROUP
          NOTIFICATIONS {
              efmCuPmiLineDefect,
              efmCuPmiLineAtnCrossing,
              efmCuPmiRemoteLineAtnCrossing,
              efmCuPmiSnrMgnCrossing,
              efmCuPmiRemoteSnrMgnCrossing
   --         efmCuPmiPerfES,
   --         efmCuPmiPerfSES,
   --         efmCuPmiPerfCRCanomalies,
   --         efmCuPmiPerfLOSWS,
   --         efmCuPmiPerfUAS,
   --         efmCuPmiDeviceFault,
   --         efmCuPmiLocalPowerLoss
          }
          STATUS      current
          DESCRIPTION
              "This group supports notifications of significant conditions
              associated with EFMCu PMIs."
          ::= { efmCuGroups 5 }

      efmCu2BGroup OBJECT-GROUP
          OBJECTS {
              efmCuPmi2BRegion,
              efmCuPmi2BPower,
              efmCuPmi2BDataRate,
              efmCuPmi2BConstellation
          }
          STATUS  current
          DESCRIPTION
             "A collection of objects that provide
             required information about a 2BaseTL PMI."
           ::= { efmCuGroups 6 }

      efmCu10PGroup OBJECT-GROUP
          OBJECTS {
              efmCuPmi10PBandplanPSDMaskProfile,
              efmCuPmi10PUPBOReferenceProfile,
              efmCuPmi10PBandNotchProfiles,
              efmCuPmi10PPayloadURateProfile,
              efmCuPmi10PPayloadDRateProfile,
              efmCuPmi10PElectricalLength
          }
```

```
          STATUS  current
          DESCRIPTION
             "A collection of objects that provide required
             information about a 10PassTS PMI."
           ::= { efmCuGroups 7 }

      -- Compliance Statements

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

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

          MODULE  -- this module
              MANDATORY-GROUPS {
                  efmCuPortBasicGroup,
                  efmCuPmiGroup,
                  efmCuPmiAlarmConfGroup,
                  efmCuPmiNotificationGroup
              }

              GROUP        efmCuPmi2BGroup
              DESCRIPTION
                  "Support for this group is only required for implementations
                  supporting 2Base-TL Phy."

              GROUP        efmCuPmi10PGroup
              DESCRIPTION
                  "Support for this group is only required for implementations
                  supporting 10Pass-TS Phy."

              OBJECT       efmCuPortSidesSupported
              SYNTAX  INTEGER {
                   subscriber(1),
                   office(2),
               }
              DESCRIPTION
                  "Support for values other than subscriber(1),
                  or office(2) is not required."
```

```
            OBJECT       efmCuPortSide
            MIN-ACCESS  read-only
            DESCRIPTION
                "Write access is not required (needed only for ports
                supporting both subscriber and office sides)"

            -- EdNote: To be Continued

        ::= { efmCuCompliances 1 }
END
```

## 5. Security Considerations

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

- Changing of efmCuPortSide may lead to a potential locking of the link, as same PHYs of the same sub-type may not be able to exchange handshake messages.

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

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

- Changing any of the efmCuPmd2* or efmCuPmd10P* configuration may lead to anything from link quality and rate degradation to a complete disabling of the link.

- Finally activation of a PMI can cause a severe degradation of service for another EFMCu Phy whose PMI(s) may be affected by the cross-talk from the newly activated PMI.

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

The readable objects in this MIB module (i.e., those with MAX-ACCESS other than not-accessible) may be considered sensitive in some environments since, collectively, they provide information about the

performance of network interfaces and can reveal some aspects of their configuration. In particular since EFMCu can be carried over Unshielded Twisted Pair (UTP) voice grade copper in a bundle with other pairs belonging to another operator/customer, it is theoretically possible to evasdrop to an EFMCu transmission simply by "listening" to a cross-talk from an EFMCu pair, especially if the parameters of the EFMCu link in question are known. In such environments it is important to control even GET and NOTIFY access to these objects and possibly even to encrypt their values when sending them over the network via SNMP.

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

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

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

## 6. Acknowledgments

Not yet.

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