Managed Objects of EPON
draft-ietf-hubmib-efm-epon-mib-05.txt

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. In particular, it defines objects for managing interfaces
that conform to the Ethernet Passive Optical Networks (EPON) standard
as defined in [802.3ah], which are extended capabilities to the
Ethernet like interfaces.

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].

Terminology

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 [RFC2119].

Table of Contents

[1](). Overview

   This document defines a portion of the Management Information Base
   (MIB) for use with network management protocols in TCP/IP based
   Internets. In particular, it defines objects for managing interfaces
   that conform to the Ethernet Passive Optical Networks (EPON) standard
   as defined in [[802.3ah]()], which are extended capabilities to the
   Ethernet like interfaces. The document contains a list of management
   objects based on the attributes defined in the relevant parts of
   [[802.3ah]()] Annex 30A, referring to EPON.

[1.1](). Terminology and abbreviations

   ACK - Acknowledge

   BER - Bit Error Rate

   BW - Bandwidth

   CO - Central Office

   CPE - Customer Premises Equipment

   CRC - Cyclic Redundancy Check

   FCS - Frame Check Sequence

   FEC - Forward Error Correction

   EFM - Ethernet First Mile

   EPON - Ethernet Passive Optical Network

   GMII - Gigabit Media Independent Interface

   LAN - Local Area Network

   LLID - Logical Link Identifier

   MAC - Media Access Control

   Mbps - Mega-bit per second

   MDI - Medium Dependent Interface

   MDIO - Management Data Input/Output

   MPCP - Multi-Point Control Protocol

MP2PE - Multi-Point to Point Emulation

OAM - Operation Administration Maintenance

OLT - Optical Line Terminal (Server unit of the EPON)

OMP - Optical Multi-Point

ONU - Optical Network Unit (Client unit of the EPON)

P2PE - Point to Point Emulation

P2MP - Point to Multi-Point

PCS - Physical Coding Sublayer

PHY - Physical Layer

PMD - Physical Medium Dependent

PMA - Physical Medium Attachment

PON - Passive Optical Network

RTT - Round Trip Time

RS - Reconciliation Sublayer

SLA - Service Level Agreement

SLD - Start of LLID Delimiter

TDM - Time Division Multiplexing

TQ - Time Quanta

1.2. EPON architecture highlights

1.2.1. Introduction

The EPON standard, as defined in [802.3ah], is defining the physical
media (Layer 1) and media access (layer 2) of the EPON interface.
The EPON is a variant of the Gigabit Ethernet protocol for the
Optical Access. The Optical Access topology is based on passive
optical splitting topology. The link of a Passive Optical Network
(PON) is based on a single, shared optical fiber with passive optical
splitters dividing the single fiber into separate subscribers.

The Optical Line Terminal (OLT) is the server unit of the network,
located at the Central Office (CO).

The Optical Network Unit (ONU) is the client unit of the network,
located at the Customer Premises Equipment (CPE).

The following diagram describes the PON topology:

```
              Device with
              one or more P2MP
              interfaces such as OLT
              for EPON                        An EPON          IP host
              ------- OLT          ONU        "modem"          --------
  Other IEEE |      | interface |  interface ------ Other IEEE|       |
  interface  |      |-------\---------------|     | interface |       |
  ==========|       |        \              |     |==========|        |
            |       |         \              ------          --------
            |       |          \             ------          --------
            .       .           \-----------|     |          |      |
            |       |------\                 |     |==========|       |
            |       |       \                ------          --------
            -------           \ etc
```
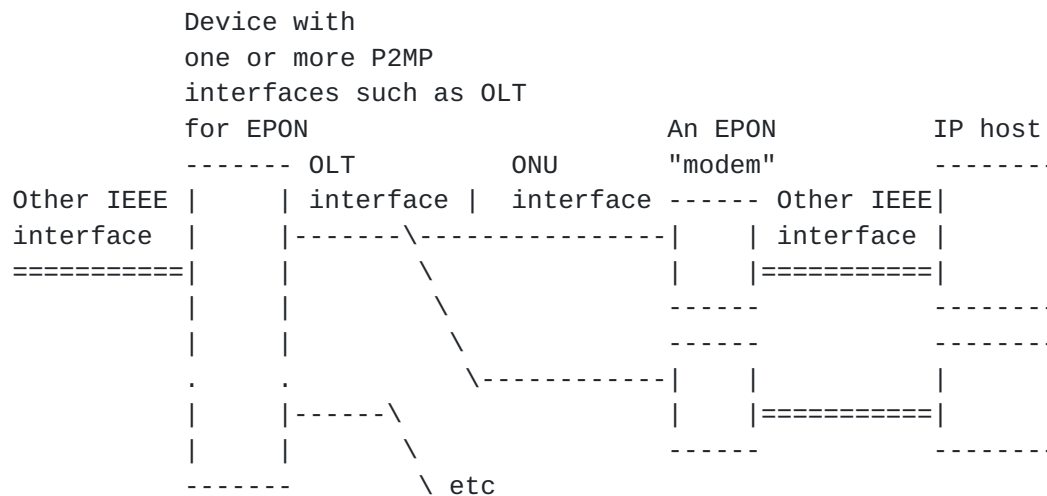
The IEEE layering architecture of an EPON interface is defined in the
diagram of figure 56.2 [802.3ah]. The following clauses in the
[802.3ah] define the corresponding layers of an EPON interface:

Clause 30 - management

Clause 60 - PMD for EPON media (Burst PMD)

Clause 64 - MPCP (Multipoint control protocol) - defines the
multipoint architecture, and control protocol for the media access of
EPON.

Clause 65 -

a) Virtual links definition for the EPON

b) FEC

c) PMA for the EPON.

1.2.2. Principles of operation

   The specification of the EPON interface is based on the specification
   of the gigabit Ethernet interface as described in [802.3] clause 35
   and 36. The Ethernet MAC is working in gigabit rate. The media
   interface to the MAC is through the GMII interface as described in
   clause 35 and the PCS layer is based on the gigabit Ethernet PCS as
   described in clause 36. The special EPON layers are added to the
   Ethernet layering in the following places:

   The MPCP is placed in the MAC control layer, providing the EPON
   control protocol. The Emulation layer, located at the RS
   (Reconciliation Sublayer), creates virtual private path to each ONU.
   The FEC layer is located between the PCS and PMA layers, enhancing
   reach and split performance of the optical link.

The following diagram describes the layering model of an EPON
interface:

```
    +==========================================+
    |               Higher layers              |
    +==========================================+
    |               802.1D Bridge              |
    +==========================================+
    | MAC client|          ...          |MAC client|
    +==========================================+
    |            MAC Control - (MPCP)          |          *NEW*
    +==========================================+
    |    MAC    |          ...          |    MAC    |
    +==========================================+
    |            P2P Emulation (P2PE)          |          *NEW*
    +==========================================+
                  |            |
                  |    GMII    |
                  |            |
    +==========================================+
    |                    PCS                   |
    +==========================================+
    |                    FEC                   |          *NEW*
    +==========================================+
    |                    PMA                   | *Enhanced parameters
    +==========================================+    for EPON*
    |                    PMD                   | *Enhanced parameters
    +==========================================+    for EPON*
                  |            |
                  |    MDI     |
                  |            |
              /==================/
             /       Media      /
            /==================/
```
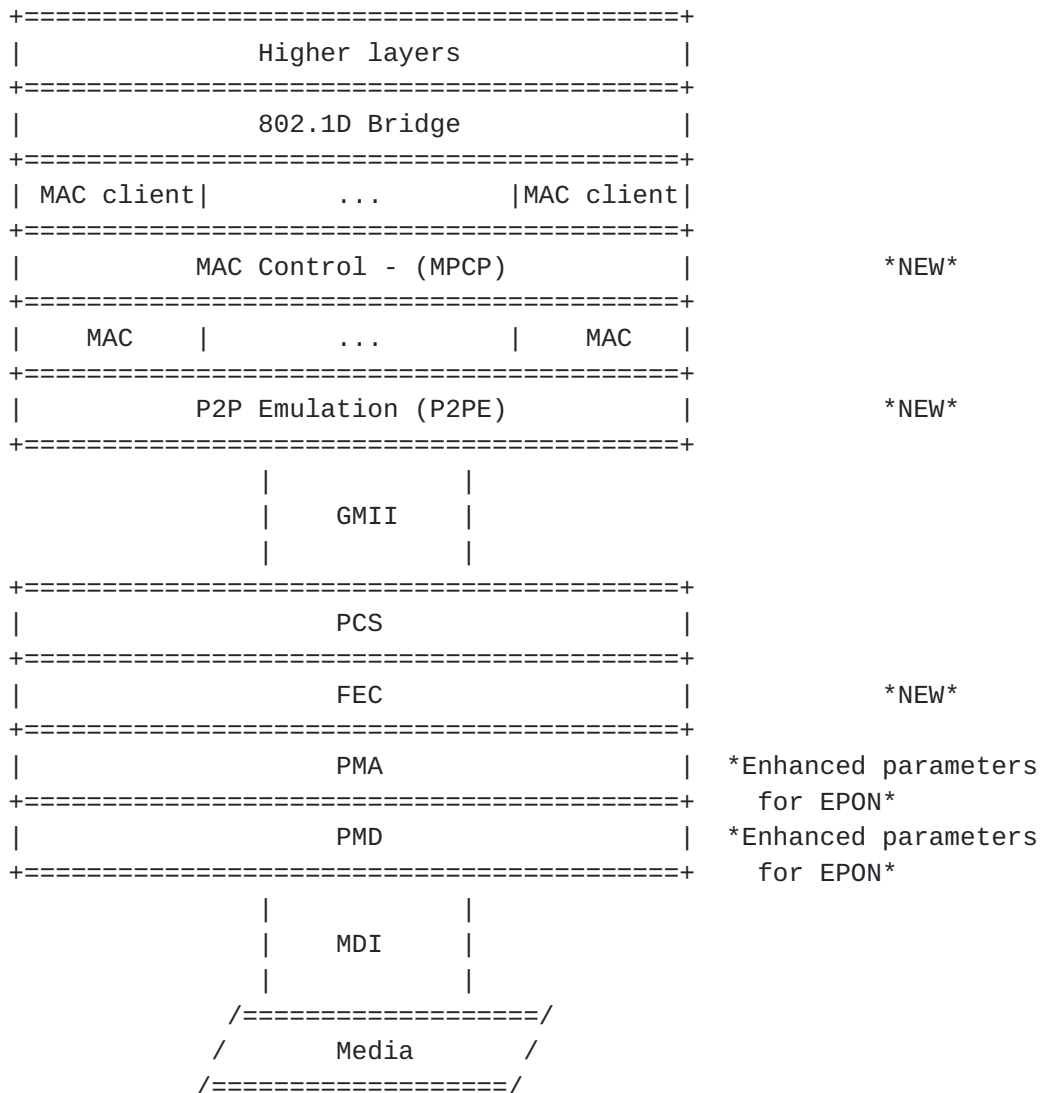
1.2.3. The physical media

The physical link is a fiber optical link. The OLT and ONUs are
connected through passive optical splitters. Downlink denotes the
transmission from the OLT to the ONUs. Uplink denotes the
transmission from the ONUs to the OLT. Uplink and downlink are
multiplexed using separated wavelengths on the same fiber. The
downlink is a broadcast medium where the OLT transmits the data to
all ONUs. The uplink is a shared transmission medium for all of the
ONUs. The uplink access is based on time division multiplexing (TDM)

and the management of the TDM media access is defined by the Multi-
Point control protocol (MPCP). The MPCP is a control protocol based
on an inband packet messaging. The OLT sends control messages (GATE
messages) allowing ONUs to transmit, defining when the transmission
occurs and what is its duration. These messages define the
transmission order and the amount of BW for each ONU. A scheduling
algorithm at the OLT, which is not defined in the [802.3ah], is
responsible of allocating the BW and controlling the delay of each
ONU according to its SLA.

1.2.4. PMD specifications

The same optical wavelength plan as the [ITU-T G.983] is selected.
The transceivers are derivatives of existing Ethernet optical
transceivers, with dual wavelength on a single fiber and extended
burst capabilities for the uplink. The uplink burst capability is
the burst transmission functionality for the ONUs and burst reception
functionality for the OLT. The [802.3ah] selected very relaxed burst
parameters to reduce the device cost of EPON products.

1.2.5. Point to point emulation

The downstream is a broadcast link meaning the OLT transmission is
shared for all ONUs. The sharing of the transmission of the OLT has
some negative privacy aspects, and should be limited to broadcast
traffic in nature only. The traffic dedicated to each ONU should not
be shared. The solution provided by the [802.3ah] is to partition
the EPON link, in a virtual manner, between the ONUs. Each ONU has a
dedicated virtual link to the OLT. The [802.3ah] also defines an
additional link for broadcast transmission. The medium becomes an
aggregation of point-to-point tunnels. The OLT can not preserve its
EPON interface as a single interface connected to N devices
(following the properties of the physical interface). The EPON
interface of the OLT is partitioned into separate virtual interfaces,
an interface for each virtual link. Hence the OLT behaves like a
device with N virtual ports (and an additional port for the broadcast
transmission). The additional single-copy-broadcast channel (tagged
as all ones LLID) is added to allow the broadcast transmission within
a single copy to all ONUs, preserving the inherent advantage of BW
efficiency of the PON shared media. The ONUs filter the downlink
traffic which is not intended for their reception, according to the
virtual link marking. An LLID tag is attached at the preamble of the
Ethernet packet denoting the virtual link. The LLID marks the
destination port in the downstream and source port in the upstream.

The virtual links concept is also used to avoid a violation of the
[802.1d] bridging rules for peer to peer traffic in the PON. Peer to
peer traffic is traffic between ONUs in the same PON. The OLT can

not preserve the EPON interface as a single interface connected to N
devices and allow traffic between these devices without violating the
bridging rules. The source address and destination address of the
peer to peer traffic are behind the same port and therefore the
traffic should be discarded. The separation of the ONUs into virtual
links solves this issue. The OLT has N virtual ports for the single
physical EPON port. A bridge sees a single MAC Client for every link
pair.

The private paths concept solves the networking problems and it
provides subscriber isolation.

As the tunneling is only a virtual tunneling, there is a single
physical interface and a single physical layer for the device so that
some attributes are shared. For example, the interface has a single
local MAC address.

The virtual tunneling for an OLT with 3 ONUs, is illustrated in the
following diagram.

```
                      Trunk Line
                          |
                          |
                          |
                        \|/
        +===============================================+
        |                802.1D Bridge                  |
        +===============================================+
        | MAC client1|            ...          |MAC client3|
        +===============================================+
        |                     MP2PE                      |
        +===============================================+
        |                      PHY                       |
        =================================================
               |                  |                 |
               |                  |                 |
              \|/                \|/               \|/
        +============+      +============+      +============+
        |    PHY     |      |    PHY     |      |    PHY     |
        +============+      +============+      +============+
        |    MP2PE   |      |    MP2PE   |      |    MP2PE   |
        +============+      +============+      +============+
        | MAC client |      | MAC client |      | MAC client |
        +============+      +============+      +============+
        |    PHY     |      |    PHY     |      |    PHY     |
        +============+      +============+      +============+
            /|\                /|\               /|\
             |                  |                 |
             |                  |                 |
             |                  |                 |
          Subscriber1        Subscriber2       Subscriber3
```
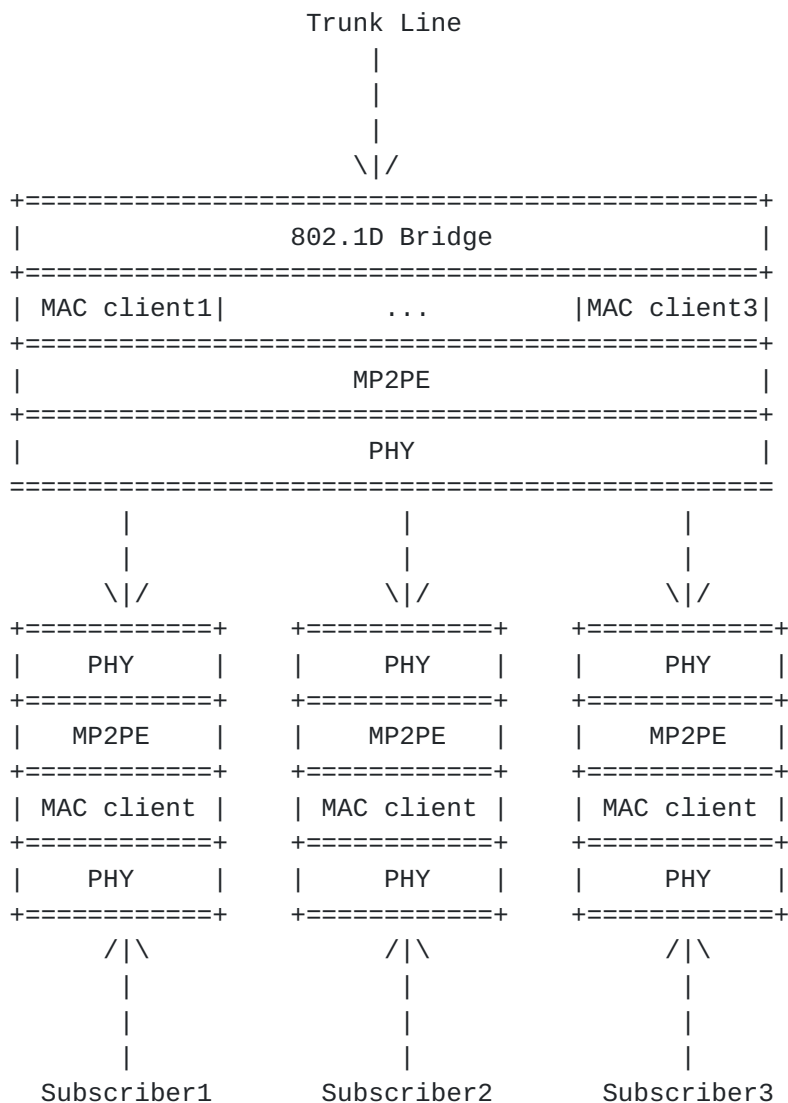
[1.2.6]. Principles of the MPCP

   The EPON standard defines a media access control of an optical Access
   network. The Access network has some substantial differences from
   the legacy LAN which the Ethernet was designed for. The differences
   mainly lie in the provisioning of the network. An Access network is
   an administrated environment, with an operator providing the service
   and subscribers consuming it. The operator is controlling the
   network and managing its traffic. For instance BW is controlled and
   subscribers are billed for services. The MPCP protocol divides the
   Ethernet interfaces into two unequal types of network units. The
   first interface is an OLT interface, which is a server unit,
   controlling the network. The second interface is an ONU interface,
   which is a client unit, participating in the network.

The OLT, which is the server unit, manages the network. The MPCP
controls the TDM transmission of the uplink. The MPCP is implemented
at the MAC control layer and the MPCP messages are MAC control
messages using the 0x8808 Ethertype. These messages are not
forwarded out of the MAC.

A concept of time must exist in the protocol in order to schedule the
uplink transmission. A timestamp which is set by the OLT and
synchronized between the network units is passed through the MPCP
messages. The timestamp is also used to measure the RTT of each ONU.
RTT is compensated by the OLT, in the generation of the grants for
the uplink transmission. The difference of incoming timestamp to
local time allows the OLT to calculate the RTT. RTT compensation is
needed as the RTT in an Access network can have a significant value.
The standard allows the network to reach a 20km distance which is
equivalent to a 200usec RTT (25Kbytes of data).

The TDM control is done using the GATE messages. These messages
define, for each ONU, the time for transmission and the length of
transmission. The RTT is reduced from the transmission time in the
GATE message to shift the transmission time of the ONU in the
opposite direction.

A scheduling algorithm at the OLT, which is not defined in the
[802.3ah], is responsible for dividing the BW and controlling the
transmission delay of each ONU according to its SLA. The MPCP
defines a closed loop operation, in order for this algorithm to be
efficient. The MPCP allows the ONUs to report on the amount of BW
they require for transmission using a special REPORT message. This
allows allocating BW to an ONU only when requested, relying on the
statistical burst property of the traffic, allowing different peak BW
for different ONUs at different times, hence allowing
oversubscription of the BW. The REPORT message reports the amount of
data waiting in the ONU queues.

In addition to that the MPCP defines a protocol of auto-discovery and
registration of ONUs.

The registration process is defined in the diagram below:

```
    OLT                                              ONU
     |                                                |
     |           Discovery Gate message              \|
     |------------------------------------------------|
     |                                               /|
     |                                                |
     |/          Register Request message             |
     |------------------------------------------------|
     |\                                               |
     |                                                |
     |           Register message                     |
     |             (assigning LLID)                  \|
     |------------------------------------------------|
     |                                               /|
     |                                                |
     |                Gate message                   \|
     |------------------------------------------------|
     |                                               /|
     |                                                |
     |/            Register ACK message               |
     |------------------------------------------------|
     |\                                               |
     |                                                |
     |                                                |
```

A new ONU requests to register (sends a REG_REQUEST message) in a
special discovery grant, allocated for that by the OLT. During that
time more than one ONU might try to register. A collision in
transmission might occur as the RTT of the new ONUs is not yet known.
A random backoff mechanism of the transmission is used to schedule
the following registration requests to avoid these collisions. When
the OLT receives REG_REQUEST message of an ONU and approves this ONU
then it sends a REGISTER message to this ONU defining its LLID. From
that point the ONU transmission is scheduled by its LLID, knowing the
RTT, and no collision can occur. The ONU replies with a REGISTER_ACK
message and the registration process of the MPCP ends. Higher layer
protocols may yet be needed to authenticate the ONU and allow it to
participate in the network.

1.2.7. **Forward Error correction (FEC)**

   The FEC is defined to enhance the link budget of the PON. As each
   splitter attenuates the optical signal, the number of the splits and
   the distance are limited by the link budget. Hence an FEC which
   improves the link budget, has a benefit. The FEC code used is the
   RS(239,255,8), similar to the FEC code in [ITU-T G.975], improving
   the BER from 1E-4 to 1E-12.

   The FEC parity encapsulation is based on the framing of the Ethernet
   packet. The Ethernet packets are spaced by MAC rate adaptation, and
   the parity bytes are inserted after the packet, in the provided
   space.

   As the start and end of packet codewords define also the FEC
   boundaries, and they are outside the FEC protection, they are
   replaced by a series of symbols to reduce their vulnerability to
   errors.

   The following diagram presents an FEC protected frame:

```
   +----------------------------------------------------------------+
   |       |               |           |     |       |         |      |
   | S_FEC | Preamble/SFD  |   Frame   | FCS | T_FEC | Parity  | T_FEC |
   |       |               |           |     |       |         |      |
   +----------------------------------------------------------------+
```
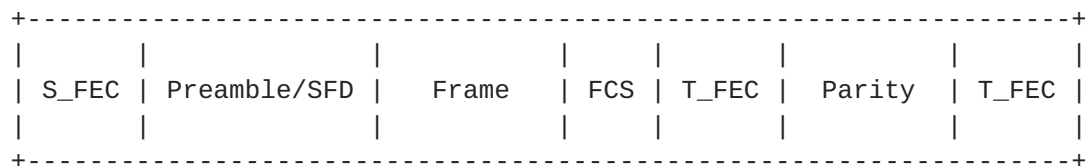
   The FEC is added in a separate layer between the PCS and PMA layers
   of the [802.3].

   The FEC layer introduces a fixed delay in receive path and transmit
   path.

   The FEC layer is optional.

1.3. **Management architecture**

   Each one of the EPON layers is accompanied with a management
   interface, which is controlled through clause 30 of the [802.3ah].
   As the [802.3ah] spec may be used for different applications and some
   of the clauses may be used separately, the IEEE management clause
   allocates for each one of them a separate package. The MIB document
   follows this partition.

The following diagram presents the relation of the MIB groups to the
[802.3ah] layers:

```
+===========================+
|       Higher layers       |
+===========================+
|       802.1D Bridge       |
+===========================+
|MAC client| ... |MAC client|
+===========================+    \ +=============================+
|    MAC Control - (MPCP)    |----- |MpcpObjects| ... |MpcpObjects|
+===========================+    / +=============================+
|    MAC    | ... |    MAC    |
+===========================+    \ +=============================+
|    P2P Emulation (P2PE)    |----- |OmpEmulat  |     |OmpEmulat  |
+===========================+    / |ionObjects | ... |ionObjects |
          |         |              +=============================+
          |  GMII   |
          |         |
+===========================+
|           PCS             |
+===========================+    \ +=============================+
|           FEC             |----- |FecObjects | ... |FecObjects |
+===========================+    / +=============================+
|           PMA             |
+===========================+
|           PMD             |
+===========================+
          |         |
          |  MDI    |
          |         |
       /==============/
      /     Media    /
     /==============/
```

The association is strait forward for the ONU interface. There is
one logical and one physical interface and a single copy exists for
each layer, that can be remotely queried by the OLT.

At the OLT there is a single physical interface and N virtual
interfaces for the virtual links of the ONUs (and another virtual
interface for the broadcast virtual link). As can be seen from the
layering diagram above, the MAC layer is virtually duplicated.

Therefore in this document it was selected that the management of a
virtual interface is like a physical interface and an interface index
is allocated for each one of the virtual links and an additional
interface index is allocated for the OLT.

To illustrate the interface modeling, consider two devices. The
first device has two physical interfaces, is typically located at a
consumer's site, and called an "ONU modem".

An "ONU modem" is shown in the figure below:

```
                         --------
            ONU interface | ONU   | 10megabit interface
            --------------| modem |--------------------
                         ---------
```
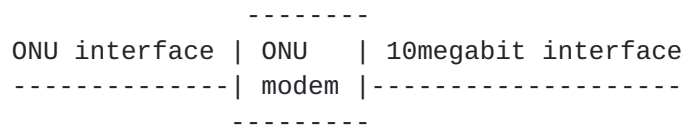
This device would have 3 entries in the IF table, and one IF stack
entry, for example:

ifIndex=1 - interface for 10megabit interface

ifIndex=2 - interface for the optical interface

ifIndex=200 - interface for the ONU interface

And then in IF stack table:

ifStackHigherLayer=200, ifStackLowerLayer=2 - map between the
physical and the ONU

The second device has three physical interfaces, is typically located
at the provider's site, and may be called a "headend".

A "headend" is shown in the figure below:

```
                         ---------
            1st OLT interface | Head  | gigE interface
            ------------------| end   |--------------------
                              |       |
            ------------------|       |
            2nd OLT interface |       |
                         ---------
```
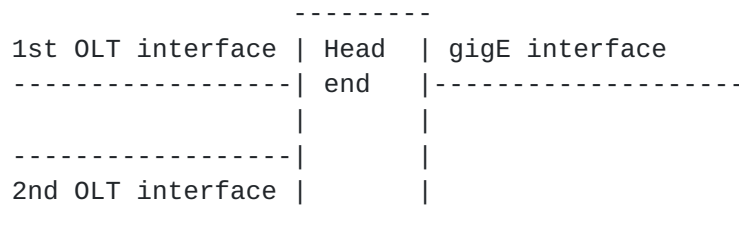
This device would have 5 entries (when no attached ONUs) in the IF
table, for example:

ifIndex=1 - interface for gigE interface

ifIndex=2 - interface for 1st optical interface

ifIndex=3 - interface for 2nd optical interface

ifIndex=265535 - interface for the 1st OLT broadcast interface

ifIndex=365535 - interface for the 2nd OLT broadcast interface

And then in IF stack table:

ifStackHigherLayer=265535, ifStackLowerLayer=2 - map between the 1st
physical and its broadcast interface

ifStackHigherLayer=365535, ifStackLowerLayer=3 - map between the 2nd
physical and its broadcast interface

If two ONUs connected to the first OLT interface, then for example,
the following entries would be added to the IF table:

ifIndex=200001 - interface for the 1st ONU of 1st OLT

ifIndex=200002 - interface for the 2nd ONU of 1st OLT

And in the IF stack table:

ifStackHigherLayer=200001, ifStackLowerLayer=2 - map between the 1st
physical and 1st ONU

ifStackHigherLayer=200002, ifStackLowerLayer=2 - map between the 1st
physical and 2nd ONU

For each physical interface, there would be an entry (ifIndex) in the
tables of the interface MIB module [RFC2863], MAU MIB module
[RFC3636] and Etherlike MIB module [RFC3635]. Additionally, there
would be entries (ifIndexes) for the virtual interfaces of the OLT
interface. The justification for the additional allocation of
indexes is that the virtual interfaces are quite well distinguished
as they connect different physical ONUs, from the OLT side. For
instance there is a meaning for separate bad frames counter or bad
octets counter for each virtual link, as the ONUs can be differently
distanced. This is quite similar to a case of separate physical
interfaces.

The same partition concept exists for the MIB module of this
document. Each row in the tables is indexed according to the ifIndex
and specifically there is a row for each virtual link. There are
some control objects which are shared and are the same for the
virtual interfaces (and they should have the same value for each
ifIndex) but most of the objects have different values for N+1
logical interfaces at the OLT. This is done for each MIB group. It
is a bit different from the [802.3ah] layering diagram which presents
the P2MP layer as a single layer while duplicating the MAC and MAC
client layers (Please see the diagram above). However from
management perspective it is more convenient and neat to partition
the management of the layers for the virtual links, as the atomic
managed entity is the virtual link. It is also convenient to use the
interface index of the virtual link for that purpose, as it is
already used to index the rows of the virtual links at the Interface,
MAU and etherLike interfaces MIBs.

[2](#). **MIB structure**

This document defines the DOT3 EPON MIB module. The DOT3 EPON MIB module defines the objects used for management of the [802.3ah] Point to Multipoint (P2MP) interfaces. These MIB objects are included in four groups.

i) The Multi-Point Control Protocol (MPCP) MIB objects - MIB objects related to [802.3ah] clause 64 Multi Point Control Protocol attributes. The following tables are presented in this group:

The dot3MpcpControlTable defines the objects used for the configuration and status indication, which are per logical link, of MPCP compliant interfaces.

The dot3MpcpStatTable defines the statistics objects, which are per logical link, of MPCP compliant interfaces.

The operational mode of an OLT/ONU for the tables is defined by the dot3MpcpMode object in the dot3MpcpControlTable.

ii) The OMPEmulation MIB objects - MIB objects related to [802.3ah] clause 65 point to point emulation attributes. The following tables are presented in this group:

The dot3OmpEmulationTable defines the objects used for the configuration and status indication, which are per logical link, of OMPEmulation compliant interfaces.

The dot3OmpEmulationStatTable defines the statistics objects which are per logical link, of OMPEmulation compliant interfaces.

The operational mode of an OLT/ONU for the tables is defined by the dot3OmpEmulationType object in the dot3OmpEmulationTable.

iii) The FEC MIB objects - MIB objects related to [802.3ah] clause 60 and clause 65 EPON FEC attributes. The following table is presented in this group:

The dot3EponFecTable defines the objects used for the configuration and status indication, which are per logical link, of FEC EPON compliant interfaces.

iv) The EPON extended package MIB objects - MIB objects used for configuration and status indication with extended capabilities of the

EPON interfaces. The following tables are presented in this group:

The dot3ExtPkgControlTable defines the objects which are per logical link, used for the configuration and status indication of EPON compliant interfaces.

The dot3ExtPkgQueueTable defines the objects which are per logical link, and per queue, used for the configuration and status indication of the ONU queues reported in the MPCP REPORT message, of EPON compliant interfaces.

The dot3ExtPkgQueueSetsTable defines the objects which are per logical link, per queue, and per queue_set, used for the configuration and status indication of the ONU queue_sets reported in the MPCP REPORT message, of EPON compliant interfaces.

The dot3ExtPkgOptIfTable defines the objects which are per logical link, used for the control and status indication of the optical interface of EPON compliant interfaces.

As described in the architecture section, each row in the tables is indexed according to the ifIndex, and specifically there is a row for each virtual link. There are a few control objects which are shared and have the same value for the virtual interfaces (and they should have the same value for each ifIndex) but most of the objects have different values for N+1 logical interfaces at the OLT. This is done for each MIB group. It is a bit different from the [802.3ah] layering diagram which presents the P2MP layer as a single layer while duplicating the MAC and MAC client layers. However from management perspective it is more convenient and neat to partition the management of the layers for the virtual links, as the atomic managed entity is the virtual link. It is also convenient to use the interface index of the virtual link for that purpose, as it is already used to index the rows of the virtual links at the Interface, MAU and etherLike interfaces MIBs.

For example provided below the values of the MPCP control table of an OLT with 3 registered ONUs:

The table below presents the MPCP control table of ONU1 in working
mode. A single row exists in the table.

```
          +----------------------------+-----------------+
          | MPCP control MIB object    | Value           |
          +----------------------------+-----------------+
          | ifIndex                    | 100             |
          |                            |                 |
          | dot3MpcpOperStatus         | true            |
          |                            |                 |
          | dot3MpcpAdminState         | true            |
          |                            |                 |
          | dot3MpcpMode               | onu             |
          |                            |                 |
          | dot3MpcpSyncTime           | 25              |
          |                            |                 |
          | dot3MpcpLinkID             | 1               |
          |                            |                 |
          | dot3MpcpRemoteMACAddress   | OLT_MAC_Address |
          |                            |                 |
          | dot3MpcpRegistrationState  | registered      |
          |                            |                 |
          | dot3MpcpTransmitElapsed    | 10              |
          |                            |                 |
          | dot3MpcpReceiveElapsed     | 10              |
          |                            |                 |
          | dot3MpcpRoundTripTime      | 100             |
          +----------------------------+-----------------+
```

                           Table 1

OLT_MAC_Address is the MAC address of the OLT EPON interface.

The creation of the rows of the ONU interface is done at
initialization.

For example, provided below are the values for the MPCP control table
of the ONU, after initialization, before registration.

The table below presents the MPCP control table of ONU1 after
initialization. A single row exists in the table.

```
+---------------------------+------------------+
| MPCP control MIB object   | Value            |
+---------------------------+------------------+
| ifIndex                   | 100              |
|                           |                  |
| dot3MpcpOperStatus        | true             |
|                           |                  |
| dot3MpcpAdminState        | true             |
|                           |                  |
| dot3MpcpMode              | onu              |
|                           |                  |
| dot3MpcpSyncTime          | 0                |
|                           |                  |
| dot3MpcpLinkID            | 0                |
|                           |                  |
| dot3MpcpRemoteMACAddress  | 00:00:00:00:00:00 |
|                           |                  |
| dot3MpcpRegistrationState | unregistered     |
|                           |                  |
| dot3MpcpTransmitElapsed   | 0                |
|                           |                  |
| dot3MpcpReceiveElapsed    | 0                |
|                           |                  |
| dot3MpcpRoundTripTime     | 0                |
+---------------------------+------------------+
```

Table 2

The table below presents the MPCP control table of the OLT in working
mode. Four rows exist in the table associated with the virtual
links.

MPCP control MIB object	Value	Value	Value	Value
ifIndex	100001	100002	100003	165535
dot3MpcpOperStatus	true	true	true	true
dot3MpcpAdminState	true	true	true	true
dot3MpcpMode	olt	olt	olt	olt
dot3MpcpSyncTime	25	25	25	25
dot3MpcpLinkID	1	2	3	65535
dot3MpcpRemoteMACAddress	ONU1_MAC_Address	ONU2_MAC_Address	ONU3_MAC_Address	BRCT_MAC_Address
dot3MpcpRegistrationState	registered	registered	registered	registered
dot3MpcpTransmitElapsed	10	10	10	10
dot3MpcpReceiveElapsed	10	10	10	10
dot3MpcpRoundTripTime	100	60	20	0

Table 3

ONU1_MAC_Address is the MAC address of ONU1 EPON interface.

ONU2_MAC_Address is the MAC address of ONU2 EPON interface.

ONU3_MAC_Address is the MAC address of ONU3 EPON interface.

BRCT_MAC_Address is the MAC address of the broadcast EPON interface,

   which is the OLT MAC address.

   The creation of the rows of the OLT interface and the broadcast
   virtual interface is done at initialization.

   The creation of rows of the virtual interfaces at the OLT is done
   when the link is established (ONU registers) and the deletion is done
   when the link is deleted (ONU deregisters).

   For example, provided below are the values of the MPCP control table
   of the OLT after initialization, before the ONUs register.

     The table below presents the MPCP control table of the OLT after
      initialization. A single row exists in this table associated with
                      the virtual broadcast link.

```
           +----------------------------+------------------+
           | MPCP control MIB object    | Value            |
           +----------------------------+------------------+
           | ifIndex                    | 165535           |
           |                            |                  |
           | dot3MpcpOperStatus         | true             |
           |                            |                  |
           | dot3MpcpAdminState         | true             |
           |                            |                  |
           | dot3MpcpMode               | olt              |
           |                            |                  |
           | dot3MpcpSyncTime           | 25               |
           |                            |                  |
           | dot3MpcpLinkID             | 65535            |
           |                            |                  |
           | dot3MpcpRemoteMACAddress   | BRCT_MAC_Address |
           |                            |                  |
           | dot3MpcpRegistrationState  | registered       |
           |                            |                  |
           | dot3MpcpTransmitElapsed    | 10               |
           |                            |                  |
           | dot3MpcpReceiveElapsed     | 100000           |
           |                            |                  |
           | dot3MpcpRoundTripTime      | 0                |
           +----------------------------+------------------+
```

                              Table 4

   BRCT_MAC_Address is the MAC address of the broadcast EPON interface,
   which is the OLT MAC address.

3. Relation to other MIB Modules

3.1. Relation to the Interfaces MIB and Ethernet-like Interfaces MIB

   EPON interface is a kind of Ether-like interface. This MIB module
   extends the objects of the Interface MIB and the Ether-like
   interfaces MIB for an EPON type interface.

   Implementing this module therefore MUST require implementation of the
   Interfaces MIB module [RFC2863] and the Ethernet-like Interfaces MIB
   module [RFC3635].

   Thus, each managed EPON interface would have a corresponding entry in
   the mandatory tables of the Ether-like MIB module found in [RFC3635],
   and likewise in the tables of the Interface MIB module found in
   [RFC2863]. Also each managed virtual EPON interface would have a
   corresponding entry in the mandatory tables of the Ether-like MIB
   module found in [RFC3635], and likewise in the tables of the
   Interface MIB module found in [RFC2863] with a dedicated ifIndex for
   this interface.

   In this document there is no replication of the objects from these
   MIBs, so for instance the document is defining
   dot3MpcpRemoteMACAddress only while assuming the local MAC address
   object is already defined in [RFC3635].

   The interface MIB module [RFC2863] defines the interface index
   (ifIndex). Interface Index, as specified in [RFC2863] is used in
   this MIB Module as an index to the EPON MIB tables. The ifIndex is
   used to denote the physical interface and the virtual link interfaces
   at the OLT. The OLT interface and the virtual link interfaces are
   stacked using the ifStack table defined in [RFC2863], and the
   ifInvStack defined in [RFC2864]. The OLT interface is the lower
   layer of all other interfaces associated with the virtual links.

   This document defines the specific EPON objects of an ONU interface
   and an OLT interface. Information in the tables is per LLID. The
   rows in the EPON MIB tables, referring to the LLIDs are denoted with
   the corresponding ifIndexes of the virtual link interfaces.

   Please note that each virtual interface does not have a different
   physical MAC address at the OLT as the physical interface is the
   same. It is specified in the [802.3ah] section 64.1.2. The
   corresponding object of the Ether-like interface MIB is duplicated
   for all the virtual interfaces.

   For example the values of the Interface MIB objects are presented in

the following tables, for an OLT with 3 registered ONUs:

The table below presents the objects of the Interface MIB of an ONU
in working mode.

Interface MIB object	Value
ifIndex	1
ifDescr	"interface description"
ifType	ethernetCsmacd (6) 1000base-Px
ifMtu	MTU size (1522)
ifSpeed	1000000000
ifPhysAddress	ONU_MAC_Address
ifAdminStatus	up
ifOperStatus	Up
ifLastChange	ONUup_time
ifInOctets	ONU_octets_number
ifInUcastPkts	ONU_unicast_frame_number
ifInNUcastPkts	ONU_non_unicast_frame_number
ifInDiscards	ONU_discard_frame_number
ifInErrors	ONU_error_frame_number
ifInUnknownProtos	ONU_unknown_frame_number
ifOutOctets	ONU_octets_number
ifOutUcastPkts	ONU_unicast_frame_number
ifOutNUcastPkts	ONU_non_unicast_frame_number
ifOutDiscards	ONU_discard_frame_number
ifOutErrors	ONU_error_frame_number

```
            | ifOutQLen            | ONU_queue_frame_number         |
            +----------------------+--------------------------------+
```

                              Table 5

   ONU_MAC_Address is the MAC address of the ONU EPON interface.

   The table below presents the objects of the Interface MIB of the ONU
                             interface.

Interface MIB object	Value
ifIndex	100
ifDescr	"interface description"
ifType	ethernetCsmacd (6) 1000base-Px
ifMtu	MTU size (1522)
ifSpeed	1000000000
ifPhysAddress	ONU_MAC_Address
ifAdminStatus	up
ifOperStatus	Up
ifLastChange	up_time
ifInOctets	ONU1_octets_number
ifInUcastPkts	ONU1_unicast_frame_number
ifInNUcastPkts	ONU1_non_unicast_frame_number
ifInDiscards	ONU1_discard_frame_number
ifInErrors	ONU1_error_frame_number
ifInUnknownProtos	ONU1_unknown_frame_number
ifOutOctets	ONU1_octets_number
ifOutUcastPkts	ONU1_unicast_frame_number
ifOutNUcastPkts	ONU1_non_unicast_frame_number

```
| ifOutDiscards        | ONU1_discard_frame_number     |
|                      |                               |
| ifOutErrors          | ONU1_error_frame_number       |
|                      |                               |
| ifOutQLen            | ONU1_queue_frame_number       |
+----------------------+-------------------------------+
```

                                Table 6

   ONU_MAC_Address is the MAC address of the ONU EPON interface.

   The following values will be set in the ifStack and ifInvStack tables
   related to this example.

   ifStackTable:

   ifStackHigherLayer=100, ifStackLowerLayer=1 - map between the
   physical interface and the ONU

   ifInvStackTable:

   ifStackLowerLayer=1, ifStackHigherLayer=100,- map between the ONU and
   the physical interface

       The table below presents the Interface MIB objects of an OLT
                              interface.

```
+----------------------+-------------------------------+
| Interface MIB object | Value                         |
+----------------------+-------------------------------+
| ifIndex              | 2                             |
|                      |                               |
| ifDescr              | "interface description"       |
|                      |                               |
| ifType               | ethernetCsmacd (6) 1000base-Px |
|                      |                               |
| ifMtu                | MTU size (1522)               |
|                      |                               |
| ifSpeed              | 1000000000                    |
|                      |                               |
| ifPhysAddress        | OLT_MAC_Address               |
|                      |                               |
| ifAdminStatus        | up                            |
|                      |                               |
| ifOperStatus         | Up                            |
|                      |                               |
| ifLastChange         | OLTup_time                    |
|                      |                               |
```

```
        | ifInOctets          | OLT_octets_number             |
        |                     |                               |
        | ifInUcastPkts       | OLT_unicast_frame_number      |
        |                     |                               |
        | ifInNUcastPkts      | OLT_non_unicast_frame_number  |
        |                     |                               |
        | ifInDiscards        | OLT_discard_frame_number      |
        |                     |                               |
        | ifInErrors          | OLT_error_frame_number        |
        |                     |                               |
        | ifInUnknownProtos   | OLT_unknown_frame_number      |
        |                     |                               |
        | ifOutOctets         | OLT_octets_number             |
        |                     |                               |
        | ifOutUcastPkts      | OLT_unicast_frame_number      |
        |                     |                               |
        | ifOutNUcastPkts     | OLT_non_unicast_frame_number  |
        |                     |                               |
        | ifOutDiscards       | OLT_discard_frame_number      |
        |                     |                               |
        | ifOutErrors         | OLT_error_frame_number        |
        |                     |                               |
        | ifOutQLen           | OLT_queue_frame_number        |
        +---------------------+-------------------------------+
```

                             Table 7

   OLT_MAC_Address is the MAC address of the OLT EPON interface.

      The table below presents the Interface MIB objects of an OLT
       interface, associated with the virtual link interfaces.

Interface MIB object	Value	Value	Value	Value
ifIndex	200001	200002	200003	265535
ifDescr	"interface description"	"interface description"	"interface description"	"interface description"
ifType	ethernetCsmacd (6)	ethernetCsmacd (6)	ethernetCsmacd (6)	ethernetCsmacd (6)
ifMtu	MTUsize(1522)	MTUsize(1522)	MTUsize(1522)	MTUsize(1522)

ifSpeed	1000000000	1000000000	1000000000	1000000000
ifPhysAddress	OLT_MAC_Address	OLT_MAC_Address	OLT_MAC_Address	OLT_MAC_Address
ifAdminStatus	up	up	up	up
ifOperStatus	Up	Up	Up	Up
ifLastChange	ONU1_up_time	ONU2_up_time	ONU3_up_time	up_time
ifInOctets	ONU1_octets_number	ONU2_octets_number	ONU3_octets_number	BRCT_octets_number
ifInUcastPkts	ONU1_unic_frame_num	ONU2_unic_frame_num	ONU3_unic_frame_num	BRCT_unic_frame_num
ifInNUcastPkts	ONU1_non_unic_frame_num	ONU2_non_unic_frame_num	ONU3_non_unic_frame_num	BRCT_non_unic_frame_num
ifInDiscards	ONU1_disc_frame_num	ONU2_disc_frame_num	ONU3_disc_frame_num	BRCT_disc_frame_numr
ifInErrors	ONU1_err_frame_num	ONU2_err_frame_num	ONU3_err_frame_num	BRCT_err_frame_num
ifInUnknownProtos	ONU1_unknw_frame_num	ONU2_unknw_frame_num	ONU3_unknw_frame_num	BRCT_unknw_frame_num
ifOutOctets	ONU1_octets_number	ONU2_octets_number	ONU3_octets_number	BRCT_octets_number
ifOutUcastPkts	ONU1_unic_frame_num	ONU2_unic_frame_num	ONU3_unic_frame_num	BRCT_unic_frame_num
ifOutNUcastPkts	ONU1_non_unic_frame_num	ONU2_non_unic_frame_num	ONU3_non_unic_frame_num	BRCT_non_unic_frame_num
ifOutDiscards	ONU1_disc_frame_num	ONU2_disc_frame_num	ONU3_disc_frame_num	BRCT_disc_frame_num

ifOutErr	ONU1_err_fr	ONU2_err_fr	ONU3_err_fr	BRCT_err_fra
ors	ame_num	ame_num	ame_num	me_num
ifOutQLe	ONU1_queue_	ONU2_queue_	ONU3_queue_	BRCt_queue_f
n	frame_num	frame_num	frame_num	rame_num

Table 8

OLT_MAC_Address is the MAC address of the OLT EPON interface.

The following values will be set in the ifStack and ifInvStack tables
related to this example:

ifStackTable:

ifStackHigherLayer=265535, ifStackLowerLayer=2 - map between the OLT
physical interface and its broadcast virtual interface

ifStackHigherLayer=200001, ifStackLowerLayer=2 - map between the OLT
physical interface and its virtual interface of the 1st ONU

ifStackHigherLayer=200002, ifStackLowerLayer=2 - map between the OLT
physical interface and its virtual interface of the 2nd ONU

ifStackHigherLayer=200003, ifStackLowerLayer=2 - map between the OLT
physical interface and its virtual interface of the 3rd ONU

ifInvStackTable:

ifStackLowerLayer=2, ifStackHigherLayer=265535, - map between the
broadcast interface of the OLT and the OLT physical interface

ifStackLowerLayer=2, ifStackHigherLayer=200001 - map between the OLT
virtual interface of the 1st ONU and the OLT physical interface

ifStackLowerLayer=2, ifStackHigherLayer=200002 - map between the OLT
virtual interface of the 2nd ONU and the OLT physical interface

ifStackLowerLayer=2, ifStackHigherLayer=200003 - map between the OLT
virtual interface of the 3rd ONU and the OLT physical interface

The rows for the ONU interface, for the OLT interface and for the OLT
broadcast interface are created in initialization.

The creation of a row for a virtual link is done when the virtual
link is established (ONU registers) and deletion is done when the

virtual link is deleted (ONU deregisters).

The EPON MIB module also extends the Interface MIB module with a set of counters, which are specific for the EPON interface. The EPON MIB module implements the same handling of the counters when the operation of the interface starts or stops. The interface MIB document describes the possible behavior of counters when an interface is re-initialized using the ifCounterDiscontinuityTime indicator, indicating the discontinuity of the counters. Please see [RFC2863] section 3.1.5 p.11 for more information. The counters of the EPON MIB should be handled in a similar manner.

3.2. Relation to the IEEE 802.3 MAU MIBs

The MAU types of the EPON Interface are defined in the amended MAU MIB document. This document assumes the implementation of the MAU MIB for this purpose and does not repeat the EPON MAU types. Therefore implementing this module MUST require implementation of the MAU-MIB module [RFC3636bis-03].

The handling of the ifMAU tables for the EPON case is similar to the handling described in the former section for the Interface and Ether-like interface MIBs. A single row exists for the ONU in the ifMauTable. A row for each virtual link (N+1 rows) exists at the OLT, with a separate value of ifMauIfIndex for each virtual link.

As specified above the rows for the ONU interface, for the OLT interface and for the OLT broadcast interface are created in initialization.

The creation of a row for a virtual link is done when the virtual link is established (ONU registers) and deletion is done when the virtual link is deleted (ONU deregisters).

3.3. Relation to the EFM OAM MIB

The EPON interfaces are aimed to the optical access networks and most probably will be accompanied with the implementation of the OAM section of the [802.3ah]. Therefore the EFM OAM MIB module [I-D.ietf-hubmib-efm-mib] MAY be implemented, when this MIB module is implemented, defining managed objects for the OAM layer that are complementary to the EFM EPON MIB module. As the OAM is defined for a point to point link it is implemented in this case, using the virtual links which are defined for the P2MP network, so that an instance is held for each Logical link (LLID) of the EPON. The corresponding ifIndex of the virtual link is used as the ifIndex of the tables of the OAM MIB module, for this purpose.

3.4. Relation to the bridge MIB

   It is very probable that an EPON OLT will implement a bridging
   functionality above the EPON interface layer, bridging between the
   EPON users and the network. Bridge functionality is specified at
   [802.1d]. In this scenario the virtual ports of the EPON are
   corresponding to the virtual bridge ports. There is a direct mapping
   between the bridge ports and the LLIDs, which are virtual EPON
   channels.

   Therefore the bridge MIB modules [RFC4188], [RFC1525] MAY be
   implemented when the EFM EPON MIB module is implemented for an EPON
   OLT, defining managed objects for the bridge layer.

   The values of dot1dBasePortIfIndex would correspond to the ifIndex of
   the virtual port (1 for LLID1, 2 for LLID2,...)

   The broadcast virtual EPON interface of the OLT has no direct mapping
   to a virtual bridge port as it is not port specific but used for
   broadcast traffic.

4. **Mapping of IEEE 802.3ah Managed Objects**

   This section contains the mapping between the managed objects defined
   in this document and the attributes defined in [802.3ah] Clause 30.
   The tables are divided to the relevant groups.

                   oMPCP managed object class (30.3.5)

   +----------------------------+------------------------+------------+
   | dot3EPON MIB module object | IEEE802.3ah attribute | Reference |
   +----------------------------+------------------------+------------+
ifIndex	aMPCPID	30.3.5.1.1
dot3MpcpOperStatus	aMPCPAdminState	30.3.5.1.2
dot3MpcpMode	aMPCPMode	30.3.5.1.3
dot3MpcpLinkID	aMPCPLinkID	30.3.5.1.4
dot3MpcpRemoteMACAddress	aMPCPRemoteMACAddress	30.3.5.1.5
dot3MpcpRegistrationState	aMPCPRegistrationState	30.3.5.1.6
dot3MpcpMACCtrlFramesTrans	aMPCPMACCtrlFramesTrans	30.3.5.1.7
mitted	mitted	
dot3MpcpMACCtrlFramesRecei	aMPCPMACCtrlFramesRecei	30.3.5.1.8
ved	ved	
dot3MpcpTxGate	aMPCPTxGate	30.3.5.1.9
dot3MpcpTxRegAck	aMPCPTxRegAck	30.3.5.1.1
		0
dot3MpcpTxRegister	aMPCPTxRegister	30.3.5.1.1
		1
dot3MpcpTxRegRequest	aMPCPTxRegRequest	30.3.5.1.1
		2
dot3MpcpTxReport	aMPCPTxReport	30.3.5.1.1
		3
dot3MpcpRxGate	aMPCPRxGate	30.3.5.1.1
		4
dot3MpcpRxRegAck	aMPCPRxRegAck	30.3.5.1.1
		5

dot3MpcpRxRegister	aMPCPRxRegister	30.3.5.1.16
dot3MpcpRxRegRequest	aMPCPRxRegRequest	30.3.5.1.17
dot3MpcpRxReport	aMPCPRxReport	30.3.5.1.18
dot3MpcpTransmitElapsed	aMPCPTransmitElapsed	30.3.5.1.19
dot3MpcpReceiveElapsed	aMPCPReceiveElapsed	30.3.5.1.20
dot3MpcpRoundTripTime	aMPCPRoundTripTime	30.3.5.1.21
dot3MpcpDiscoveryWindowsSent	aMPCPDiscoveryWindowsSent	30.3.5.1.22
dot3MpcpDiscoveryTimeout	aMPCPDiscoveryTimeout	30.3.5.1.23
dot3MpcpMaximumPendingGrants	aMPCPMaximumPendingGrants	30.3.5.1.24
dot3MpcpAdminState	aMPCPAdminControl	30.3.5.2.1
dot3MpcpSyncTime	SyncTime	64.3.3.2

Table 9

oOMPEmulation managed object class (30.3.7)

dot3EPON MIB module object	IEEE802.3ah attribute	Reference
ifIndex	aOMPEmulationID	30.3.7.1. 1
dot3OmpEmulationType	aOMPEmulationType	30.3.7.1. 2
dot3OmpEmulationSLDErrors	aSLDErrors	30.3.7.1. 3
dot3OmpEmulationCRC8Errors	aCRC8Errors	30.3.7.1. 4
dot3OmpEmulationGoodLLID	aGoodLLID	30.3.7.1. 5
dot3OmpEmulationOnuPonCastLLID	aONUPONcastLLID	30.3.7.1. 6
dot3OmpEmulationOltPonCastLLID	aOLTPONcastLLID	30.3.7.1. 7
dot3OmpEmulationBadLLID	aBadLLID	30.3.7.1. 8
dot3OmpEmulationBroadcastBitNotOnuLLid		
dot3OmpEmulationOnuLLIDNotBroadcast		
dot3OmpEmulationBroadcastBitPlusOnuLlid		
dot3OmpEmulationNotBroadcastBitNotOnuLlid		

Table 10

oMAU managed object class (30.5.1)

dot3EPON MIB module object	IEEE802.3ah attribute	Reference
dot3EponFecPCSCodingViolation	aPCSCodingViolation	30.5.1.1.12
dot3EponFecAbility	aFECAbility	30.5.1.1.13
dot3EponFecMode	aFECmode	30.5.1.1.14
dot3EponFecCorrectedBlocks	aFECCorrectedBlocks	30.5.1.1.15
dot3EponFecUncorrectableBlocks	aFECUncorrectableBlocks	30.5.1.1.16
dot3EponFecBufferHeadCodingViolation		

Table 11

[5](). Definitions - The DOT3 EPON MIB module

```
DOT3-EPON-MIB DEFINITIONS ::= BEGIN

    IMPORTS
        MODULE-IDENTITY, mib-2, OBJECT-TYPE, Counter32,
        Integer32, Unsigned32, Counter64
            FROM SNMPv2-SMI
        TruthValue, MacAddress
            FROM SNMPv2-TC
        ifIndex
            FROM IF-MIB
        MODULE-COMPLIANCE, OBJECT-GROUP
            FROM SNMPv2-CONF
        ;

dot3EponMIB MODULE-IDENTITY
    LAST-UPDATED "200607210000Z"  -- July 21, 2006
    ORGANIZATION "IETF Ethernet Interfaces and Hub MIB Working
                 Group"
    CONTACT-INFO
                 "WG charter:
              http://www.ietf.org/html.charters/hubmib-charter.html
                  Mailing Lists:
                   General Discussion: hubmib@ietf.org
                   To Subscribe: hubmib-request@ietf.org
                   In Body: subscribe your_email_address
                   Chair: Dan Romascanu
                   Postal: Avaya
                          Atidim Technology Park, Bldg. 3
                          Tel Aviv 61131
                          Israel
                    Tel: +972-3-645-8414
                    E-mail: dromasca@avaya.com

                  Editor: Lior Khermosh
                  Postal: PMC-SIERRA
                          Kohav Hertzelia bldg,
                          94 Hasadnaot St.
                          Hertzliya Pituach 46120,
                          ISRAEL
                  P.O.Box 2089 Hertzliya Pituach 46120 Israel
                  Tel:    +972-9-9628000 Ext: 302
                     E-mail: lior_khermosh@pmc-sierra.com"
    DESCRIPTION
```

                "The objects in this MIB module are used to manage the
                 Ethernet in the First Mile(EFM) Ethernet Passive Optical
                 Network(EPON) Interfaces as defined in IEEE P802.3ah
                 clause 60,64,65.
             The following reference is used throughout this MIB module:
               [802.3ah] refers 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. IEEE Std 802.3ah-2004, October 2004.

              Of particular interest are Clause 64(Multi-Point Control
              Protocol - MPCP), Clause 65(Point to Multipoint
              Reconciliation Sublayer - P2MP RS), Clause 60 (Ethernet
              Passive Optical Network Physical Medium Dependent - EPON
              PMDs), Clause 30, 'Management', and Clause 45, 'Management
              Data Input/Output (MDIO) Interface'.

              Copyright (C) The Internet Society (2006). This version
              of this MIB module is part of XXXX see the RFC itself for
              full legal notices.

              Key abbreviations:
                BER - Bit Error Rate
                BW - bandwidth
                CRC - Cyclic Redundancy Check
                EFM - Ethernet First Mile
                EPON - Ethernet Passive Optical Network
                FEC - Forward Error Correction
                LLID - Logical Link Identifier
                MAC - Media Access Control
                Mbps - Mega-bit per second
                MDIO - Management Data Input/Output
                MPCP - Multi-Point Control Protocol
                OLT - Optical Line Terminal (Server unit of the EPON)
                OMP - Optical Multi-Point
                ONU - Optical Network Unit (Client unit of the EPON)
                P2MP - Point to Multi-Point
                PHY - Physical Layer
                PMD - Physical Medium Dependent
                PON - Passive Optical Network
                RTT - Round Trip Time
                SLD - Start of LLID Delimiter
                TQ - Time Quanta

```
             "

             -- Editor's Note: Replace XXXX with the actual RFC number
             -- assigned by RFC Editor and remove this note

        REVISION    "200607210000Z"  -- July 21, 2006
        DESCRIPTION "Initial version, published as RFC XXXX."

        ::= { mib-2 XXX }

        -- Editor's Note (to be removed prior to publication): the
        -- IANA is requested to assign a value for "XXX" under the
        -- 'mib-2' subtree and to record the assignment in the SMI
        -- Numbers registry.  When the assignment has been made, the
        -- RFC Editor is asked to replace "XXX" (here and in the MIB
        -- module) with the assigned value and to remove this note.


    dot3EponObjects OBJECT IDENTIFIER ::= { dot3EponMIB 1}

    dot3EponConformance OBJECT IDENTIFIER ::= { dot3EponMIB 2}

    -- MPCP MIB modules definitions ([802.3ah] clause 30.3.5)

    dot3EponMpcpObjects
         OBJECT IDENTIFIER ::= { dot3EponObjects 1 }



    dot3MpcpControlTable OBJECT-TYPE
        SYNTAX  SEQUENCE OF Dot3MpcpControlEntry
        MAX-ACCESS  not-accessible
        STATUS  current
        DESCRIPTION
                "Table of dot3 Multi-Point Control Protocol (MPCP)
                 MIB objects. The entries in the table are control and
                 status objects of the MPCP.
                 Each object has a row for every virtual link denoted by
                 the corresponding ifIndex.
                 Typically the number of expected virtual links in a PON
                 is like the number of ONUs, which is 32-64, plus an
                 additional entry for broadcast LLID (with a value of
                 0xffff).
                 In the [802.3ah] the LLID is a 2bytes register and the
                 number of LLIDs is limited by that."
        ::= { dot3EponMpcpObjects 1 }

    dot3MpcpControlEntry OBJECT-TYPE
```

```
        SYNTAX  Dot3MpcpControlEntry
        MAX-ACCESS  not-accessible
        STATUS  current
        DESCRIPTION
                "An entry in the dot3 MPCP Control table.
                 Rows exist for an OLT interface and an ONU interface.
                 Rows in the table are denoted by the ifIndexes and they
                 are created when the ifIndexes are created.
                 For the ONU rows are created at system initialization.
                 For the OLT the row of the OLT ifIndex and the row of
                 the ifIndex referring to the broadcast virtual link are
                 created at system initialization. For the ifIndexes
                 referring to the virtual links at the OLT, a row is
                 created when a virtual link is established (ONU
                 registers) and deleted when the virtual link is deleted
                 (ONU deregisters)."
        INDEX  { ifIndex }
        ::= { dot3MpcpControlTable 1}

    Dot3MpcpControlEntry ::=
        SEQUENCE {
            dot3MpcpOperStatus                 TruthValue,
            dot3MpcpAdminState                 TruthValue,
            dot3MpcpMode                       INTEGER,
            dot3MpcpSyncTime                   Unsigned32,
            dot3MpcpLinkID                     Unsigned32,
            dot3MpcpRemoteMACAddress           MacAddress,
            dot3MpcpRegistrationState          INTEGER,
            dot3MpcpTransmitElapsed            Unsigned32,
            dot3MpcpReceiveElapsed             Unsigned32,
            dot3MpcpRoundTripTime              Unsigned32,
            dot3MpcpMaximumPendingGrants       Unsigned32
        }

    dot3MpcpOperStatus OBJECT-TYPE
        SYNTAX  TruthValue
        MAX-ACCESS  read-only
        STATUS  current
        DESCRIPTION
                "This object reflects the operational state of the
                 Multi-Point MAC Control sublayer as defined in [802.3ah]
                 clause 64. When the value is true(1) the interface will
                 act as if Multi-Point control protocol is enabled.
                 When the value is false(2) the interface will act as if
                 it does not have the Multi-Point control protocol. The
                 operational state can be changed using the
                 dot3MpcpAdminState object.
                 This object is applicable for an OLT, with the same
```

                       value for all virtual interfaces, and for an ONU."
         REFERENCE   "[802.3ah], 30.3.5.1.2."
         ::= { dot3MpcpControlEntry 1 }

      dot3MpcpAdminState OBJECT-TYPE
         SYNTAX   TruthValue
         MAX-ACCESS   read-write
         STATUS   current
         DESCRIPTION
                 "This object is used to define the admin state of
                  the Multi-Point MAC Control sublayer as defined in
                  [802.3ah] clause 64. When selecting the value as true(1)
                  the Multi-Point control protocol of the interface is
                  enabled.
                  When selecting the value as false(2) the interface acts
                  as if the Multi-Point Control protocol does not exist.
                  Reading reflects the state of the object which is the
                  mode of operation of the Multi-Point control protocol of
                  the interface.
                  Writing can be done at any time.
                  This object is applicable for an OLT, with the same
                  value for all virtual interfaces, and for an ONU."
         REFERENCE   "[802.3ah], 30.3.5.2.1."
         DEFVAL { false }
         ::= { dot3MpcpControlEntry 2 }

      dot3MpcpMode   OBJECT-TYPE
         SYNTAX   INTEGER {
                 olt(1),
                 onu(2)
         }
         MAX-ACCESS   read-only
         STATUS   current
         DESCRIPTION
                 "This object is used to identify the operational
                  state of the Multi-Point MAC Control sublayer as
                  defined in [802.3ah] clause 64. Reading olt(1) for an
                  OLT (server) mode and onu(2) for an ONU (client) mode.
                  This object is used to identify the operational mode
                  for the MPCP tables.
                  This object is applicable for an OLT, with the same
                  value for all virtual interfaces, and for an ONU."
         REFERENCE   "[802.3ah], 30.3.5.1.3."
         DEFVAL { 1 }
         ::= { dot3MpcpControlEntry 3 }

    dot3MpcpSyncTime OBJECT-TYPE
        SYNTAX Unsigned32
        UNITS   "TQ (16nsec)"
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
                "An object that reports the 'sync lock time' of the
                 OLT receiver in increments of Time Quanta (TQ)-16ns
                 as defined in [802.3ah] 60,64,65. The value returned
                 shall be (sync lock time ns)/16. If this value exceeds
                 (2^32-1) the value (2^32-1) shall be returned.
                 This object is applicable for an OLT, with the same
                 value for all virtual interfaces, and for an ONU."
        REFERENCE   "[802.3ah], 64.3.3.2."
        ::= { dot3MpcpControlEntry 4 }

    dot3MpcpLinkID OBJECT-TYPE
        SYNTAX Unsigned32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
                "An object that identifies the Logical Link
                 identifier (LLID) associated with the MAC of the virtual
                 link, as specified in [802.3ah] clause 65.1.3.2.2.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 For the same virtual link, the ONU and the corresponding
                 virtual MAC of the OLT have the same value.
                 Value is assigned when the ONU registers.
                 Value is freed when the ONU deregisters."
        REFERENCE   "[802.3ah], 30.3.5.1.4."
        ::= { dot3MpcpControlEntry 5 }

    dot3MpcpRemoteMACAddress OBJECT-TYPE
        SYNTAX MacAddress
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
                "An object that identifies the source_address
                 parameter of the last MPCPDUs passed to the MAC Control.
                 This value is updated on reception of a valid frame with
                 (1) a destination Field equal to the reserved multicast
                 address for MAC Control specified in [802.3] Annex
                 31A, (2) lengthOrType field value equal to the reserved
                 Type for MAC Control as specified in [802.3] Annex
                 31A. (3) an MPCP subtype value equal to the subtype
                 reserved for MPCP as specified in [802.3ah] Annex 31A.
                 This object is applicable for an OLT and an ONU. At the

                 OLT it has a value for each virtual interface.
                 The value reflects the MAC address of the remote entity
                 and therefore the OLT holds a value for each LLID which
                 is the MAC address of the ONU and the ONU has a single
                 value which is the OLT MAC address."
         REFERENCE   "[802.3ah], 30.3.5.1.5."
         ::= { dot3MpcpControlEntry 6 }

     dot3MpcpRegistrationState OBJECT-TYPE
         SYNTAX   INTEGER {
                 unregistered(1),
                 registering(2),
                 registered(3)
         }
         MAX-ACCESS   read-only
         STATUS   current
         DESCRIPTION
                 "An object that identifies the registration state
                  of the Multi-Point MAC Control sublayer as defined in
                  [802.3ah] clause 64. When this object has the
                  enumeration unregistered(1) the interface is
                  unregistered and may be used for registering a link
                  partner. When this object has the enumeration
                  registering(2) the interface is in the process of
                  registering a link-partner. When this object has the
                  enumeration registered(3) the interface has an
                  established link-partner.
                  This object is applicable for an OLT and an ONU. At the
                  OLT it has a value for each virtual interface."
         REFERENCE   "[802.3ah], 30.3.5.1.6."
         ::= { dot3MpcpControlEntry 7 }

     dot3MpcpTransmitElapsed OBJECT-TYPE
         SYNTAX   Unsigned32
         UNITS   "TQ (16nsec)"
         MAX-ACCESS   read-only
         STATUS   current
         DESCRIPTION
                 "An object that reports the interval from last
                  MPCP frame transmission in increments of Time Quanta
                  (TQ)-16ns. The value returned shall be (interval from
                  last MPCP frame transmission in ns)/16. If this value
                  exceeds (2^32-1) the value (2^32-1) shall be returned.
                  This object is applicable for an OLT and an ONU. At the
                  OLT it has a value for each virtual interface."
         REFERENCE   "[802.3ah], 30.3.5.1.19."
         ::= { dot3MpcpControlEntry 8 }

    dot3MpcpReceiveElapsed OBJECT-TYPE
        SYNTAX Unsigned32
        UNITS   "TQ (16nsec)"
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
                "An object that reports the interval from last MPCP frame
                 reception in increments of Time Quanta (TQ)-16ns. The
                 value returned shall be (interval from last MPCP frame
                 reception in ns)/16. If this value exceeds (2^32-1) the
                 value (2^32-1) shall be returned.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface."
        REFERENCE   "[802.3ah], 30.3.5.1.20."
        ::= { dot3MpcpControlEntry 9 }

    dot3MpcpRoundTripTime OBJECT-TYPE
        SYNTAX Unsigned32 (0..'ffff'h)
        UNITS   "TQ (16nsec)"
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
                "An object that reports the MPCP round trip time in
                 increments of Time Quanta (TQ)-16ns. The value returned
                 shall be (round trip time in ns)/16. If this value
                 exceeds (2^16-1) the value (2^16-1) shall be returned.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface."
        REFERENCE   "[802.3ah], 30.3.5.1.21."
        ::= { dot3MpcpControlEntry 10 }

    dot3MpcpMaximumPendingGrants OBJECT-TYPE
        SYNTAX Unsigned32 (0..255)
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
                "An object that reports the maximum number of grants an
                 ONU can store for handling. The maximum number of grants
                 an ONU can store for handling has a range of 0 to 255.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 At the OLT the value should be zero."
        REFERENCE   "[802.3ah], 30.3.5.1.24."
        ::= { dot3MpcpControlEntry 11 }

    dot3MpcpStatTable OBJECT-TYPE
        SYNTAX   SEQUENCE OF Dot3MpcpStatEntry

         MAX-ACCESS not-accessible
         STATUS   current
         DESCRIPTION
                 "This table defines the list of statistics counters of
                  an interface implementing the [802.3ah] clause 64 MPCP.
                  Each object has a row for every virtual link denoted by
                  the corresponding ifIndex.
                  Typically the number of expected virtual links in a PON
                  is like the number of ONUs, which is 32-64, plus an
                  additional entry for broadcast LLID (with a value of
                  0xffff).
                  In the [802.3ah] the LLID is a 2bytes register and the
                  number of LLIDs is limited by that."
     ::= { dot3EponMpcpObjects 2 }

     dot3MpcpStatEntry OBJECT-TYPE
         SYNTAX   Dot3MpcpStatEntry
         MAX-ACCESS not-accessible
         STATUS   current
         DESCRIPTION
                 "Table entries for the table of statistics counters of
                  the [802.3ah] clause 64 MPCP interface.
                  Rows exist for an OLT interface and an ONU interface.
                  Rows in the table are denoted by the ifIndexes and they
                  are created when the ifIndexes are created.
                  For the ONU rows are created at system initialization.
                  For the OLT the row of the OLT ifIndex and the row of
                  the ifIndex referring to the broadcast virtual link are
                  created at system initialization. For the ifIndexes
                  referring to the virtual links at the OLT, a row is
                  created when a virtual link is established (ONU
                  registers) and deleted when the virtual link is deleted
                  (ONU deregisters)."

         INDEX { ifIndex}
         ::= { dot3MpcpStatTable 1 }

     Dot3MpcpStatEntry ::=
         SEQUENCE {
                 dot3MpcpMACCtrlFramesTransmitted   Counter64,
                 dot3MpcpMACCtrlFramesReceived   Counter64,
                 dot3MpcpDiscoveryWindowsSent   Counter32,
                 dot3MpcpDiscoveryTimeout   Counter32,
                 dot3MpcpTxRegRequest   Counter64,
                 dot3MpcpRxRegRequest   Counter64,
                 dot3MpcpTxRegAck   Counter64,
                 dot3MpcpRxRegAck   Counter64,
                 dot3MpcpTxReport   Counter64,

```
            dot3MpcpRxReport                          Counter64,
            dot3MpcpTxGate                            Counter64,
            dot3MpcpRxGate                            Counter64,
            dot3MpcpTxRegister                        Counter64,
            dot3MpcpRxRegister                        Counter64
        }

    dot3MpcpMACCtrlFramesTransmitted OBJECT-TYPE
        SYNTAX   Counter64
        UNITS        "frames"
        MAX-ACCESS  read-only
        STATUS   current
        DESCRIPTION
                "A count of MPCP frames passed to the MAC sublayer for
                 transmission. This counter is incremented when a
                 MA_CONTROL.request service primitive is generated within
                 the MAC control sublayer with an opcode indicating an
                 MPCP frame.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
        REFERENCE   "[802.3ah], 30.3.5.1.7."
        ::= { dot3MpcpStatEntry 1 }

    dot3MpcpMACCtrlFramesReceived OBJECT-TYPE
        SYNTAX   Counter64
        UNITS        "frames"
        MAX-ACCESS  read-only
        STATUS   current
        DESCRIPTION
                "A count of MPCP frames passed by the MAC sublayer to the
                 MAC Control sublayer. This counter is incremented when a
                 ReceiveFrame function call returns a valid frame with:
                 (1) a lengthOrType field value equal to the reserved
                 Type for 802.3_MAC_Control as specified in 31.4.1.3, and
                 (2) an opcode indicating an MPCP frame.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
        REFERENCE   "[802.3ah], 30.3.5.1.8."
         ::= { dot3MpcpStatEntry 2}
```

     dot3MpcpDiscoveryWindowsSent OBJECT-TYPE
         SYNTAX   Counter32
         MAX-ACCESS   read-only
         STATUS   current
         DESCRIPTION
                 "A count of discovery windows generated. The counter is
                  incremented by one for each generated discovery window.
                  This object is applicable for an OLT and an ONU. At the
                  OLT it has a value for each virtual interface.
                  At the ONU the value should be zero.
                  Discontinuities of this counter can occur at
                  re-initialization of the management system, and at other
                  times as indicated by the value of the
                  ifCounterDiscontinuityTime."
         REFERENCE   "[802.3ah], 30.3.5.1.22."
          ::= { dot3MpcpStatEntry 3}

     dot3MpcpDiscoveryTimeout OBJECT-TYPE
         SYNTAX   Counter32
         MAX-ACCESS   read-only
         STATUS   current
         DESCRIPTION
                 "A count of the number of times a discovery timeout
                  occurs. Increment the counter by one for each discovery
                  processing state-machine reset resulting from timeout
                  waiting for message arrival.
                  This object is applicable for an OLT and an ONU. At the
                  OLT it has a value for each virtual interface.
                  Discontinuities of this counter can occur at
                  re-initialization of the management system, and at other
                  times as indicated by the value of the
                  ifCounterDiscontinuityTime."
         REFERENCE   "[802.3ah], 30.3.5.1.23."
          ::= { dot3MpcpStatEntry 4}

     dot3MpcpTxRegRequest OBJECT-TYPE
         SYNTAX   Counter64
         UNITS   "frames"
         MAX-ACCESS   read-only
         STATUS   current
         DESCRIPTION
                 "A count of the number of times a REGISTER_REQ MPCP
                  frame transmission occurs. Increment the counter by one
                  for each REGISTER_REQ MPCP frame transmitted as defined
                  in [802.3ah] clause 64.
                  This object is applicable for an OLT and an ONU. At the
                  OLT it has a value for each virtual interface.

```
                At the OLT the value should be zero.
                Discontinuities of this counter can occur at
                re-initialization of the management system, and at other
                times as indicated by the value of the
                ifCounterDiscontinuityTime."
        REFERENCE   "[802.3ah], 30.3.5.1.12."
        ::= { dot3MpcpStatEntry 5}

    dot3MpcpRxRegRequest OBJECT-TYPE
        SYNTAX  Counter64
        UNITS       "frames"
        MAX-ACCESS  read-only
        STATUS  current
        DESCRIPTION
                "A count of the number of times a REGISTER_REQ MPCP
                 frame reception occurs.
                 Increment the counter by one for each REGISTER_REQ MPCP
                 frame received as defined in [802.3ah] clause 64.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 At the ONU the value should be zero.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
      REFERENCE    "[802.3ah], 30.3.5.1.17."
        ::= { dot3MpcpStatEntry 6}

    dot3MpcpTxRegAck OBJECT-TYPE
        SYNTAX  Counter64
        UNITS       "frames"
        MAX-ACCESS  read-only
        STATUS  current
        DESCRIPTION
                "A count of the number of times a REGISTER_ACK MPCP
                 frame transmission occurs. Increment the counter by one
                 for each REGISTER_ACK MPCP frame transmitted as defined
                 in [802.3ah] clause 64.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 At the OLT the value should be zero.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
      REFERENCE    "[802.3ah], 30.3.5.1.10."
        ::= { dot3MpcpStatEntry 7}
```

```
    dot3MpcpRxRegAck OBJECT-TYPE
        SYNTAX  Counter64
        UNITS      "frames"
        MAX-ACCESS  read-only
        STATUS  current
        DESCRIPTION
                "A count of the number of times a REGISTER_ACK MPCP
                 frame reception occurs.
                 Increment the counter by one for each REGISTER_ACK MPCP
                 frame received, as defined in [802.3ah] clause 64.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 At the ONU the value should be zero.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
        REFERENCE   "[802.3ah], 30.3.5.1.15."
        ::= { dot3MpcpStatEntry 8}

    dot3MpcpTxReport OBJECT-TYPE
        SYNTAX  Counter64
        UNITS      "frames"
        MAX-ACCESS  read-only
        STATUS  current
        DESCRIPTION
                "A count of the number of times a REPORT MPCP frame
                 transmission occurs. Increment the counter by one for
                 each REPORT MPCP frame transmitted as defined in
                 [802.3ah] clause 64.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 At the OLT the value should be zero.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
        REFERENCE   "[802.3ah], 30.3.5.1.13."
        ::= { dot3MpcpStatEntry 9}

    dot3MpcpRxReport OBJECT-TYPE
        SYNTAX  Counter64
        UNITS      "frames"
        MAX-ACCESS  read-only
        STATUS  current
        DESCRIPTION
                "A count of the number of times a REPORT MPCP frame
                 reception occurs.
```

                    Increment the counter by one for each REPORT MPCP frame
                    received, as defined in [802.3ah] clause 64.
                    This object is applicable for an OLT and an ONU. At the
                    OLT it has a value for each virtual interface.
                    At the ONU the value should be zero.
                    Discontinuities of this counter can occur at
                    re-initialization of the management system, and at other
                    times as indicated by the value of the
                    ifCounterDiscontinuityTime."
        REFERENCE   "[802.3ah], 30.3.5.1.18."
        ::= { dot3MpcpStatEntry 10}

    dot3MpcpTxGate OBJECT-TYPE
        SYNTAX Counter64
        UNITS   "frames"
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
                "A count of the number of times a GATE MPCP frame
                 transmission occurs.
                 Increment the counter by one for each GATE MPCP frame
                 transmitted, as defined in [802.3ah] clause 64.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 At the ONU the value should be zero.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
        REFERENCE   "[802.3ah], 30.3.5.1.9."
        ::= { dot3MpcpStatEntry 11}

    dot3MpcpRxGate OBJECT-TYPE
        SYNTAX Counter64
        UNITS   "frames"
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
                "A count of the number of times a GATE MPCP frame
                 reception occurs.
                 Increment the counter by one for each GATE MPCP frame
                 received, as defined in [802.3ah] clause 64.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 At the OLT the value should be zero.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the

                     ifCounterDiscontinuityTime."
          REFERENCE   "[802.3ah], 30.3.5.1.14."
          ::= { dot3MpcpStatEntry 12}

    dot3MpcpTxRegister OBJECT-TYPE
        SYNTAX Counter64
        UNITS   "frames"
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
                "A count of the number of times a REGISTER MPCP frame
                 transmission occurs.
                 Increment the counter by one for each REGISTER MPCP
                 frame transmitted, as defined in [802.3ah] clause 64.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 At the ONU the value should be zero.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
          REFERENCE   "[802.3ah], 30.3.5.1.11."
           ::= { dot3MpcpStatEntry 13}

    dot3MpcpRxRegister OBJECT-TYPE
        SYNTAX Counter64
        UNITS   "frames"
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
                "A count of the number of times a REGISTER MPCP frame
                 reception occurs.
                 Increment the counter by one for each REGISTER MPCP
                 frame received, as defined in [802.3ah] clause 64.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 At the OLT the value should be zero.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
          REFERENCE   "[802.3ah], 30.3.5.1.16."
          ::= { dot3MpcpStatEntry 14}

    -- Optical Multi Point Emulation (OMPEmulation)

    -- managed object definitions

    dot3OmpEmulationObjects OBJECT IDENTIFIER ::={dot3EponObjects 2}

    dot3OmpEmulationTable OBJECT-TYPE
        SYNTAX   SEQUENCE OF Dot3OmpEmulationEntry
        MAX-ACCESS not-accessible
        STATUS current
        DESCRIPTION
                "Table of dot3 OmpEmulation MIB objects. The table
                 defines the management settings of the OMPEmulation
                 sublayer.
                 Each object has a row for every virtual link denoted by
                 the corresponding ifIndex.
                 Typically the number of expected virtual links in a PON
                 is like the number of ONUs, which is 32-64, plus an
                 additional entry for broadcast LLID (with a value of
                 0xffff).
                 In the [802.3ah] the LLID is a 2bytes register and the
                 number of LLIDs is limited by that."
        ::= { dot3OmpEmulationObjects 1 }

    dot3OmpEmulationEntry OBJECT-TYPE
        SYNTAX   Dot3OmpEmulationEntry
        MAX-ACCESS not-accessible
        STATUS current
        DESCRIPTION
                "An entry in the dot3 OmpEmulation table.
                 Rows exist for an OLT interface and an ONU interface.
                 Rows in the table are denoted by the ifIndexes and they
                 are created when the ifIndexes are created.
                 For the ONU rows are created at system initialization.
                 For the OLT the row of the OLT ifIndex and the row of
                 the ifIndex referring to the broadcast virtual link are
                 created at system initialization. For the ifIndexes
                 referring to the virtual links at the OLT, a row is
                 created when a virtual link is established (ONU
                 registers) and deleted when the virtual link is deleted
                 (ONU deregisters)."
        INDEX { ifIndex }
        ::= { dot3OmpEmulationTable 1 }

        Dot3OmpEmulationEntry ::=
        SEQUENCE {
                dot3OmpEmulationType   INTEGER
        }

    dot3OmpEmulationType OBJECT-TYPE
        SYNTAX INTEGER {
                unknown(1),
                olt(2),
                onu(3)
        }
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
                "An object that indicates the mode of operation
                 of the Reconciliation Sublayer for Point to Point
                 Emulation (see [802.3ah] clause 65.1). unknown(1) value
                 is assigned in initialization, true state or type not
                 yet known. olt(2) value is assigned when the sublayer is
                 operating in OLT mode. onu(3) value is assigned when the
                 sublayer is operating in ONU mode.
                 This object is applicable for an OLT, with the same
                 value for all virtual interfaces, and for an ONU."
        REFERENCE   "[802.3ah], 30.3.7.1.2."
        ::= { dot3OmpEmulationEntry 1}

    dot3OmpEmulationStatTable OBJECT-TYPE
        SYNTAX   SEQUENCE OF Dot3OmpEmulationStatEntry
        MAX-ACCESS not-accessible
        STATUS   current
        DESCRIPTION
                "This table defines the list of statistics counters of
                 [802.3ah] clause 65 OMPEmulation sublayer.
                 Each object has a row for every virtual link denoted by
                 the corresponding ifIndex.
                 Typically the number of expected virtual links in a PON
                 is like the number of ONUs, which is 32-64, plus an
                 additional entry for broadcast LLID (with a value of
                 0xffff).
                 In the [802.3ah] the LLID is a 2bytes register and the
                 number of LLIDs is limited by that."
        ::= { dot3OmpEmulationObjects 2}

    dot3OmpEmulationStatEntry OBJECT-TYPE
        SYNTAX   Dot3OmpEmulationStatEntry
        MAX-ACCESS not-accessible
        STATUS   current
        DESCRIPTION
                "Table entries for the table of statistics counters of
                 [802.3ah] clause 65 OMPEmulation sublayer.
                 Rows exist for an OLT interface and an ONU interface.
                 Rows in the table are denoted by the ifIndexes and they
                 are created when the ifIndexes are created.

```
                For the ONU rows are created at system initialization.
                For the OLT the row of the OLT ifIndex and the row of
                the ifIndex referring to the broadcast virtual link are
                created at system initialization. For the ifIndexes
                referring to the virtual links at the OLT, a row is
                created when a virtual link is established (ONU
                registers) and deleted when the virtual link is deleted
                (ONU deregisters)."
        INDEX  { ifIndex}
        ::= { dot3OmpEmulationStatTable 1 }

    Dot3OmpEmulationStatEntry::=
        SEQUENCE {
                dot3OmpEmulationSLDErrors                 Counter64,
                dot3OmpEmulationCRC8Errors               Counter64,
                dot3OmpEmulationBadLLID                  Counter64,
                dot3OmpEmulationGoodLLID                 Counter64,
                dot3OmpEmulationOnuPonCastLLID           Counter64,
                dot3OmpEmulationOltPonCastLLID           Counter64,
                dot3OmpEmulationBroadcastBitNotOnuLlid   Counter64,
                dot3OmpEmulationOnuLLIDNotBroadcast      Counter64,
                dot3OmpEmulationBroadcastBitPlusOnuLlid   Counter64,
                dot3OmpEmulationNotBroadcastBitNotOnuLlid  Counter64
        }

    dot3OmpEmulationSLDErrors OBJECT-TYPE
        SYNTAX  Counter64
        UNITS      "frames"
        MAX-ACCESS  read-only
        STATUS  current
        DESCRIPTION
                "A count of frames received that do not contain a valid
                 SLD field as defined in [802.3ah] clause 65.1.3.3.1.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
        REFERENCE   "[802.3ah], 30.3.7.1.3."
        ::= { dot3OmpEmulationStatEntry 1}

    dot3OmpEmulationCRC8Errors OBJECT-TYPE
        SYNTAX  Counter64
        UNITS      "frames"
        MAX-ACCESS  read-only
        STATUS  current
        DESCRIPTION
```

                    "A count of frames received that contain a valid SLD
                     field, as defined in [802.3ah] clause 65.1.3.3.1, but do
                     not pass the CRC-8 check as defined in [802.3ah] clause
                     65.1.3.3.3.
                     This object is applicable for an OLT and an ONU. At the
                     OLT it has a value for each virtual interface.
                     Discontinuities of this counter can occur at
                     re-initialization of the management system, and at other
                     times as indicated by the value of the
                     ifCounterDiscontinuityTime."
            REFERENCE   "[802.3ah], 30.3.7.1.4."
            ::= { dot3OmpEmulationStatEntry 2}

        dot3OmpEmulationBadLLID OBJECT-TYPE
            SYNTAX Counter64
            UNITS   "frames"
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                    "A count of frames received that contain a valid SLD
                     field, as defined in [802.3ah] clause 65.1.3.3.1, and
                     pass the CRC-8 check, as defined in [802.3ah] clause
                     65.1.3.3.3, but are discarded due to the LLID check as
                     defined in [802.3ah] clause 65.1.3.3.2.
                     This object is applicable for an OLT and an ONU. At the
                     OLT it has a value for each virtual interface.
                     Discontinuities of this counter can occur at
                     re-initialization of the management system, and at other
                     times as indicated by the value of the
                     ifCounterDiscontinuityTime."
            REFERENCE   "[802.3ah], 30.3.7.1.8."
            ::= { dot3OmpEmulationStatEntry 3}

    dot3OmpEmulationGoodLLID OBJECT-TYPE
            SYNTAX Counter64
            UNITS   "frames"
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION
                    "A count of frames received that contain a valid SLD
                     field, as defined in [802.3ah] clause 65.1.3.3.1, and
                     pass the CRC-8 check, as defined in [802.3ah] clause
                     65.1.3.3.3.
                     This object is applicable for an OLT and an ONU. At the
                     OLT it has a value for each virtual interface.
                     Discontinuities of this counter can occur at
                     re-initialization of the management system, and at other

                    times as indicated by the value of the
                    ifCounterDiscontinuityTime."
        REFERENCE   "[802.3ah], 30.3.7.1.5."
        ::= { dot3OmpEmulationStatEntry 4}

    dot3OmpEmulationOnuPonCastLLID OBJECT-TYPE
        SYNTAX   Counter64
        UNITS   "frames"
        MAX-ACCESS   read-only
        STATUS   current
        DESCRIPTION
                "A count of frames received that contain a valid SLD
                 field, as defined in [802.3ah] 65.1.3.3.1,
                 pass the CRC-8 check, as defined in [802.3ah]
                 65.1.3.3.3, and the meet the rules for acceptance
                 defined in [802.3ah] 65.1.3.3.2, for an ONU.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 At the OLT the value should be zero.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
        REFERENCE   "[802.3ah], 30.3.7.1.6."
        ::= { dot3OmpEmulationStatEntry 5}

    dot3OmpEmulationOltPonCastLLID OBJECT-TYPE
        SYNTAX   Counter64
        UNITS   "frames"
        MAX-ACCESS   read-only
        STATUS   current
        DESCRIPTION
                "A count of frames received that contain a valid SLD
                 field, as defined in [802.3ah] 65.1.3.3.1,
                 pass the CRC-8 check, as defined in [802.3ah]
                 65.1.3.3.3, and the meet the rules for acceptance
                 defined in [802.3ah] 65.1.3.3.2, for an OLT.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 At the ONU the value should be zero.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
      REFERENCE   "[802.3ah], 30.3.7.1.7."
        ::= { dot3OmpEmulationStatEntry 6}

    dot3OmpEmulationBroadcastBitNotOnuLlid OBJECT-TYPE
        SYNTAX   Counter64
        UNITS   "frames"
        MAX-ACCESS   read-only
        STATUS   current
        DESCRIPTION
                "A count of frames received that contain a valid SLD
                 field, as defined in [802.3ah] clause
                 65.1.3.3.1, and pass the CRC-8 check, as defined in
                 [802.3ah] clause 65.1.3.3.3, and contain the broadcast
                 bit in the LLID and not the ONU's LLID (frame accepted)
                 as defined in [802.3ah] clause 65.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 At the OLT the value should be zero.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
        ::= { dot3OmpEmulationStatEntry 7}

    dot3OmpEmulationOnuLLIDNotBroadcast OBJECT-TYPE
        SYNTAX   Counter64
        UNITS   "frames"
        MAX-ACCESS   read-only
        STATUS   current
        DESCRIPTION
                "A count of frames received that contain a valid SLD
                 field, as defined in [802.3ah] clause
                 65.1.3.3.1, and pass the CRC-8 check, as defined in
                 [802.3ah] clause 65.1.3.3.3, and contain the ONU's LLID
                 as defined in [802.3ah] clause 65.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 At the OLT the value should be zero.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
        ::= { dot3OmpEmulationStatEntry 8}

    dot3OmpEmulationBroadcastBitPlusOnuLlid OBJECT-TYPE
        SYNTAX   Counter64
        UNITS   "frames"
        MAX-ACCESS   read-only
        STATUS   current
        DESCRIPTION
                "A count of frames received that contain a valid SLD

                field, as defined in [802.3ah] clause
                65.1.3.3.1, and pass the CRC-8 check, as defined in
                [802.3ah] clause 65.1.3.3.3, and contain the broadcast
                bit in the LLID and match the ONU's LLID (frame
                reflected) as defined in [802.3ah] clause 65.
                This object is applicable for an OLT and an ONU. At the
                OLT it has a value for each virtual interface.
                At the OLT the value should be zero.
                Discontinuities of this counter can occur at
                re-initialization of the management system, and at other
                times as indicated by the value of the
                ifCounterDiscontinuityTime."
        ::= { dot3OmpEmulationStatEntry 9}

    dot3OmpEmulationNotBroadcastBitNotOnuLlid OBJECT-TYPE
        SYNTAX   Counter64
        UNITS   "frames"
        MAX-ACCESS read-only
        STATUS   current
        DESCRIPTION
                "A count of frames received that contain a valid SLD
                 field, as defined in [802.3ah] clause
                 65.1.3.3.1, and pass the CRC-8 check, as defined in
                 [802.3ah] clause 65.1.3.3.3, and does not contain
                 the ONU's LLID as defined in [802.3ah] clause 65.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 At the OLT the value should be zero.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
        ::= { dot3OmpEmulationStatEntry 10}

    -- FEC managed object definitions (30.5.1)

    dot3EponFecObjects OBJECT IDENTIFIER ::={dot3EponObjects 3}

    dot3EponFecTable OBJECT-TYPE
        SYNTAX   SEQUENCE OF Dot3EponFecEntry
        MAX-ACCESS not-accessible
        STATUS   current
        DESCRIPTION
                "Table of dot3 EPON FEC management objects.

                    The entries in the table are control and status objects
                    and statistic counters for the FEC layer.
                    Each object has a row for every virtual link denoted by
                    the corresponding ifIndex.
                    Typically the number of expected virtual links in a PON
                    is like the number of ONUs, which is 32-64, plus an
                    additional entry for broadcast LLID (with a value of
                    0xffff).
                    In the [802.3ah] the LLID is a 2bytes register and the
                    number of LLIDs is limited by that."
            ::= { dot3EponFecObjects 1 }

        dot3EponFecEntry OBJECT-TYPE
            SYNTAX Dot3EponFecEntry
            MAX-ACCESS not-accessible
            STATUS current
            DESCRIPTION
                    "An entry in the dot3 EPON FEC table.
                    Rows exist for an OLT interface and an ONU interface.
                    Rows in the table are denoted by the ifIndexes and they
                    are created when the ifIndexes are created.
                    For the ONU rows are created at system initialization.
                    For the OLT the row of the OLT ifIndex and the row of
                    the ifIndex referring to the broadcast virtual link are
                    created at system initialization. For the ifIndexes
                    referring to the virtual links at the OLT, a row is
                    created when a virtual link is established (ONU
                    registers) and deleted when the virtual link is deleted
                    (ONU deregisters)."
            INDEX { ifIndex}
            ::= { dot3EponFecTable 1 }

        Dot3EponFecEntry ::=
            SEQUENCE {
                    dot3EponFecPCSCodingViolation   Counter64,
                    dot3EponFecAbility   INTEGER,
                    dot3EponFecMode   INTEGER,
                    dot3EponFecCorrectedBlocks   Counter64,
                    dot3EponFecUncorrectableBlocks   Counter64,
                    dot3EponFecBufferHeadCodingViolation   Counter64
            }

        dot3EponFecPCSCodingViolation OBJECT-TYPE
            SYNTAX Counter64
            UNITS   "octets"
            MAX-ACCESS read-only
            STATUS current
            DESCRIPTION

                "For 100 Mbps operation it is a count of the number of
                 times an invalid code-group is received, other than the
                 /H/ code-group. For 1000 Mbps operation it is a count
                 of the number of times an invalid codegroup is received,
                 other than the /V/ code-group. /H/ denotes a special
                 4b5b codeword of [802.3] 100 Mbps PCS layer (clause 24),
                 and /V/ denotes a special 8b10b codeword of the [802.3]
                 1000 Mbps PCS layer (clause 36).
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
        REFERENCE   "[802.3ah], 30.5.1.1.12."
        ::= { dot3EponFecEntry 1}

    dot3EponFecAbility OBJECT-TYPE
        SYNTAX   INTEGER {
                unknown (1),
                unsupported (2),
                supported (3)
        }
        MAX-ACCESS   read-only
        STATUS   current
        DESCRIPTION
                "An object that indicates the support of operation of the
                 optional FEC sublayer of the 1000BASE-PX PHY, specified
                 in [802.3ah] clause 65.2.
                 unknown(1) value is assigned in initialization, for non
                 FEC support state or type not yet known. unsupported(2)
                 value is assigned when sublayer is not supported.
                 supported(3) value is assigned when sublayer is
                 supported.
                 This object is applicable for an OLT, with the same
                 value for all virtual interfaces, and for an ONU.
                 When the interface is not supporting FEC the FEC
                 counters will have a zero value.
                 The counters:
                  dot3EponFecPCSCodingViolation - not affected by FEC
                  ability.
                  dot3EponFecCorrectedBlocks   - has a zero value when
                   dot3EponFecAbility is unknown (1) and unsupported (2).
                  dot3EponFecUncorrectableBlocks - has a zero value when
                   dot3EponFecAbility is unknown (1) and unsupported (2).
                  dot3EponFecBufferHeadCodingViolation - has a zero value
                   when dot3EponFecAbility is unknown (1) and
                   unsupported (2). "

```
        REFERENCE   "[802.3ah], 30.5.1.1.13."
        ::= { dot3EponFecEntry 2}


    dot3EponFecMode OBJECT-TYPE
        SYNTAX  INTEGER {
                unknown (1),
                disabled (2),
                enabled (3)
        }
        MAX-ACCESS  read-write
        STATUS  current
        DESCRIPTION
                "An object that defines and indicates the mode of
                 operation of the optional FEC sublayer of the
                 1000BASE-PX PHY, specified in [802.3ah] clause 65.2.
                 A GET operation returns the current mode of operation
                 of the PHY. A SET operation changes the mode of
                 operation of the PHY to the indicated value.
                 unknown(1) value is assigned in initialization, for non
                   FEC support state or type not yet known.
                 disabled(2) value is assigned when the FEC sublayer is
                   operating in disabled mode.
                 enabled(3) value is assigned when the FEC sublayer is
                   operating in FEC mode.
                 writing can be done at any time.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 When the interface is not enabling FEC the counting of
                 the FEC counters will stop. Generally the FEC counters
                 are referring to the receive path and affected by
                 fecRxEnabled and fecTxRxEnabled.
                 The counters:
                  dot3EponFecPCSCodingViolation - not affected by FEC
                  mode.
                  dot3EponFecCorrectedBlocks    - stops counting when
                  Rx_FEC is not enabled. (unknown (1) and disabled (2)).
                  dot3EponFecUncorrectableBlocks - stops counting when
                  Rx_FEC is not enabled (unknown (1) and disabled (2)).
                  dot3EponFecBufferHeadCodingViolation  - stops counting
                  when Rx_FEC is not enabled (unknown (1) and
                  disabled (2)).
                 The object:
                  dot3EponFecAbility - indicates the FEC ability and is
                  not affected by the FEC mode."
        REFERENCE   "[802.3ah], 30.5.1.1.14."
        DEFVAL { 1 }
        ::= { dot3EponFecEntry 3}
```

```
    dot3EponFecCorrectedBlocks OBJECT-TYPE
        SYNTAX  Counter64
        MAX-ACCESS  read-only
        STATUS  current
        DESCRIPTION
                "For 10PASS-TS, 2BASE-TL and 1000BASE-PX PHYs it is a
                 count of corrected FEC blocks. This counter will not
                 increment for other PHY Types. Increment the counter by
                 one for each received block that is corrected by the FEC
                 function in the PHY.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
        REFERENCE   "[802.3ah], 30.5.1.1.15."
        ::= { dot3EponFecEntry 4}

    dot3EponFecUncorrectableBlocks OBJECT-TYPE
        SYNTAX  Counter64
        MAX-ACCESS  read-only
        STATUS  current
        DESCRIPTION
                "For 10PASS-TS, 2BASE-TL and 1000BASE-PX PHYs it is a
                 count of uncorrectable FEC blocks. This counter will not
                 increment for other PHY Types. Increment the counter by
                 one for each FEC block that is determined to be
                 uncorrectable by the FEC function in the PHY.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
        REFERENCE   "[802.3ah], 30.5.1.1.16."
        ::= { dot3EponFecEntry 5}

    dot3EponFecBufferHeadCodingViolation OBJECT-TYPE
        SYNTAX  Counter64
        UNITS       "octets"
        MAX-ACCESS  read-only
        STATUS  current
        DESCRIPTION
                "For 1000 Mbps operation it is a count of the number of
                 invalid code-group received directly from the link. The
                 value has a meaning only in 1000 Mbps mode and it is
                 zero otherwise.
```

```
                This object is applicable for an OLT and an ONU. At the
                OLT it has a value for each virtual interface.
                Discontinuities of this counter can occur at
                re-initialization of the management system, and at other
                times as indicated by the value of the
                ifCounterDiscontinuityTime."
        ::= { dot3EponFecEntry 6}



    -- ExtendedPackage managed object definitions


    dot3ExtPkgObjects OBJECT IDENTIFIER ::={dot3EponObjects 4}

    dot3ExtPkgControlObjects OBJECT IDENTIFIER ::= { dot3ExtPkgObjects 1}


    dot3ExtPkgControlTable OBJECT-TYPE
        SYNTAX   SEQUENCE OF Dot3ExtPkgControlEntry
        MAX-ACCESS  not-accessible
        STATUS   current
        DESCRIPTION
                "A table of Extended package Control management
                 objects. Entries in the table are control and status
                 indication objects of an EPON interface which are
                 gathered in an extended package as an addition to the
                 objects based on the [802.3ah] clause 30 attributes.
                 Each object has a row for every virtual link denoted by
                 the corresponding ifIndex.
                 Typically the number of expected virtual links in a PON
                 is like the number of ONUs, which is 32-64, plus an
                 additional entry for broadcast LLID (with a value of
                 0xffff).
                 In the [802.3ah] the LLID is a 2bytes register and the
                 number of LLIDs is limited by that."
        ::= { dot3ExtPkgControlObjects 1 }

  dot3ExtPkgControlEntry OBJECT-TYPE
        SYNTAX   Dot3ExtPkgControlEntry
        MAX-ACCESS  not-accessible
        STATUS   current
        DESCRIPTION
                "An entry in the Extended package Control table.
                 Rows exist for an OLT interface and an ONU interface.
                 Rows in the table are denoted by the ifIndexes and they
                 are created when the ifIndexes are created.
                 For the ONU rows are created at system initialization.
```

                    For the OLT the row of the OLT ifIndex and the row of
                    the ifIndex referring to the broadcast virtual link are
                    created at system initialization. For the ifIndexes
                    referring to the virtual links at the OLT, a row is
                    created when a virtual link is established (ONU
                    registers) and deleted when the virtual link is deleted
                    (ONU deregisters)."
            INDEX { ifIndex}
            ::= { dot3ExtPkgControlTable 1 }

    Dot3ExtPkgControlEntry ::=
            SEQUENCE {
             dot3ExtPkgObjectReset   INTEGER,
             dot3ExtPkgObjectPowerDown   TruthValue,
             dot3ExtPkgObjectNumberOfLLIDs   Unsigned32,
             dot3ExtPkgObjectFecEnabled   INTEGER,
             dot3ExtPkgObjectReportMaximumNumQueues   Unsigned32,
             dot3ExtPkgObjectRegisterAction   INTEGER
            }

    dot3ExtPkgObjectReset OBJECT-TYPE
            SYNTAX INTEGER {
                    running(1),
                    reset(2)
            }
            MAX-ACCESS read-write
            STATUS current
            DESCRIPTION
                    "This object is used to reset the EPON interface. The
                     interface may be unavailable while the reset occurs and
                     data may be lost.
                     Setting this object to running(1) will cause the
                     interface to enter into running mode. Setting this
                     object to reset(2) will cause the interface to go into
                     reset mode. When getting running(1) the interface is in
                     running mode. When getting reset(2) the interface is in
                     reset mode.
                     Writing can be done at any time.
                     This object is applicable for an OLT and an ONU. At the
                     OLT it has a value for each virtual interface.
                     A reset for a virtual interface resets only the virtual
                     interface and not the physical interface. Thus, a
                     virtual link which is mal-functioning can be reset
                     without affecting the operation of other virtual
                     interfaces.
                     The reset can cause Discontinuities in the values of the
                     counters of the interface, similar to re-initialization
                     of the management system. Discontinuity should be

                     indicated by the ifCounterDiscontinuityTime object. "
         DEFVAL { 1 }
         ::= { dot3ExtPkgControlEntry 1 }

    dot3ExtPkgObjectPowerDown OBJECT-TYPE
         SYNTAX   TruthValue
         MAX-ACCESS read-write
         STATUS   current
         DESCRIPTION
                 "This object is used to power down the EPON interface.
                  The interface may be unavailable while the power down
                  occurs and data may be lost.
                  Setting this object to true(1) will cause the interface
                  to enter into power down mode. Setting this object to
                  false(2) will cause the interface to go out of power
                  down mode. When getting true(1) the interface is in
                  power down mode. When getting false(2) the interface is
                  not in power down mode.
                  Writing can be done at any time.
                  This object is applicable for an OLT and an ONU. At the
                  OLT it has a value for each virtual interface.
                  A power down/up of a virtual interface affects only the
                  virtual interface and not the physical interface. Hence
                  a virtual link which needs a certain handling can be
                  powered down and then powered up without disrupting the
                  operation of other virtual interfaces.
                  The object is relevant when the admin state of the
                  device is active as set by the dot3MpcpAdminState."
         DEFVAL { false }
         ::= { dot3ExtPkgControlEntry 2 }

    dot3ExtPkgObjectNumberOfLLIDs OBJECT-TYPE
         SYNTAX   Unsigned32
         MAX-ACCESS read-only
         STATUS   current
         DESCRIPTION
                 "A read only object which indicates the number of
                  registered LLIDs. Initialization value is 0.
                  This object is applicable for an OLT, with the same
                  value for all virtual interfaces, and for an ONU.
                  Typically the number of expected virtual links in a PON
                  is like the number of ONUs, which is 32-64, plus an
                  additional entry for broadcast LLID (with a value of
                  0xffff).
                  In the [802.3ah] the LLID is a 2bytes register and the
                  number of LLIDs is limited by that. At the ONU the
                  number of LLIDs for an interface is one."

```
        ::= { dot3ExtPkgControlEntry 3 }



    dot3ExtPkgObjectFecEnabled OBJECT-TYPE
        SYNTAX  INTEGER {
               noFecEnabled (1),
               fecTxEnabled (2),
               fecRxEnabled (3),
               fecTxRxEnabled (4)
        }
        MAX-ACCESS  read-write
        STATUS  current
        DESCRIPTION
               "This object defines a list of actions for the
                FEC state of an interface, and indicates the FEC state of
                the interface.
               When noFECEnabled(1) the interface does not enable FEC
               mode.
               When fecTxEnabled(2) the interface enables the FEC
               transmit mode.
               When fecRxEnabled(3) the interface enables the FEC
               receive mode.
               When fecTxRxEnabled(4) the interface enables the FEC
               transmit and receive mode.
               This object is applicable for an OLT and an ONU. At the
               OLT it has a value for each virtual interface.
               When the interface is not enabling FEC the counting of
               the FEC counters will stop. Generally the FEC counters are
               referring to the receive path and affected by fecRxEnabled
               and fecTxRxEnabled.
               The counters:
                dot3EponFecPCSCodingViolation - not affected by FEC mode.
                dot3EponFecCorrectedBlocks    - stops counting when
                Rx_FEC is not enabled. (noFecEnabled (1) and
                fecTxEnabled (2)).
                dot3EponFecUncorrectableBlocks - stops counting when
                Rx_FEC is not enabled (noFecEnabled (1) and
                fecTxEnabled (2)).
                dot3EponFecBufferHeadCodingViolation  - stops counting
                when Rx_FEC is not enabled (noFecEnabled (1) and
                fecTxEnabled (2)).
               The objects:
                dot3EponFecAbility - indicates the FEC ability and is not
                affected by the FEC mode.
                dot3EponFecMode - indicates the FEC mode for combined RX
                and TX.
               Writing can be done at any time."
```

```
     DEFVAL { 1 }
     ::= { dot3ExtPkgControlEntry 4 }


 dot3ExtPkgObjectReportMaximumNumQueues OBJECT-TYPE
     SYNTAX  Unsigned32 (0..7)
     MAX-ACCESS  read-only
     STATUS  current
     DESCRIPTION
             "An object, that defines the maximal number of queues in
              the REPORT message, as defined in [802.3ah] 64. For
              further information please see the description of the
              queue table.
              This object is applicable for an OLT and an ONU. At the
              OLT it has a value for each virtual interface."
     DEFVAL { 0 }
     ::= { dot3ExtPkgControlEntry 5 }


 dot3ExtPkgObjectRegisterAction OBJECT-TYPE
     SYNTAX  INTEGER {
             none (1),
             register (2),
             deregister (3),
             reregister (4)
     }
     MAX-ACCESS  read-write
     STATUS  current
     DESCRIPTION
             "An object which defines a list of actions for the
              registration state of an interface, and indicates the
              registration state of the interface.
              When writing the state is changed to the new value.
              When reading the state value is returned.
              none(1) indicates an unknown state,
              register(2) indicates a registered LLID,
              deregister(3) indicates a deregistered LLID,
              reregister(4) indicates an LLID which is reregistering.
              When writing the object changes the LLID state as
              specified in [802.3ah] clause 64. The actions that can
              be done for an LLID as described in the [802.3] are
               none (1) - not doing any action.
               register (2) - registering an LLID which request to
                 register (in registering mode
                 (dot3MpcpRegistrationState - registering (2)).
               deregister (3) - deregisters an LLID which is registered
                 (dot3MpcpRegistrationState - registered (3) ).
               reregister (4) - reregister an LLID which is registered
                 (dot3MpcpRegistrationState - registered (3) ).
```

The behavior of an ONU and OLT interfaces, at each one
of the states is described in the registration state
machine in figure 64-22 of [802.3ah].
The indication of the registration state is reflected in
this object and in the dot3MpcpRegistrationState object.
This object is applicable for an OLT and an ONU. At the
OLT it has a value for each virtual interface."
DEFVAL { 1 }
::= { dot3ExtPkgControlEntry 6 }

dot3ExtPkgQueueTable OBJECT-TYPE
    SYNTAX   SEQUENCE OF Dot3ExtPkgQueueEntry
    MAX-ACCESS   not-accessible
    STATUS   current
    DESCRIPTION
            "A table of the extended package objects for queue
             management. The [802.3ah] MPCP defines a report of the
             occupancy of the transmit queues for the feedback BW
             request from the ONUs. These queues serve the uplink
             transmission of the ONU and data is gathered there until
             the ONU is granted for transmission.
             The management table of the queues is added here mainly
             to gather some statistics of their operation. This table
             is not duplicating existing management objects of
             bridging queues, specified in [802.1d], since the ONU
             may not be a bridge device, with embedded bridging
             queues and the existence of the transmit queuing
             mechanism is implied in the [802.3ah] spec.
             The format of the REPORT message, as specified
             in [802.3], is presented below:
             +-----------------------------------+
             | Destination Address |
             +-----------------------------------+
             | Source Address |
             +-----------------------------------+
             | Length/Type |
             +-----------------------------------+
             | OpCode |
             +-----------------------------------+
             | TimeStamp |
             +-----------------------------------+
             | Number of queue Sets |
             +-----------------------------------+   /|\
             | Report bitmap | |
             +-----------------------------------+ |
             | Queue 0 report | |
             +-----------------------------------+ | repeated for
```

```
                      |         Queue 1 report          |      | every
                      +---------------------------------+      | queue_set
                      |         Queue 2 report          |      |
                      +---------------------------------+      |
                      |         Queue 3 report          |      |
                      +---------------------------------+      |
                      |         Queue 4 report          |      |
                      +---------------------------------+      |
                      |         Queue 5 report          |      |
                      +---------------------------------+      |
                      |         Queue 6 report          |      |
                      +---------------------------------+      |
                      |         Queue 7 report          |      |
                      +---------------------------------+     \|/
                      |         Pad/reserved            |
                      +---------------------------------+
                      |             FCS                 |
                      +---------------------------------+
```

            The 'Queue report' field reports the occupancy of each
            uplink transmission queue.
            The number of queue sets defines the number of the
            reported sets, as would be explained in the description
            of the dot3ExtPkgQueueSetsTable table. For each set the
            report bitmap defines which queue is present in the
            report, meaning that although the MPCP REPORT message
            can report of up to 8 queues in a REPORT message, the
            actual number is flexible. The Queue table has a
            variable size which is limited by the
            dot3ExtPkgObjectReportMaximumNumQueues object as an
            ONU can have fewer queues to report.
            The entries in the table are control and status
            indication objects for managing the queues of an EPON
            interface which are gathered in an extended package as
            an addition to the objects which are based on the
            [802.3ah] attributes.
            Each object has a row for every virtual link and for
            every queue in the report.
            Typically the number of expected virtual links in a PON
            is like the number of ONUs, which is 32-64, plus an
            additional entry for broadcast LLID (with a value of
            0xffff).
            In the [802.3ah] the LLID is a 2bytes register and the
            number of LLIDs is limited by that.
            The number of queues is between 0 and 7 and limited by
            dot3ExtPkgObjectReportMaximumNumQueues."
        ::= { dot3ExtPkgControlObjects 2 }

```
dot3ExtPkgQueueEntry OBJECT-TYPE
    SYNTAX  Dot3ExtPkgQueueEntry
    MAX-ACCESS  not-accessible
    STATUS  current
    DESCRIPTION
            "An entry in the Extended package Queue table. At the
             OLT, the rows exist for each ifIndex and dot3QueueIndex.
             At the ONU, rows exist for the single ifIndex for each
             dot3QueueIndex.
             Rows in the table are created when the ifIndexes are
             created. A set of rows per queue is added for each
             ifIndex, denoted with the dot3QueueIndex.
             For the ONU rows are created at system initialization.
             For the OLT the rows of the OLT ifIndex and the rows of
             the ifIndex referring to the broadcast virtual link are
             created at system initialization. For the ifIndexes
             referring to the virtual links at the OLT, a set of rows
             per queue are created when a virtual link is established
             (ONU registers) and deleted when the virtual link is
             deleted (ONU deregisters)."
    INDEX  { ifIndex, dot3QueueIndex }
    ::= { dot3ExtPkgQueueTable 1 }

Dot3ExtPkgQueueEntry ::=
    SEQUENCE {
     dot3QueueIndex                             Unsigned32,
     dot3ExtPkgObjectReportNumThreshold         Unsigned32,
     dot3ExtPkgObjectReportMaximumNumThreshold  Unsigned32,
     dot3ExtPkgStatTxFramesQueue                Counter64,
     dot3ExtPkgStatRxFramesQueue                Counter64,
     dot3ExtPkgStatDroppedFramesQueue           Counter64
    }


dot3QueueIndex OBJECT-TYPE
    SYNTAX  Unsigned32 (0..7)
    MAX-ACCESS  not-accessible
    STATUS  current
    DESCRIPTION
            "An object that identifies an index for the queue table
             reflecting the queue index of the queues which are
             reported in the MPCP REPORT message, as defined in
             [802.3ah] clause 64.
             The number of queues is between 0 and 7 and limited by
             dot3ExtPkgObjectReportMaximumNumQueues."
    ::= { dot3ExtPkgQueueEntry 1 }

dot3ExtPkgObjectReportNumThreshold OBJECT-TYPE
```

         SYNTAX   Unsigned32 (0..7)
         MAX-ACCESS   read-write
         STATUS   current
         DESCRIPTION
                 "An object that defines the number of thresholds for each
                  queue in the REPORT message, as defined in [802.3ah] 64.
                  Each queue_set reporting will provide information on the
                  queue occupancy of frames below the matching Threshold.
                  When reading, the value reflects the number of
                  thresholds.
                  When writing, the number of thresholds for each queue is
                  set.
                  Writing can be done at any time. Value can not exceed
                  the maximal value defined by the
                  dot3ExtPkgObjectReportMaximumNumThreshold object.
                  This object is applicable for an OLT and an ONU. At the
                  OLT it has a value for each virtual interface and for
                  each queue. At the ONU it has a value for each queue."
         DEFVAL { 0 }
         ::= { dot3ExtPkgQueueEntry 2 }

     dot3ExtPkgObjectReportMaximumNumThreshold OBJECT-TYPE
         SYNTAX   Unsigned32 (0..7)
         MAX-ACCESS   read-only
         STATUS   current
         DESCRIPTION
                 "An object, that defines the maximal number of thresholds
                  for each queue in the REPORT message, as defined in
                  [802.3ah] 64. Each queue_set reporting will provide
                  information on the queue occupancy of frames below the
                  matching Threshold.
                  This object is applicable for an OLT and an ONU. At the
                  OLT it has a value for each virtual interface and for
                  each queue. At the ONU it has a value for each queue."
         DEFVAL { 0 }
         ::= { dot3ExtPkgQueueEntry 3 }

      dot3ExtPkgStatTxFramesQueue OBJECT-TYPE
         SYNTAX   Counter64
         UNITS   "frames"
         MAX-ACCESS   read-only
         STATUS   current
         DESCRIPTION
                 "A count of the number of times a frame transmission
                  occurs from the corresponding 'Queue'.
                  Increment the counter by one for each frame transmitted

```
                    which is an output of the 'Queue'.
                    The 'Queue' marking matches the REPORT MPCP message
                    Queue field, as defined in [802.3ah] clause 64.
                    This object is applicable for an OLT and an ONU. At the
                    OLT it has a value for each virtual interface and for
                    each queue. At the ONU it has a value for each queue.
                    At the OLT the value should be zero.
                    Discontinuities of this counter can occur at
                    re-initialization of the management system, and at other
                    times as indicated by the value of the
                    ifCounterDiscontinuityTime."
            ::= { dot3ExtPkgQueueEntry 4}


    dot3ExtPkgStatRxFramesQueue OBJECT-TYPE
        SYNTAX  Counter64
        UNITS       "frames"
        MAX-ACCESS  read-only
        STATUS  current
        DESCRIPTION
                "A count of the number of times a frame reception
                 occurs from the corresponding 'Queue'.
                 Increment the counter by one for each frame received
                 which is an output of the corresponding 'Queue'.
                 The 'Queue' marking matches the REPORT MPCP message
                 Queue field, as defined in [802.3ah] clause 64.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface and for
                 each queue. At the ONU it has a value for each queue.
                 Discontinuities of this counter can occur at
                 re-initialization of the management system, and at other
                 times as indicated by the value of the
                 ifCounterDiscontinuityTime."
            ::= { dot3ExtPkgQueueEntry 5}

    dot3ExtPkgStatDroppedFramesQueue OBJECT-TYPE
        SYNTAX  Counter64
        UNITS       "frames"
        MAX-ACCESS  read-only
        STATUS  current
        DESCRIPTION
                "A count of the number of times a frame drop
                 occurs from the corresponding 'Queue'.
                 Increment the counter by one for each frame dropped
                 from the corresponding 'Queue'.
                 The 'Queue' marking matches the REPORT MPCP message
                 Queue field, as defined in [802.3ah] clause 64.
                 This object is applicable for an OLT and an ONU. At the
```

                    OLT it has a value for each virtual interface and for
                    each queue. At the ONU it has a value for each queue.
                    At the OLT the value should be zero.
                    Discontinuities of this counter can occur at
                    re-initialization of the management system, and at other
                    times as indicated by the value of the
                    ifCounterDiscontinuityTime."
          ::= { dot3ExtPkgQueueEntry 6}

      dot3ExtPkgQueueSetsTable OBJECT-TYPE
          SYNTAX   SEQUENCE OF Dot3ExtPkgQueueSetsEntry
          MAX-ACCESS   not-accessible
          STATUS   current
          DESCRIPTION
                    "A table of Extended package objects used for the
                    management of the queue_sets. Entries are control and
                    status indication objects of an EPON interface which
                    are gathered in an extended package as an addition to
                    the objects based on the [802.3ah] attributes. The
                    objects in this table are specific for the queue_sets
                    which are reported in the MPCP REPORT message as defined
                    in [802.3ah] clause 64.
                    The [802.3ah] MPCP defines a report of the occupancy of
                    the transmit queues for the feedback BW request from the
                    ONUs. These queues serve the uplink transmission of the
                    ONU and data is gathered there until the ONU is granted
                    for transmission.
                    The management table of the queues is added here mainly
                    to gather some statistics of their operation. This table
                    is not duplicating existing management object of
                    bridging queues, specified in [802.1d], since the ONU
                    may not be a bridge device, with embedded bridging
                    queues and the existence of the transmit queuing
                    mechanism is implied in the [802.3ah] spec.
                    The format of the REPORT message, as specified
                    in [802.3], is presented below:
                    +-----------------------------------+
                    | Destination Address |
                    +-----------------------------------+
                    | Source Address |
                    +-----------------------------------+
                    | Length/Type |
                    +-----------------------------------+
                    | OpCode |
                    +-----------------------------------+

```
                    |              TimeStamp              |
                    +-------------------------------------+
                    |          Number of queue Sets       |
                    +-------------------------------------+   /|\
                    |             Report bitmap           |    |
                    +-------------------------------------+    |
                    |             Queue 0 report          |    |
                    +-------------------------------------+    | repeated for
                    |             Queue 1 report          |    | every
                    +-------------------------------------+    | queue_set
                    |             Queue 2 report          |    |
                    +-------------------------------------+    |
                    |             Queue 3 report          |    |
                    +-------------------------------------+    |
                    |             Queue 4 report          |    |
                    +-------------------------------------+    |
                    |             Queue 5 report          |    |
                    +-------------------------------------+    |
                    |             Queue 6 report          |    |
                    +-------------------------------------+    |
                    |             Queue 7 report          |    |
                    +-------------------------------------+   \|/
                    |             Pad/reserved            |
                    +-------------------------------------+
                    |                FCS                  |
                    +-------------------------------------+
```

As can be seen from the message format, the ONU device
reports of the status of up to 8 queues and it can
report in a single MPCP REPORT message of a few sets
of queues.
The number of queue_sets defines the number of the
reported sets, and it can reach up to a value of 8. It
means that a device can hold a variable number of sets
between 0 to 7.
The dot3ExtPkgQueueSetsTable table has a variable
queue_set size which is limited by the
dot3ExtPkgObjectReportMaximumNumThreshold object as an
ONU can have fewer queue_sets to report.
The 'Queue report' field reports the occupancy of each
uplink transmission queue. The queue_sets can be used to
report the occupancy of the queues in a few levels as to
allow granting, in an accurate manner, of only part of
the data available in the queues. A Threshold is
defined for each queue_set to define the level of the
queue which is counted for the report of the occupancy.
The threshold is reflected in the queue_set table by the
dot3ExtPkgObjectReportThreshold object.

                    For each queue set, the report bitmap defines which
                    queues are present in the report, meaning that
                    although the MPCP REPORT message can report of up to 8
                    queues in a REPORT message, the actual number is
                    flexible.
                    The dot3ExtPkgQueueSetsTable table has a variable queue
                    size which is limited by the
                    dot3ExtPkgObjectReportMaximumNumQueues object as an ONU
                    can have fewer queues to report.
                    Each object has a row for every virtual link, for each
                    queue in the report and for each queue_set in the queue.
                    Typically the number of expected virtual links in a PON
                    is like the number of ONUs, which is 32-64, plus an
                    additional entry for broadcast LLID (with a value of
                    0xffff).
                    In the [802.3ah] the LLID is a 2bytes register and the
                    number of LLIDs is limited by that.
                    The number of queues is between 0 and 7 and limited by
                    dot3ExtPkgObjectReportMaximumNumQueues.
                    The number of queues_sets is between 0 and 7 and limited
                    by dot3ExtPkgObjectReportMaximumNumThreshold."

          ::= { dot3ExtPkgControlObjects 3 }

    dot3ExtPkgQueueSetsEntry OBJECT-TYPE
        SYNTAX   Dot3ExtPkgQueueSetsEntry
        MAX-ACCESS not-accessible
        STATUS   current
        DESCRIPTION
                "An entry in the Extended package queue_set table. At
                 the OLT, the rows exist for each ifIndex,
                 dot3QueueSetQueueIndex and dot3QueueSetIndex. At the
                 ONU, rows exist for the single ifIndex, for each
                 dot3QueueSetQueueIndex and dot3QueueSetIndex.
                 Rows in the table are created when the ifIndexes are
                 created. A set of rows per queue and per queue_set is
                 added for each ifIndex, denoted with the
                 dot3QueueSetIndex and dot3QueueSetQueueIndex.
                 For the ONU rows are created at system initialization.
                 For the OLT the rows of the OLT ifIndex and the rows of
                 the ifIndex referring to the broadcast virtual link are
                 created at system initialization. For the ifIndexes
                 referring to the virtual links at the OLT, a set of rows
                 per queue and queue_set are created when a virtual link
                 is established (ONU registers) and deleted when the
                 virtual link is deleted (ONU deregisters)."
                 INDEX { ifIndex,
                dot3QueueSetQueueIndex,dot3QueueSetIndex}

```
        ::= { dot3ExtPkgQueueSetsTable 1 }

    Dot3ExtPkgQueueSetsEntry ::=
        SEQUENCE {
         dot3QueueSetQueueIndex                    Unsigned32,
         dot3QueueSetIndex                         Unsigned32,
         dot3ExtPkgObjectReportThreshold       Unsigned32
        }

    dot3QueueSetQueueIndex OBJECT-TYPE
        SYNTAX   Unsigned32 (0..7)
        MAX-ACCESS  not-accessible
        STATUS   current
        DESCRIPTION
                "An object that identifies the queue index for the
                 dot3ExtPkgQueueSetsTable table. The queues are reported
                 in the MPCP REPORT message as defined in [802.3ah]
                 clause 64.
                 The number of queues is between 0 and 7 and limited by
                 dot3ExtPkgObjectReportMaximumNumQueues.
                 Value corresponds to the dot3QueueIndex of the queue
                 table."
        ::= { dot3ExtPkgQueueSetsEntry 1 }


    dot3QueueSetIndex OBJECT-TYPE
        SYNTAX   Unsigned32 (0..7)
        MAX-ACCESS  not-accessible
        STATUS   current
        DESCRIPTION
                "An object that identifies the queue_set index for the
                 dot3ExtPkgQueueSetsTable table. The queues are reported
                 in the MPCP REPORT message as defined in [802.3ah]
                 clause 64.
                 The number of queues_sets is between 0 and 7. and
                 limited by dot3ExtPkgObjectReportMaximumNumThreshold."
        ::= { dot3ExtPkgQueueSetsEntry 2 }

        dot3ExtPkgObjectReportThreshold OBJECT-TYPE
        SYNTAX   Unsigned32
        UNITS        "TQ (16nsec)"
        MAX-ACCESS  read-write
        STATUS   current
        DESCRIPTION
                "An object that defines the value of threshold report for
                 each queue_set in the REPORT message, as defined in
                 [802.3ah] clause 64. The number of sets for each queue
                 is dot3ExtPkgObjectReportNumThreshold.
```

                    In the REPORT message, each queue_set reporting will
                    provide information on the occupancy of the queues for
                    frames below the matching Threshold.
                    The value returned shall be in Time quanta (TQ) which
                    is 16nsec or 2 octets increments.
                    Reading will present the threshold value. Writing will
                    set the value of the threshold.
                    Writing can be done at any time.
                    This object is applicable for an OLT and an ONU. At the
                    OLT it has a value for each virtual interface, for each
                    queue and for each queue_set. At the ONU it has a value
                    for each queue and for each queue_set."
          DEFVAL { 0 }
          ::= { dot3ExtPkgQueueSetsEntry 3 }

     --Optical Interface status tables

     dot3ExtPkgOptIfTable OBJECT-TYPE
          SYNTAX   SEQUENCE OF Dot3ExtPkgOptIfEntry
          MAX-ACCESS not-accessible
          STATUS   current
          DESCRIPTION
                    "This table defines the control and status indication
                    objects for the optical interface of the EPON interface.
                    Each object has a row for every virtual link denoted by
                    the corresponding ifIndex.
                    Typically the number of expected virtual links in a PON
                    is like the number of ONUs, which is 32-64, plus an
                    additional entry for broadcast LLID (with a value of
                    0xffff).
                    In the [802.3ah] the LLID is a 2bytes register and the
                    number of LLIDs is limited by that.
                    Although the optical interface is a physical interface,
                    there is a row in the table for each virtual interface.
                    The reason for having a separate row for each virtual
                    link is that the OLT has a separate link for each one of
                    the ONUs. For instance, they could be in different
                    distances with different link budgets and different
                    receive powers, therefore having different power alarms.
                    It is quite similar to a case of different physical
                    interfaces."
            ::= { dot3ExtPkgControlObjects 5}

     dot3ExtPkgOptIfEntry OBJECT-TYPE
          SYNTAX   Dot3ExtPkgOptIfEntry
          MAX-ACCESS not-accessible

```
        STATUS      current
        DESCRIPTION
                "An entry in the optical interface table of the EPON
                 interface.
                 Rows exist for an OLT interface and an ONU interface.
                 Rows in the table are denoted by the ifIndexes and they
                 are created when the ifIndexes are created.
                 For the ONU rows are created at system initialization.
                 For the OLT the row of the OLT ifIndex and the row of
                 the ifIndex referring to the broadcast virtual link are
                 created at system initialization. For the ifIndexes
                 referring to the virtual links at the OLT, a row is
                 created when a virtual link is established (ONU
                 registers) and deleted when the virtual link is deleted
                 (ONU deregisters)."
        INDEX       { ifIndex }
        ::= { dot3ExtPkgOptIfTable 1 }

     Dot3ExtPkgOptIfEntry ::=
       SEQUENCE {
         dot3ExtPkgOptIfSuspectedFlag            TruthValue,
         dot3ExtPkgOptIfInputPower               Integer32,
         dot3ExtPkgOptIfLowInputPower            Integer32,
         dot3ExtPkgOptIfHighInputPower           Integer32,
         dot3ExtPkgOptIfLowerInputPowerThreshold Integer32,
         dot3ExtPkgOptIfUpperInputPowerThreshold Integer32,
         dot3ExtPkgOptIfOutputPower              Integer32,
         dot3ExtPkgOptIfLowOutputPower           Integer32,
         dot3ExtPkgOptIfHighOutputPower          Integer32,
         dot3ExtPkgOptIfLowerOutputPowerThreshold Integer32,
         dot3ExtPkgOptIfUpperOutputPowerThreshold Integer32,
         dot3ExtPkgOptIfSignalDetect             TruthValue,
         dot3ExtPkgOptIfTransmitAlarm            TruthValue,
         dot3ExtPkgOptIfTransmitEnable           TruthValue
         }


    dot3ExtPkgOptIfSuspectedFlag OBJECT-TYPE
      SYNTAX   TruthValue
      MAX-ACCESS   read-only
      STATUS   current
      DESCRIPTION
        "If true, the data in this entry may be unreliable.
         This object is applicable for an OLT and an ONU. At the
         OLT it has a value for each virtual interface."
      ::= { dot3ExtPkgOptIfEntry 1 }

    dot3ExtPkgOptIfInputPower OBJECT-TYPE
```

```
   SYNTAX  Integer32
   UNITS  "0.1 dbm"
   MAX-ACCESS  read-only
   STATUS  current
   DESCRIPTION
     "The optical power monitored at the input.
      This object is applicable for an OLT and an ONU. At the
      OLT it has a value for each virtual interface."
::= { dot3ExtPkgOptIfEntry 2 }

dot3ExtPkgOptIfLowInputPower OBJECT-TYPE
   SYNTAX  Integer32
   UNITS  "0.1 dbm"
   MAX-ACCESS  read-only
   STATUS  current
   DESCRIPTION
     "The lowest optical power monitored at the input during the
      current 15-minute interval.
      This object is applicable for an OLT and an ONU. At the
      OLT it has a value for each virtual interface."
   ::= { dot3ExtPkgOptIfEntry 3 }

dot3ExtPkgOptIfHighInputPower OBJECT-TYPE
   SYNTAX  Integer32
   UNITS  "0.1 dbm"
   MAX-ACCESS  read-only
   STATUS  current
   DESCRIPTION
     "The highest optical power monitored at the input during the
      current 15-minute interval.
      This object is applicable for an OLT and an ONU. At the
      OLT it has a value for each virtual interface."
   ::= { dot3ExtPkgOptIfEntry 4 }

dot3ExtPkgOptIfLowerInputPowerThreshold OBJECT-TYPE
   SYNTAX  Integer32
   UNITS  "0.1 dbm"
   MAX-ACCESS  read-write
   STATUS  current
   DESCRIPTION
     "The lower limit threshold on input power.  If
      dot3ExtPkgOptIfInputPower drops to this value or below,
      a Threshold Crossing Alert (TCA) should be sent.
      Reading will present the threshold value. Writing will
      set the value of the threshold.
      Writing can be done at any time.
      This object is applicable for an OLT and an ONU. At the
      OLT it has a value for each virtual interface."
```

```
     ::= { dot3ExtPkgOptIfEntry 5 }

  dot3ExtPkgOptIfUpperInputPowerThreshold OBJECT-TYPE
    SYNTAX   Integer32
    UNITS  "0.1 dbm"
    MAX-ACCESS  read-write
    STATUS  current
    DESCRIPTION
      "The upper limit threshold on input power.  If
       dot3ExtPkgOptIfInputPower reaches or exceeds this value,
       a Threshold Crossing Alert (TCA) should be sent.
       Reading will present the threshold value. Writing will
       set the value of the threshold.
       Writing can be done at any time.
       This object is applicable for an OLT and an ONU. At the
       OLT it has a value for each virtual interface."
   ::= { dot3ExtPkgOptIfEntry 6 }

  dot3ExtPkgOptIfOutputPower OBJECT-TYPE
    SYNTAX   Integer32
    UNITS  "0.1 dbm"
    MAX-ACCESS  read-only
    STATUS  current
    DESCRIPTION
      "The optical power monitored at the output.
       This object is applicable for an OLT and an ONU. At the
       OLT it has a value for each virtual interface."
    ::= { dot3ExtPkgOptIfEntry 7 }

  dot3ExtPkgOptIfLowOutputPower OBJECT-TYPE
    SYNTAX   Integer32
    UNITS  "0.1 dbm"
    MAX-ACCESS  read-only
    STATUS  current
    DESCRIPTION
      "The lowest optical power monitored at the output during the
       current 15-minute interval.
       This object is applicable for an OLT and an ONU. At the
       OLT it has a value for each virtual interface."
    ::= { dot3ExtPkgOptIfEntry 8 }

  dot3ExtPkgOptIfHighOutputPower OBJECT-TYPE
    SYNTAX   Integer32
    UNITS  "0.1 dbm"
    MAX-ACCESS  read-only
    STATUS  current
    DESCRIPTION
      "The highest optical power monitored at the output during the
```

         current 15-minute interval.
         This object is applicable for an OLT and an ONU. At the
         OLT it has a value for each virtual interface."
      ::= { dot3ExtPkgOptIfEntry 9 }

   dot3ExtPkgOptIfLowerOutputPowerThreshold OBJECT-TYPE
      SYNTAX Integer32
      UNITS "0.1 dbm"
      MAX-ACCESS read-write
      STATUS current
      DESCRIPTION
        "The lower limit threshold on output power. If
         dot3ExtPkgOptIfOutputPower drops to this value or below,
         a Threshold Crossing Alert (TCA) should be sent.
         Reading will present the threshold value. Writing will
         set the value of the threshold.
         Writing can be done at any time.
         This object is applicable for an OLT and an ONU. At the
         OLT it has a value for each virtual interface."
      ::= { dot3ExtPkgOptIfEntry 10 }

   dot3ExtPkgOptIfUpperOutputPowerThreshold OBJECT-TYPE
      SYNTAX Integer32
      UNITS "0.1 dbm"
      MAX-ACCESS read-write
      STATUS current
      DESCRIPTION
        "The upper limit threshold on output power. If
         dot3ExtPkgOptIfOutputPower reaches or exceeds this value,
         a Threshold Crossing Alert (TCA) should be sent.
         Reading will present the threshold value. Writing will
         set the value of the threshold.
         Writing can be done at any time.
         This object is applicable for an OLT and an ONU. At the
         OLT it has a value for each virtual interface."
      ::= { dot3ExtPkgOptIfEntry 11 }

   dot3ExtPkgOptIfSignalDetect OBJECT-TYPE
       SYNTAX TruthValue
       MAX-ACCESS read-only
       STATUS current
       DESCRIPTION
              "When getting true(1) there is a valid optical signal at
               the receive, that is above the optical power level for
               signal detection. When getting false(2) the optical
               signal at the receive is below the optical power level
               for signal detection.
               This object is applicable for an OLT and an ONU. At the

                    OLT it has a value for each virtual interface."
        DEFVAL { false }
        ::= { dot3ExtPkgOptIfEntry 12 }

    dot3ExtPkgOptIfTransmitAlarm OBJECT-TYPE
        SYNTAX TruthValue
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
                "When getting true(1) there is a non-valid optical signal
                 at the transmit of the interface, either a higher level
                 or lower level than expected. When getting false(2) the
                 optical signal at the transmit is valid and in the
                 required range.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface."
        DEFVAL { false }
        ::= { dot3ExtPkgOptIfEntry 13 }

    dot3ExtPkgOptIfTransmitEnable OBJECT-TYPE
        SYNTAX TruthValue
        MAX-ACCESS read-write
        STATUS current
        DESCRIPTION
                "Setting this object to true(1) will cause the optical
                 interface to start transmission (according to the
                 control protocol specified for the logical interface).
                 Setting this object to false(2) will cause the
                 interface to stop the optical transmission.
                 When getting true(1) the optical interface is in
                 transmitting mode (obeying to the logical control
                 protocol).
                 When getting false(2) the optical interface is not in
                 transmitting mode.
                 Writing can be done at any time.
                 The object is relevant when the admin state of the
                 device is active as set by the dot3MpcpAdminState.
                 This object is applicable for an OLT and an ONU. At the
                 OLT it has a value for each virtual interface."
        DEFVAL { false }
        ::= { dot3ExtPkgOptIfEntry 14 }

    -- Conformance Statements

    -- Conformance Groups

```
    dot3EponGroups      OBJECT IDENTIFIER ::= { dot3EponConformance 1 }

    dot3MpcpGroupBase OBJECT-GROUP
        OBJECTS {
                dot3MpcpOperStatus,
                dot3MpcpAdminState,
                dot3MpcpMode,
                dot3MpcpSyncTime,
                dot3MpcpLinkID,
                dot3MpcpRemoteMACAddress,
                dot3MpcpRegistrationState,
                dot3MpcpMaximumPendingGrants,
                dot3MpcpTransmitElapsed,
                dot3MpcpReceiveElapsed,
                dot3MpcpRoundTripTime
        }
        STATUS  current
        DESCRIPTION
                "A collection of objects of dot3 Mpcp Control entity state
                definition. Objects are per LLID."
        ::= { dot3EponGroups 1 }


    dot3MpcpGroupStat OBJECT-GROUP
        OBJECTS {
                dot3MpcpMACCtrlFramesTransmitted,
                dot3MpcpMACCtrlFramesReceived,
                dot3MpcpDiscoveryWindowsSent,
                dot3MpcpDiscoveryTimeout ,
                dot3MpcpTxRegRequest,
                dot3MpcpRxRegRequest,
                dot3MpcpTxRegAck,
                dot3MpcpRxRegAck,
                dot3MpcpTxReport,
                dot3MpcpRxReport,
                dot3MpcpTxGate,
                dot3MpcpRxGate,
                dot3MpcpTxRegister,
                dot3MpcpRxRegister
        }
        STATUS  current
        DESCRIPTION
                "A collection of objects of dot3 Mpcp Statistics.
                 Objects are per LLID."
        ::= { dot3EponGroups 2 }

    dot3OmpeGroupID OBJECT-GROUP
        OBJECTS {
```

```
                dot3OmpEmulationType

        }
        STATUS  current
        DESCRIPTION
                "A collection of objects of dot3 OMP emulation entity
                 state definition. Objects are per LLID."
        ::= { dot3EponGroups 3 }


    dot3OmpeGroupStat OBJECT-GROUP
        OBJECTS {
                dot3OmpEmulationSLDErrors,
                dot3OmpEmulationCRC8Errors,
                dot3OmpEmulationBadLLID,
                dot3OmpEmulationGoodLLID,
                dot3OmpEmulationOnuPonCastLLID,
                dot3OmpEmulationOltPonCastLLID,
                dot3OmpEmulationBroadcastBitNotOnuLlid,
                dot3OmpEmulationOnuLLIDNotBroadcast,
                dot3OmpEmulationBroadcastBitPlusOnuLlid,
                dot3OmpEmulationNotBroadcastBitNotOnuLlid
        }
        STATUS  current
        DESCRIPTION
                "A collection of objects of dot3 OMP emulation
                 Statistics. Objects are per LLID."
        ::= { dot3EponGroups 4 }


    dot3EponFecGroupAll OBJECT-GROUP
        OBJECTS {
                dot3EponFecPCSCodingViolation,
                dot3EponFecAbility,
                dot3EponFecMode,
                dot3EponFecCorrectedBlocks,
                dot3EponFecUncorrectableBlocks,
                dot3EponFecBufferHeadCodingViolation
        }
        STATUS  current
        DESCRIPTION
                "A collection of objects of dot3 FEC group control and
                statistics. Objects are per LLID."
        ::= { dot3EponGroups 5 }



    dot3ExtPkgGroupControl OBJECT-GROUP
```

```
        OBJECTS {
                dot3ExtPkgObjectReset,
                dot3ExtPkgObjectPowerDown,
                dot3ExtPkgObjectNumberOfLLIDs,
                dot3ExtPkgObjectFecEnabled,
                dot3ExtPkgObjectReportMaximumNumQueues,
                dot3ExtPkgObjectRegisterAction
        }
        STATUS  current
        DESCRIPTION
                "A collection of objects of dot3ExtPkg control
                 definition. Objects are per LLID."
        ::= { dot3EponGroups 6 }

    dot3ExtPkgGroupQueue OBJECT-GROUP
        OBJECTS {
         dot3ExtPkgObjectReportNumThreshold,
         dot3ExtPkgObjectReportMaximumNumThreshold,
         dot3ExtPkgStatTxFramesQueue,
         dot3ExtPkgStatRxFramesQueue,
         dot3ExtPkgStatDroppedFramesQueue
        }
        STATUS  current
        DESCRIPTION
                "A collection of objects of dot3ExtPkg Queue
                 control. Objects are per LLID, per queue."
        ::= { dot3EponGroups 7 }

    dot3ExtPkgGroupQueueSets OBJECT-GROUP
        OBJECTS {
         dot3ExtPkgObjectReportThreshold
        }
        STATUS  current
        DESCRIPTION
                "A collection of objects of dot3ExtPkg queue_set
                 control. Objects are per LLID, per queue, per
                 queue_set."
        ::= { dot3EponGroups 8 }



    dot3ExtPkgGroupOptIf OBJECT-GROUP
        OBJECTS {
        dot3ExtPkgOptIfSuspectedFlag,
          dot3ExtPkgOptIfInputPower,
          dot3ExtPkgOptIfLowInputPower,
          dot3ExtPkgOptIfHighInputPower,
          dot3ExtPkgOptIfLowerInputPowerThreshold,
```

```
        dot3ExtPkgOptIfUpperInputPowerThreshold,
        dot3ExtPkgOptIfOutputPower,
        dot3ExtPkgOptIfLowOutputPower,
        dot3ExtPkgOptIfHighOutputPower,
        dot3ExtPkgOptIfLowerOutputPowerThreshold,
        dot3ExtPkgOptIfUpperOutputPowerThreshold,
        dot3ExtPkgOptIfSignalDetect,
        dot3ExtPkgOptIfTransmitAlarm,
        dot3ExtPkgOptIfTransmitEnable
        }
    STATUS  current
    DESCRIPTION
            "A collection of objects of control and status indication
             of the optical interface for the EPON Interfaces.
             Objects are per LLID."
     ::= { dot3EponGroups 9 }

-- Compliance

   dot3EponCompliances
       OBJECT IDENTIFIER ::= { dot3EponConformance 2 }



   dot3MPCPCompliance MODULE-COMPLIANCE
       STATUS      current
       DESCRIPTION "The compliance statement for Multi-Point
                    control protocol interfaces."

       MODULE  -- this module
       MANDATORY-GROUPS { dot3MpcpGroupBase}

       GROUP       dot3MpcpGroupStat
     DESCRIPTION "This group is mandatory for all MPCP supporting
                    interfaces for statistics collection."
     ::= { dot3EponCompliances 1}


   dot3OmpeCompliance MODULE-COMPLIANCE
       STATUS      current
       DESCRIPTION "The compliance statement for OMPEmulation
                    interfaces."

       MODULE  -- this module
       MANDATORY-GROUPS { dot3OmpeGroupID}

       GROUP       dot3OmpeGroupStat
       DESCRIPTION "This group is mandatory for all OMPemulation
```

```
                     supporting interfaces for statistics collection."

       ::= { dot3EponCompliances 2}


   dot3EponFecCompliance MODULE-COMPLIANCE
       STATUS      current
       DESCRIPTION "The compliance statement for FEC EPON interfaces.
                    This group is mandatory for all EPON interfaces
                    supporting FEC functionality of control and
                    statistics collection."

       MODULE  -- this module
       MANDATORY-GROUPS { dot3EponFecGroupAll }

       ::= { dot3EponCompliances 3}


   dot3ExtPkgCompliance MODULE-COMPLIANCE
       STATUS      current
       DESCRIPTION "The compliance statement for EPON Interfaces
                     using the extended package."
       MODULE  -- this module
       MANDATORY-GROUPS { dot3ExtPkgGroupControl }

       GROUP       dot3ExtPkgGroupQueue
       DESCRIPTION " This group is mandatory for all EPON interfaces
                      supporting REPORT queue management of the extended
                      package."

       GROUP       dot3ExtPkgGroupQueueSets
       DESCRIPTION " This group is mandatory for all EPON interfaces
                      supporting REPORT queue_sets management of the
                      extended package."

       GROUP       dot3ExtPkgGroupOptIf
       DESCRIPTION "This group is mandatory for all EPON interfaces
                      supporting optical interfaces management,
                      of the extended package."

       ::= { dot3EponCompliances 4}



   END
```

[6](#). IANA Considerations

   The DOT3 EPON MIB module requires the allocation of a single object
   identifier for its MODULE-IDENTITY under the MIB-2 tree.

   The MIB module in this document uses the following IANA-assigned
   OBJECT IDENTIFIER values recorded in the SMI Numbers registry:

          Descriptor   OBJECT IDENTIFIER value
          ----------   -----------------------

          dot3EponMIB   { mib-2 XXX }

   Editor's Note (to be removed prior to publication): the IANA is
   requested to assign a value for "XXX" under the 'mib-2' subtree and
   to record the assignment in the SMI Numbers registry. When the
   assignment has been made, the RFC Editor is asked to replace "XXX"
   (here and in the MIB module) with the assigned value and to remove
   this note.

7. **Security Considerations**

   There are number of managed objects defined in this MIB module that
   have a MAX-ACCESS clause of read-write or read-create. Writing to
   these objects can have potentially disruptive effects on network
   operation: Including:

   Changing dot3MpcpAdminState state (Writing can be done at any time)

   Changing dot3EponFecMode mode (Writing can be done at any time)

   Changing dot3ExtPkgObjectReset mode (Writing can be done at any time)

   Changing dot3ExtPkgObjectFecEnabled mode (Writing can be done at any
   time)

   Changing dot3ExtPkgObjectPowerDown (Writing can be done at any time)

   Changing dot3ExtPkgObjectReportNumThreshold (Writing can be done at
   any time)

   Changing dot3ExtPkgObjectReportThreshold (Writing can be done at any
   time)

   Changing dot3ExtPkgObjectRegisterAction (Writing can be done at any
   time)

   Changing dot3ExtPkgRMadlEntryStatus (Writing can be done at any time)

   Changing dot3ExtPkgOptIfLowerInputPowerThreshold (Writing can be done
   at any time)

   Changing dot3ExtPkgOptIfUpperInputPowerThreshold (Writing can be done
   at any time)

   Changing dot3ExtPkgOptIfLowerOutputPowerThreshold (Writing can be
   done at any time)

   Changing dot3ExtPkgOptIfUpperOutputPowerThreshold (Writing can be
   done at any time)

   Changing dot3ExtPkgOptIfTransmitEnable (Writing can be done at any
   time)

   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 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.

8. References

8.1. Normative References

[802.1d]   IEEE, "Institute of Electrical and Electronic Engineers,
            802.1D-2004, IEEE Standard for Local and metropolitan area
            networks Media Access Control (MAC) Bridges.", June 2004.

[802.3]   IEEE, "Institute of Electrical and Electronic Engineers,
            IEEE Std 802.3-2002, "IEEE Standard for Carrier Sense
            Multiple Access with Collision Detection (CSMA/CD) Access
            Method and Physical Layer Specifications.", December 2002.

[802.3ah]   IEEE, "Institute of Electrical and Electronic Engineers,
            IEEE Std 802.3ah-2004. 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.", IEEE Std 802.3ah-2004, October 2004.

[ITU-T G.975]
            ITU, "ITU-T, SERIES G: TRANSMISSION SYSTEMS AND MEDIA,
            DIGITAL SYSTEMS AND NETWORKS Digital sections and digital
            line system - Optical fibre submarine cable systems
            Forward error correction for submarine systems, ITU-T
            Recommendation G.975", October 2000.

[ITU-T G.983]
            ITU, "ITU-T, SERIES G: TRANSMISSION SYSTEMS AND MEDIA,
            DIGITAL SYSTEMS AND NETWORKS, Digital transmission systems
            - Digital sections and digital line system - Optical line
            systems for local and access networks Broadband optical
            access systems based on Passive Optical Networks (PON),
            ITU-T Recommendation G.983.1", October 1998.

[RFC2578]   McCloghrie, K., Ed., Perkins, D., Ed., and J.
            Schoenwaelder, Ed., "Structure of Management Information
            Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.

[RFC2579]   McCloghrie, K., Ed., Perkins, D., Ed., and J.
            Schoenwaelder, Ed., "Textual Conventions for SMIv2",
            STD 58, RFC 2579, April 1999.

[RFC2580]   McCloghrie, K., Perkins, D., and J. Schoenwaelder,
            "Conformance Statements for SMIv2", STD 58, RFC 2580,

April 1999.

   [RFC2863] McCloghrie, K. and F. Kastenholz, "The Interfaces Group
              MIB", RFC 2863, June 2000.

   [RFC2864] McCloghrie, K. and G. Hanson, "The Inverted Stack Table
              Extension to the Interfaces Group MIB", RFC 2864,
              June 2000.

   [RFC3635] Flick, J., "Definitions of Managed Objects for the
              Ethernet-like Interface Types", RFC 3635, September 2003.

   [RFC3636] Flick, J., "Definitions of Managed Objects for IEEE 802.3
              Medium Attachment Units (MAUs)", RFC 3636, September 2003.

   [RFC3636bis-03]
              Beili, E., "Definitions of Managed Objects for IEEE 802.3
              Medium Attachment Units (MAUs)
              draft-ietf-hubmib-rfc3636bis-03.txt",
              draft-ietf-hubmib-rfc3636bis-03.txt (work in progress),
              June 2006.

8.2. Informative References

   [I-D.ietf-hubmib-efm-mib]
              Squire, M., "Definitions and Managed Objects for OAM
              Functions on Ethernet Like Interfaces",
              draft-ietf-hubmib-efm-mib-04 (work in progress),
              March 2006.

   [RFC1525] Decker, E., McCloghrie, K., Langille, P., and A.
              Rijsinghani, "Definitions of Managed Objects for Source
              Routing Bridges", RFC 1525, September 1993.

   [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
              Requirement Levels", BCP 14, RFC 2119, March 1997.

   [RFC3410] Case, J., Mundy, R., Partain, D., and B. Stewart,
              "Introduction and Applicability Statements for Internet-
              Standard Management Framework", RFC 3410, December 2002.

   [RFC4188] Norseth, K. and E. Bell, "Definitions of Managed Objects
              for Bridges", RFC 4188, September 2005.

Author's Address

    Lior Khermosh
    PMC-SIERRA
    Kohav Hertzelia bldg,
    4 Hasadnaot St.,
    Hertzliya Pituach, 46120
    ISRAEL

    Phone: +972-9-9628000 Ext: 302
    Fax: +972-9-9628001
    Email: lior_khermosh@pmc-sierra.com

Intellectual Property Statement

Disclaimer of Validity

Copyright Statement

Acknowledgment