9. Ethernet passive optical networks (EPON) MIB module

9.1 Overview

This clause defines a MIB module for use with SNMP to manage ~~1G-EPON~~ interfaces for Ethernet Passive Optical Networks. The clause contains a list of management objects based on the attributes defined in the relevant parts of Clause 30 of IEEE Std 802.3, referring to EPON.

9.1.1 EPON architecture highlights

9.1.1.1 Introduction

The EPON standard, now part of IEEE Std 802.3, defines the Physical Layer and Media Access Control sublayer of EPON interfaces. EPON is a variant of Gigabit Ethernet used in optical access. The passive optical network (PON) comprises sections of single-mode fiber connected with passive optical splitter/coupler devices, forming a passive optical tree, as shown in Figure 9-1. Individual branches of the PON are terminated with the optical line terminal (OLT) in the central office and optical network units (ONUs) near the subscribers. ONUs can be located either in some remote location (e.g., basement in a multidwelling unit) or directly at the subscriber premises. Various types of customer premises equipment (CPE) can be connected to ONUs or even integrated with such devices. Figure 9-1 presents an example PON topology.

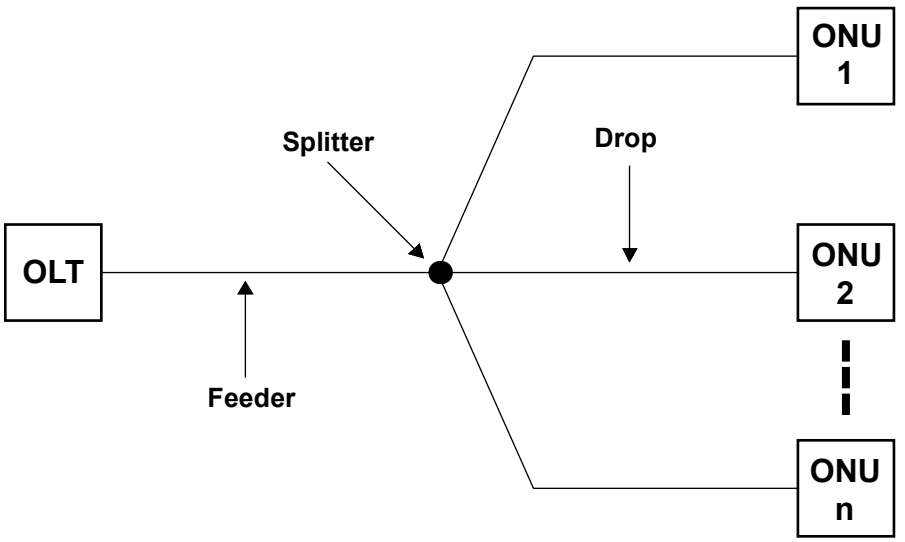


Figure 9-1—PON topology example

The IEEE layering architecture of an EPON interface is defined in the diagram of Figure 56-2 in IEEE Std 802.3. The following clauses in IEEE Std 802.3 define the corresponding layers of an EPON interface:

— Clause 30: Management
— Clause 60: PMD for ~~EPON~~ media (burst-mode PMD)
— Clause 64: MPCP (Multipoint Control Protocol), which defines the Multipoint architecture, and control protocol for the media access of ~~EPON~~.
— Clause 65: Reconciliation Sublayer and Physical Coding Sublayer, which defines a number of extensions to standard Gigabit Ethernet PCS, i.e.:
  a) Definition of Point-to-Point emulation function for ~~EPON~~
  b) Definition of the optional (frame-based) FEC for ~~EPON~~
  c) PMA for ~~EPON~~

9.1.1.2 Principles of operation

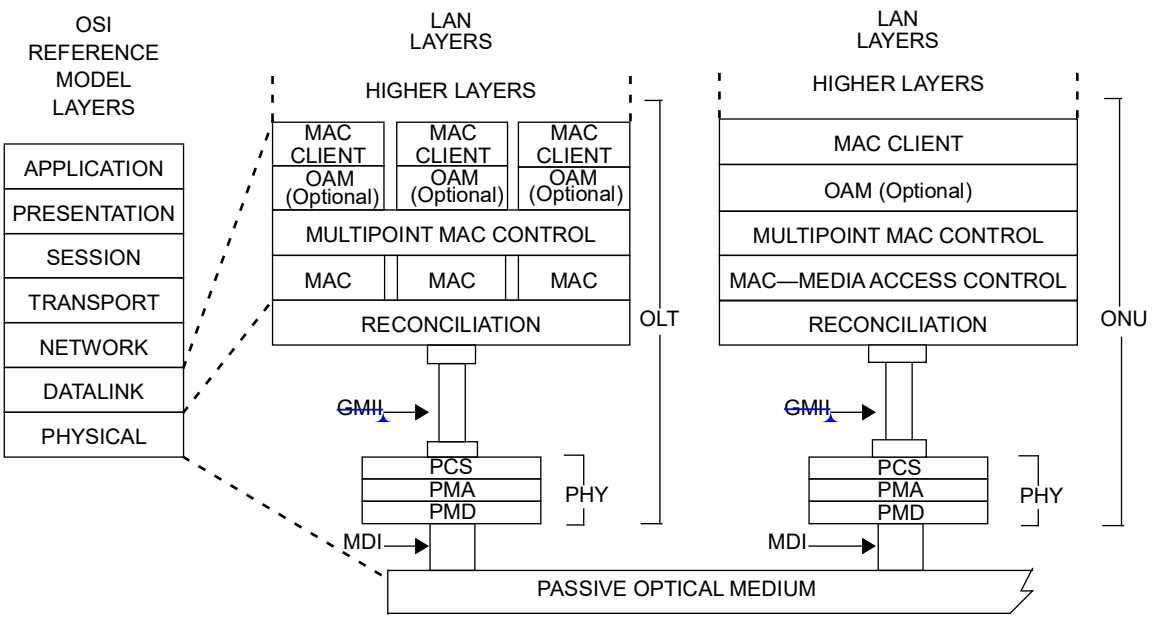
The ~~EPON~~ interface specification extends the specification of Gigabit Ethernet as described in Clause 35 and Clause 36 of IEEE Std 802.3. The Ethernet MAC operates at the data rate of 1 Gb/s, and it is connected to a media-dependent interface through the GMII interface, as described in Clause 35. The EPON PCS layer extends the Gigabit Ethernet PCS as described in Clause 36. New~~,~~ EPON-specific layers are added to Gigabit Ethernet layers in the following locations:

— MPCP is placed in the MAC control layer, providing EPON media access, station discovery, and registration protocol.

— Functionality of the reconciliation sublayer (RS) of Gigabit Ethernet was extended, creating logical links over shared passive optical medium, providing private transmission channels to each of the connected ONUs.

— (Optional) FEC functionality located between the PCS and PMA layers was added, extending the Gigabit Ethernet PCS layer, enhancing reach and split performance of the EPON optical link.

Figure 9-2 presents the EPON layering model.



GMII = GIGABIT MEDIA INDEPENDENT INTERFACE
MDI = MEDIUM DEPENDENT INTERFACE
OAM = OPERATIONS, ADMINISTRATION & MAINTENANCE
OLT = OPTICAL LINE TERMINAL
ONU = OPTICAL NETWORK UNIT
PCS = PHYSICAL CODING SUBLAYER
PHY = PHYSICAL LAYER DEVICE
PMA = PHYSICAL MEDIUM ATTACHMENT
PMD = PHYSICAL MEDIUM DEPENDENT

Figure 9-2—Relationship of Multipoint MAC control and the OSI protocol stack

9.1.1.3 Physical media

The physical link in EPON comprises single-mode fiber. The OLT and ONUs are connected through a passive optical network comprising sections of single-mode fiber interconnected with passive splitter/coupler devices.

The term *downstream* denotes transmission from the OLT to all connected ONUs, while the term *upstream* denotes transmission from the connected ONUs (one at the time) to the OLT. Upstream and downstream transmissions are wavelength division multiplexed (WDM) into a single strand of single-mode fiber, sharing the same physical link.

The downstream transmission channel is continuously available to the OLT;~~;~~ thus, Time Division Multiplexing (TDM) is used. Transmissions from the OLT arrive at all of the connected ONUs and the individual ONUs filter data from the OLT's transmission based on the logical link identifiers (LLIDs) assigned to them during the registration and discovery process.

The upstream transmission channel is shared among a number of connected and registered ONUs using Time Division Multiple Access (TDMA). Access to the upstream channel is controlled via the Multipoint Control Protocol (MPCP), where the OLT plays the role of the master and ONUs play the role of slave devices. An ONU upon registration remains silent until registered, and once registered, it transmits data toward OLT only when granted a transmission opportunity (slot).

9.1.1.4 PMD specifications

The EPON PMD specifications are based on a wavelength plan similar to that used by ITU-T G.983.1. The OLT and ONU optical parameters were derived in part from earlier ~~1000 Mb/s~~ Ethernet PMD specifications, with the addition of WDM capabilities, and burst mode operation for ONU transmitters and the OLT receiver.

The upstream burst mode operation capability corresponds directly to the TDMA operation in the upstream direction, where queued data is burst from individual ONUs at full data rate for the duration of the allocated transmission period. Once completed, the ONU goes silent and another ONU starts transmitting its data.

9.1.1.5 Point-to-point emulation

The downstream link is a broadcast medium, which means that all data transmitted by the OLT is received by all connected ONUs. In order to facilitate compliance of EPON with Ethernet architecture, the P2PE function was included in the RS, creating a series of logical links between the OLT and connected ONUs. An additional broadcast link is also provided for delivery of any broadcast content. In this way, EPON becomes a collection of logical P2P connections established between the OLT and the ONUs. Therefore, the OLT can be seen as an Ethernet device with N+1 logical ports (N P2P logical interfaces and 1 broadcast interface, where N designates the number of connected ONUs).

Logical links also provide a solution for privacy of data, which otherwise would be shared by all subscribers connected to a single OLT port. In this way, each subscriber is isolated and restricted to accessing data streams addressed only to that particular subscriber.

This concept is illustrated in Figure 9-3, which shows an example of an EPON with a single OLT and three connected ONUs.

The single copy broadcast channel (addressed with a special, reserved LLID, see 65.1.3.1 of IEEE Std 802.3) was added to take advantage of the broadcast transmission capability of the underlying physical medium. In this way, it is very simple and very bandwidth efficient to deliver broadcast content to all ONUs at the same time, avoiding the need to replicate data into a series of P2P links.

Editor's Note (to be removed prior to publication):

Reference to IEEE Std 802.1D was replaced with IEEE Std 802.1Q (text and Figure 9-3) per Maintenance Request 1383 (see https://www.ieee802.org/3/maint/requests/maint_1383.pdf)

The ONUs filter all downstream data and drop all frames addressed to other devices. Only broadcast frames and frames with correct unicast logical link ID (LLID) are admitted and processed. The LLID replaces two octets of the Ethernet frame preamble, identifying a logical link established between the OLT and the given ONU during the discovery and registration process. The LLID indicates the destination port in the downstream and the source port in the upstream. The logical links are used effectively to prevent EPON from violating the IEEE 802.1Q bridging rules.

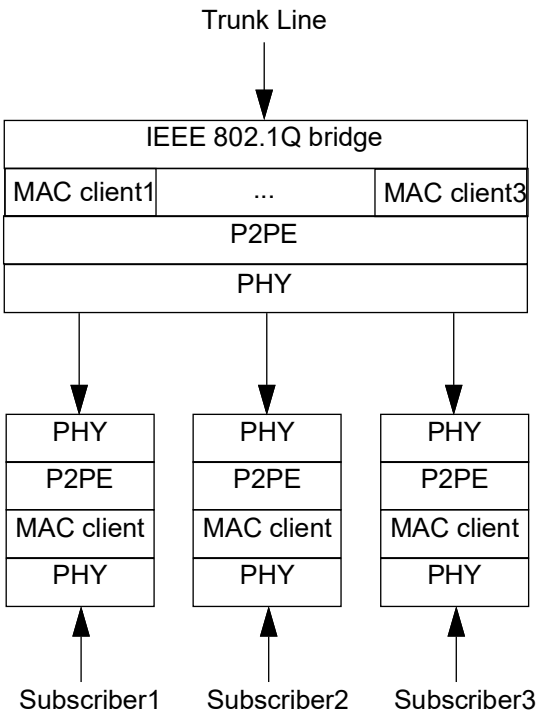


Figure 9-3—Example of point-to-point emulation used between an OLT and three ONUs

9.1.1.6 Principles of the MPCP

The EPON standard comprises a mechanism for media access control, referred to as the Multipoint Control Protocol (MPCP). An access network architecture is different from a typical LAN environment, primarily in terms of network provisioning. An access network is an administrated environment, with an operator providing services and subscribers consuming it depending on service provisioning contracts. The operator controls the network, manages traffic and medium access, and enforces the service level agreements (SLAs). For instance, the available bandwidth is controlled and subscribers may be billed for services. In this sense, the access network (and EPON specifically) requires a media access control protocol that provides a mechanism for station discovery and registration as well as bandwidth provisioning capabilities.

In the MPCP, the OLT is considered to be the master, controlling a series of connected ONUs (slave devices). The OLT manages the network and controls access to network resources from individual slave devices. The MPCP is also used for provisioning upstream channel access to individual slave devices via a MPCPDU pair, i.e., GATE and REPORT. The MPCP is part of the MAC control layer, and MPCPDUs are considered MAC control messages, carrying a specific Ethertype of 0x8808. These messages are not forwarded outside of the EPON domain and are used to manage the EPON link only.

A concept of time exists in the MPCP in order to schedule the upstream transmission. A timestamp, which is transmitted in the MPCPDUs downstream by the OLT and received by the connected ONUs, is used to synchronize slave devices to the master device clock. This coordinates upstream transmissions from individual ONUs so that the transmissions arrive at the OLT at precisely the anticipated time, and thus, data from different ONUs does not overlap.

The MPCP plane is also used to measure the round-trip time (RTT) for each connected ONU. Each MPCPDU carries a generalized timestamp field, which is filled in by the transmitting station with the current value of its MPCP clock at the time when the given MPCPDU is transmitted. The RTT is measured first during the discovery and registration process and then updated regularly upon each exchange of MPCPDUs between the OLT and one of the ONUs. RTT is used by the OLT bandwidth scheduler to schedule upstream transmission slots for individual ONUs in a non-overlapping manner. The IEEE 802.3 EPON standard provides support for the network diameter (distance between the OLT and the farthest ONU) of nominally up to 20 km, which corresponds to the RTT of approximately 200 µs. However, nothing in the standard precludes support for larger network diameters.

The TDMA control is performed using a pair of MPDPUs, namely GATE generated by the OLT to indicate a future transmission opportunity to an ONU and REPORT generated by the ONU with information on the current queue status (bandwidth demand). Internal structure and possible encoding of GATE and REPORT MPCPDUs are defined in ~~Clause 64 of IEEE Std 802.3~~.

A scheduling algorithm at the OLT, which is not defined in IEEE Std 802.3, is responsible for dividing the bandwidth 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 bandwidth they require for transmission using a special REPORT message. This allows allocating bandwidth to an ONU only when requested, relying on the statistical burst property of the traffic, and allowing different peak bandwidths for different ONUs at different times, hence, allowing oversubscription of the bandwidth. The REPORT message reports the amount of data waiting in the ONU queues.

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

The MPCP registration process is presented in Figure 9-4, while details are described in ~~Clause 64 of IEEE Std 802.3~~.

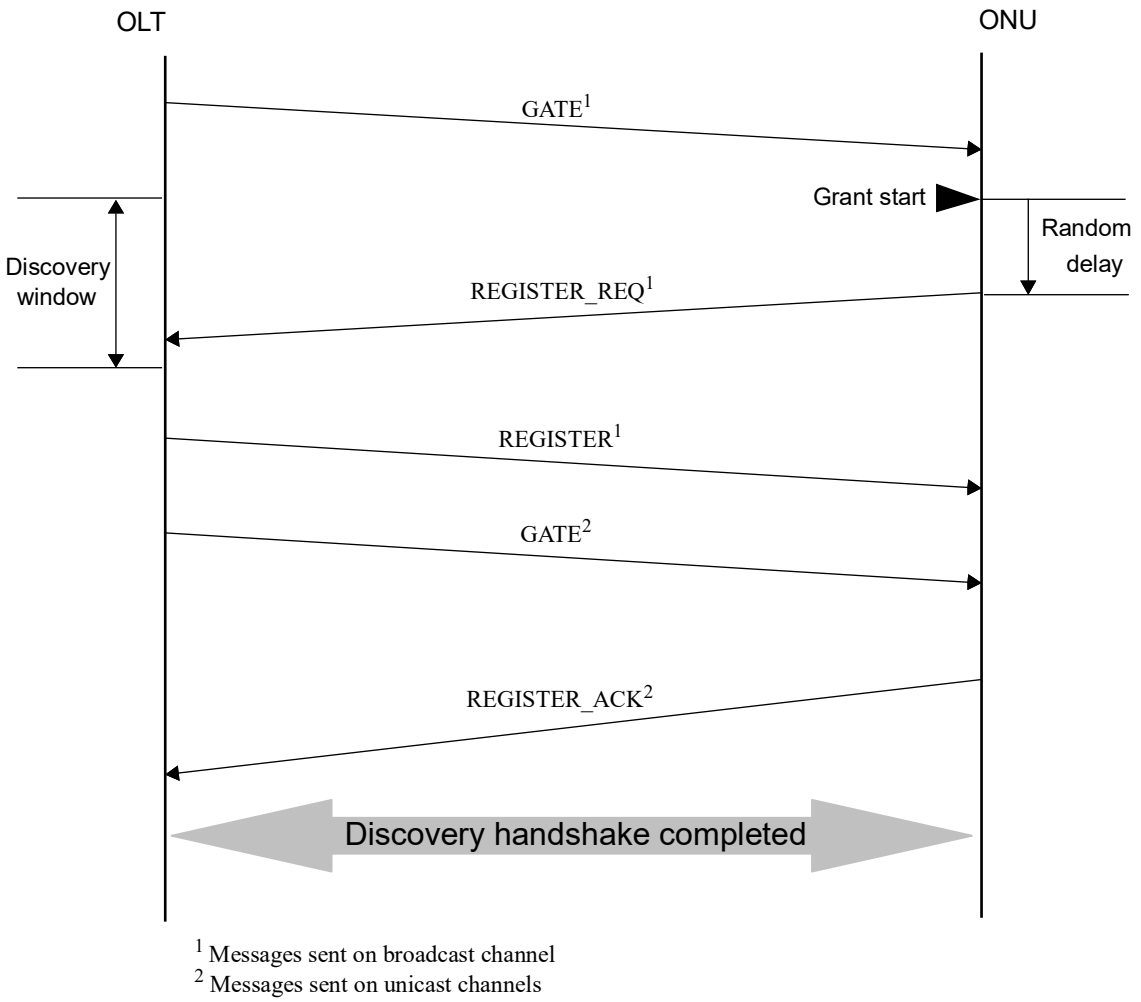


Figure 9-4—Discovery handshake message exchange

A new ONU requests to register during a special upstream window (called Discovery Window), sending the REGISTER_REQ MPCPDU. More than one ONU may attempt registration during that window, which means that their REGISTER_REQ MPCPDUs can potentially collide at the OLT receiver, since the ONU-specific RTT is not yet known and transmissions from individual ONUs cannot be scheduled in an non-overlapping manner. A random backoff mechanism was therefore developed and is used to increase the registration success probability.

When the OLT receives a REGISTER_REQ MPCPDU from an ONU, a decision on registration is taken and an LLID is assigned to that ONU. Next, the OLT sends a REGISTER MPCPDU to that ONU, informing the given slave device whether it is admitted to a network or not. The registration process is completed with the ONU sending REGISTER_ACK MPCPDU to the OLT, confirming assigned parameters and registration in the network. From that point onward, the OLT can schedule transmissions from that ONU using its LLID, using the measured RTT so that its transmissions do not collide with other ONUs.

Additional higher layer protocols may be employed to authenticate the ONU and allow it to participate in the network; however, their specification is outside the scope of IEEE Std 802.3.

9.1.1.7 Forward error correction (FEC)

The optional FEC mechanism is defined to enhance the EPON link budget. All the passive components of the fiber plant attenuate the optical signal; thus, the target distance (network diameter) and the number of supported splits are limited by the available link budget. The optional FEC mechanism increases the available link budget by improving the link BER from 10^{-4} to 10^{-12} (the target BER at the MAC), effectively increasing the target network diameter and/or split ratio. The target use of the increased power budget remains at the sole discretion of the network architects and is out of the scope of IEEE Std 802.3.

The optional FEC used in EPON is frame-based, meaning that parity information is added at the end of each Ethernet packet. Extra space between individual Ethernet packets is provided by the MAC rate adaptation function, while extra idle symbols were replaced within the FEC function.

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

Figure 9-5 presents the structure of an FEC-protected EPON frame.

The optional FEC function is added to the extended Gigabit Ethernet PCS per 65.2 in IEEE Std 802.3. The added, optional FEC function introduces a fixed delay in the receive path and in the transmit path.

Figure 9-5—FEC-protected frame

9.1.2 Management architecture

All EPON layers are accompanied by a management interface that is controlled through mechanisms defined in Clause 30 of IEEE Std 802.3. Since IEEE Std 802.3 specifications may be used for different applications (and hence are extensible), and some of the clauses may be used separately, the management clause allocates a separate package for each independent layer. The structure of the MIB modules follows this separation.

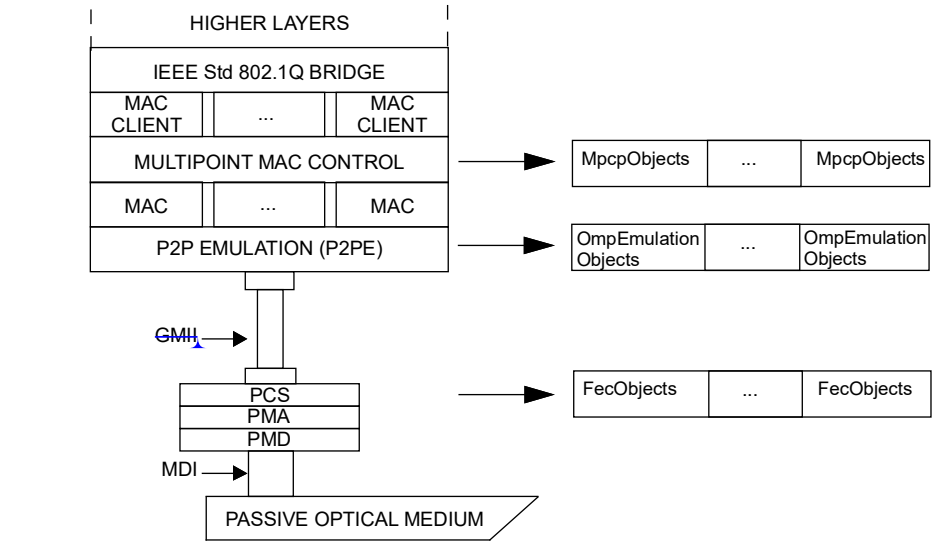
Figure 9-6 presents the relation of the MIB module groups to the individual IEEE 802.3 layers.

Editor's Note (to be removed prior to publication):

Reference to IEEE Std 802.1D was replaced with IEEE Std 802.1Q (Figure 9-6) per Maintenance Request 1383 (see https://www.ieee802.org/3/maint/requests/maint_1383.pdf)

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

The OLT has a single physical interface and N logical interfaces, one for each logical link connected to an ONU. There is also one logical interface for the single copy broadcast link. Per layering diagram in Figure 9-6, the MAC sublayer is virtually replicated. Therefore, in this clause it was elected that management of logical interfaces is performed in the manner identical to management of any physical interfaces—an interface index is allocated for each one of the logical links, and an additional interface index is allocated for the OLT.



GMII = GIGABIT MEDIA INDEPENDENT INTERFACE
MDI = MEDIUM DEPENDENT INTERFACE
PCS = PHYSICAL CODING SUBLAYER
PMA = PHYSICAL MEDIUM ATTACHMENT
PMD = PHYSICAL MEDIUM DEPENDENT
P2P = POINT TO POINT

Figure 9-6—Relationship of the MIB groups to the EPON sublayers

For each physical interface, there would be an entry (ifIndex) in the tables of the interface MIB module defined in IETF RFC 2863, the MAU MIB module defined in Clause 13, and the Ethernet-like MIB module defined in Clause 10. 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 clause. Each row in the tables is indexed according to the ifIndex; specifically, there is a row for each virtual link. There are some control objects that 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 different from the EPON layering diagram, which presents the P2MP layer as a single layer, while duplicating the MAC and MAC client layers (please see Figure 9-6). However, from a management perspective, it is more convenient 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 Ethernet-like interface MIBs.

9.2 MIB structure

This subclause defines the DOT3 EPON MIB module. The DOT3 EPON MIB module defines the objects used for management of the IEEE Std 802.3 EPON interfaces. These MIB objects are included in the following four groups:

a) MPCP MIB objects—MIB objects related to ~~Clause 64 of IEEE Std 802.3~~, Multipoint Control Protocol attributes. The following tables are presented in this group:
   1) The dot3MpcpControlTable defines the objects used for the configuration and status indication, which are per logical link, of MPCP compliant interfaces.
   2) The dot3MpcpStatTable defines the statistics objects that are per logical link, of MPCP compliant interfaces.
   3) The operational mode of an OLT/ONU for the tables is defined by the dot3MpcpMode object in the dot3MpcpControlTable.

b) The OMPEmulation MIB objects—MIB objects related to ~~Clause 65 of IEEE Std 802.3~~, point-to-point emulation attributes. The following tables are presented in this group:
   1) The dot3OmpEmulationTable defines the objects used for the configuration and status indication, which are per logical links, of OMPEmulation compliant interfaces.
   2) The dot3OmpEmulationStatTable defines the statistics objects that are per logical link, of OMPEmulation compliant interfaces.
   3) The operational mode of an OLT/ONU for the tables is defined by the dot3OmpEmulationType object in the dot3OmpEmulationTable.

c) The FEC MIB objects—MIB objects related to ~~Clause 60 and Clause 65 of IEEE Std 802.3~~, EPON FEC attributes. The following table is presented in this group:
   1) The dot3EponFecTable defines the objects used for the configuration and status indication, which are per logical link, of FEC EPON compliant interfaces.

d) 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:
   1) The dot3ExtPkgControlTable defines the objects, which are per logical link, used for the configuration and status indication of EPON compliant interfaces.
   2) 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.
   3) 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.
   4) 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.

The interface MIB module defined in IETF RFC 2863 defines the interface index (ifIndex). Interface Index, as specified in IETF RFC 2863, 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 IETF RFC 2863 and the ifInvStack defined in IETF RFC 2864. The OLT interface is the lower layer of all other interfaces associated with the virtual links.

As described in 9.1.2, each row in the tables is indexed according to the ifIndex; specifically, there is a row for each virtual link. There are a few control objects that 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 EPON layering diagram, which presents the P2MP layer as a single layer while duplicating the MAC and MAC client layers. However, from a management perspective, it is more convenient 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 Ethernet-like interface MIB modules.

The creation of the rows of the ONU interface is done at initialization. Table 9-1 presents the MPCP control table of ONU1 after initialization. A single row exists in the table.

Table 9-1—MPCP control table of ONU1 after initialization

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 9-2 presents the MPCP control table of ONU1 in working mode. A single row exists in the table.

Table 9-2—MPCP control table of ONU1 in working mode

MPCP control MIB object	Value
ifIndex	100
dot3MpcpOperStatus	true
dot3MpcpAdminState	true
dot3MpcpMode	onu
dot3MpcpSyncTime	25
dot3MpcpLinkID	1
dot3MpcpRemoteMACAddress	OLT_MAC_Address[a]
dot3MpcpRegistrationState	registered
dot3MpcpTransmitElapsed	10
dot3MpcpReceiveElapsed	10
dot3MpcpRoundTripTime	100

[a]OLT_MAC_Address is the MAC address of the OLT EPON interface.

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).

Table 9-3 presents the MPCP control table of the OLT after initialization, before the ONUs register. A single row exists in this table associated with the virtual broadcast link.

Table 9-3—MPCP control table of the OLT after initialization

MPCP control MIB object	Value
ifIndex	165535
dot3MpcpOperStatus	true
dot3MpcpAdminState	true
dot3MpcpMode	olt
dot3MpcpSyncTime	25
dot3MpcpLinkID	65535
dot3MpcpRemoteMACAddress	BRCT_MAC_Address[a]
dot3MpcpRegistrationState	registered
dot3MpcpTransmitElapsed	10
dot3MpcpReceiveElapsed	100000
dot3MpcpRoundTripTime	0

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

Table 9-4 presents the MPCP control table of the OLT in working mode. Three rows exist in the table associated with the virtual links.

9.3 Relationship to other MIB modules

9.3.1 Relation to the Interfaces Group MIB and Ethernet-like interface MIB

This MIB module extends the objects of the Interfaces Group MIB and the Ethernet-like interface MIB for the EPON type interface. Therefore, if this module is implemented, the Interfaces Group MIB module

Table 9-4—MPCP control table of the OLT in working mode

MPCP control MIB object	Value	Value	Value
ifIndex	100001	100002	165535
dot3MpcpOperStatus	true	true	true
dot3MpcpAdminState	true	true	true
dot3MpcpMode	olt	olt	olt
dot3MpcpSyncTime	25	25	25
dot3MpcpLinkID	1	2	65535
dot3MpcpRemote MACAddress	ONU1_MAC_Address[a]	ONU2_MAC_Address[b]	BRCT_MAC_Address[c]
dot3MpcpRegistrationState	registered	registered	registered
dot3MpcpTransmitElapsed	10	10	10
dot3MpcpReceiveElapsed	10	10	10
dot3MpcpRoundTripTime	100	60	0

[a]ONU1_MAC_Address is the MAC address of the ONU1 EPON interface.
[b]ONU2_MAC_Address is the MAC address of the ONU2 EPON interface.
[c]BRCT_MAC_Address is the MAC address of the broadcast EPON interface, which is the OLT MAC address.

defined in IETF RFC 2863 and the Ethernet-like interface MIB module defined in Clause 10 shall also be implemented.

Thus, each managed EPON interface would have a corresponding entry in the mandatory tables of the Ethernet-like MIB module found in Clause 10, and likewise in the tables of the Interfaces Group MIB module found in IETF RFC 2863. Also, each managed virtual EPON interface would have a corresponding entry in the mandatory tables of the Ethernet-like MIB module found in Clause 10, and likewise in the tables of the Interfaces Group MIB module found in IETF RFC 2863 with a dedicated ifIndex for this interface.

In this clause, there is no replication of the objects from these MIBs. Therefore, for instance, the clause is defining the dot3MpcpRemoteMACAddress only while assuming that the local MAC address object is already defined in Clause 10.

This clause 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.

Note that all virtual interfaces have the same physical MAC address at the OLT since the physical OLT interface used by all virtual interfaces is the same. The value of this physical MAC interface is specified in ~~64.1.2 of IEEE Std 802.3~~. The corresponding object of the Ethernet-like interface MIB is replicated for all virtual interfaces.

For example, the values of the Interfaces Group MIB objects are presented in the following tables, for an OLT with three registered ONUs.

Table 9-5 presents the objects of the Interfaces Group MIB of an ONU in working mode.

Table 9-5—Interfaces Group MIB of an ONU in working mode

Interfaces Group MIB object	Value
ifIndex	1
ifDescr	“interface description”
ifType	ethernetCsmacd (6) 1000base-Px
ifMtu	MTU size (1522)
ifSpeed	1000000000
ifPhysAddress	ONU_MAC_Address[a]
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

[a]ONU_MAC_Address is the MAC address of the ONU EPON interface.

Table 9-6 presents the objects of the Interfaces Group MIB of the ONU interface.

Table 9-6—Interfaces Group MIB of the ONU interface

Interfaces Group MIB object	Value
ifIndex	100
ifDescr	“interface description”
ifType	ethernetCsmacd (6) 1000base-Px
ifMtu	MTU size (1522)
ifSpeed	1000000000
ifPhysAddress	ONU_MAC_Address[a]
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

[a]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

Table 9-7 presents the Interfaces Group MIB objects of an OLT interface.

Table 9-7—Interfaces Group MIB objects of an OLT interface

Interfaces Group MIB object	Value
ifIndex	2
ifDescr	“interface description”
ifType	ethernetCsmacd (6) 1000base-Px
ifMtu	MTU size (1522)
ifSpeed	1000000000
ifPhysAddress	OLT_MAC_Address[a]
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

Table 9-7—Interfaces Group MIB objects of an OLT interface *(continued)*

Interfaces Group MIB object	Value
ifOutDiscards	OLT_discard_frame_number
ifOutErrors	OLT_error_frame_number
ifOutQLen	OLT_queue_frame_number

[a]OLT_MAC_Address is the MAC address of the OLT EPON interface.

Table 9-8 presents the Interfaces Group MIB objects of an OLT interface, associated with the virtual link interfaces.

Table 9-8—Interfaces Group MIB objects of an OLT interface, associated with the virtual link interfaces

Interface MIB object	Value	Value	Value
ifIndex	200001	200002	265535
ifDescr	“interface description”	“interface description”	“interface description”
ifType	ethernetCsmacd (6)	ethernetCsmacd (6)	ethernetCsmacd (6)
ifMtu	MTUsize(1522)	MTUsize(1522)	MTUsize(1522)
ifSpeed	1000000000	1000000000	1000000000
ifPhysAddress	OLT_MAC_Address[a]	OLT_MAC_Address	OLT_MAC_Address
ifAdminStatus	up	up	up
ifOperStatus	Up	Up	Up
ifLastChange	ONU1_up_time	ONU2_up_time	up_time
ifInOctets	ONU1_octets_number	ONU2_octets_number	BRCT_octets_number
ifInUcastPkts	ONU1_unic_frame_num	ONU2_unic_frame_num	BRCT_unic_frame_num
ifInNUcastPkts	ONU1_non_unic_frame_num	ONU2_non_unic_frame_num	BRCT_non_unic_frame_num
ifInDiscards	ONU1_disc_frame_num	ONU2_disc_frame_num	BRCT_disc_frame_numr
ifInErrors	ONU1_err_frame_num	ONU2_err_frame_num	BRCT_err_frame_num
ifInUnknownProtos	ONU1_unknw_frame_num	ONU2_unknw_frame_num	BRCT_unknw_frame_num
ifOutOctets	ONU1_octets_number	ONU2_octets_number	BRCT_octets_number
ifOutUcastPkts	ONU1_unic_frame_num	ONU2_unic_frame_num	BRCT_unic_frame_num
ifOutNUcastPkts	ONU1_non_unic_frame_num	ONU2_non_unic_frame_num	BRCT_non_unic_frame_num

Table 9-8—Interfaces Group MIB objects of an OLT interface, associated with the virtual link interfaces *(continued)*

Interface MIB object	Value	Value	Value
ifOutDiscards	ONU1_disc_frame_num	ONU2_disc_frame_num	BRCT_disc_frame_num
ifOutErrors	ONU1_err_frame_num	ONU2_err_frame_num	BRCT_err_frame_num
ifOutQLen	ONU1_queue_frame_num	ONU2_queue_frame_num	BRCt_queue_frame_num

[a]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, the OLT interface, and 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 Interfaces Group 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 clause describes the possible behavior of counters when an interface is re-initialized using the ifCounterDiscontinuityTime indicator, indicating the discontinuity of the counters. See Section 3.1.5 of IETF RFC 2863 for more information. The counters of the EPON MIB should be handled in a similar manner.

9.3.2 Relation to the IEEE 802.3 MAU MIBs

The MAU types of the EPON Interface are defined in Clause 13. This clause assumes the implementation of the MAU MIB for this purpose and does not repeat the EPON MAU types. Therefore, if this module is implemented, the MAU-MIB module defined in Clause 13 shall also be implemented.

The handling of the ifMAU tables for the EPON case is similar to the handling described in the former subclause for the Interface and Ethernet-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, the OLT interface, and 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).

9.3.3 Relation to the Ethernet OAM MIB

The EPON interfaces are intended for use in optical subscriber access networks and most probably will be accompanied with the implementation of the OAM protocol defined in Clause 57 of IEEE Std 802.3. Therefore, the Ethernet OAM MIB module defined in Clause 6 may be implemented when this MIB module is implemented defining managed objects for the OAM protocol that are complementary to the EPON MIB module.

9.3.4 Relation to the bridge MIB

Editor's Note (to be removed prior to publication):

Reference to IEEE Std 802.1D was replaced with IEEE Std 802.1Q per Maintenance Request 1383 (see https://www.ieee802.org/3/maint/requests/maint_1383.pdf)

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 in IEEE Std 802.1Q. 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 defined in IEEE Std 802.1Q [B5] may be implemented when the 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, etc.).

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.

9.4 Mapping of IEEE 802.3 managed objects

This subclause contains the mapping between the managed objects defined in this clause and the attributes defined in Clause 30 of IEEE Std 802.3. Table 9-9 provides the mapping between the dot3EPON MIB module MPCP objects and the MPCP attributes of Clause 30 of IEEE Std 802.3.

Table 9-10 provides the mapping between the dot3EPON MIB module OMPEmulation objects and the OMPE attributes of Clause 30 of IEEE Std 802.3.

Table 9-9—oMPCP managed object class (30.3.5 of IEEE Std 802.3)

dot3EPON MIB module object	IEEE 802.3 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
dot3MpcpMACCtrlFramesTransmitted	aMPCPMACCtrlFramesTransmitted	30.3.5.1.7
dot3MpcpMACCtrlFramesReceived	aMPCPMACCtrlFramesReceived	30.3.5.1.8
dot3MpcpTxGate	aMPCPTxGate	30.3.5.1.9
dot3MpcpTxRegAck	aMPCPTxRegAck	30.3.5.1.10
dot3MpcpTxRegister	aMPCPTxRegister	30.3.5.1.11
dot3MpcpTxRegRequest	aMPCPTxRegRequest	30.3.5.1.12
dot3MpcpTxReport	aMPCPTxReport	30.3.5.1.13
dot3MpcpRxGate	aMPCPRxGate	30.3.5.1.14
dot3MpcpRxRegAck	aMPCPRxRegAck	30.3.5.1.15
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 9-10—oOMPEmulation managed object class (30.3.7 of IEEE Std 802.3)

dot3EPON MIB module object	IEEE 802.3 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	N/A	—
dot3OmpEmulationOnuLLIDNotBroadcast	N/A	—
dot3OmpEmulationBroadcastBitPlusOnuLlid	N/A	—
dot3OmpEmulationNotBroadcastBitNotOnuLlid	N/A	—

Table 9-11 provides the mapping between the dot3EPON MIB module FEC objects and the MAU attributes of Clause 30 of IEEE Std 802.3.

Table 9-11—oMAU managed object class (30.5.1 of IEEE Std 802.3)

dot3EPON MIB module object	IEEE 802.3 attribute	Reference
dot3EponFecPCSCodingViolation	aPCSCodingViolation	30.5.1.1.14
dot3EponFecAbility	aFECAbility	30.5.1.1.15
dot3EponFecMode	aFECmode	30.5.1.1.16
dot3EponFecCorrectedBlocks	aFECCorrectedBlocks	30.5.1.1.17
dot3EponFecUncorrectableBlocks	aFECUncorrectableBlocks	30.5.1.1.18
dot3EponFecBufferHeadCodingViolation	N/A	—

9.5 Security considerations for Ethernet passive optical network (EPON) MIB module

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 those listed in 9.5.1 to 9.5.13.

9.5.1 dot3MpcpAdminState

Changing the dot3MpcpAdminState state can lead to disabling the Multipoint Control Protocol on the respective interface, leading to the interruption of service for the users connected to the respective EPON interface.

9.5.2 dot3EponFecMode

Changing the dot3EponFecMode state can lead to disabling the Forward Error Correction on the respective interface, which can lead to a degradation of the optical link, and therefore, it may lead to an interruption of service for the users connected to the respective EPON interface.

9.5.3 dot3ExtPkgObjectReset

Changing the dot3ExtPkgObjectReset state can lead to a reset of the respective interface leading to an interruption of service for the users connected to the respective EPON interface.

9.5.4 dot3ExtPkgObjectPowerDown

Changing the dot3ExtPkgObjectPowerDown state can lead to a power down of the respective interface, leading to an interruption of service for the users connected to the respective EPON interface.

9.5.5 dot3ExtPkgObjectFecEnabled

Changing the dot3ExtPkgObjectFecEnabled state can lead to disabling the Forward Error Correction on the respective interface, which can lead to a degradation of the optical link, and therefore, it may lead to an interruption of service for the users connected to the respective EPON interface.

9.5.6 dot3ExtPkgObjectRegisterAction

Changing the dot3ExtPkgObjectRegisterAction state can lead to a change in the registration state of the respective interface, leading to a deregistration and an interruption of service for the users connected to the respective EPON interface.

9.5.7 dot3ExtPkgObjectReportNumThreshold

Changing the dot3ExtPkgObjectReportNumThreshold can lead to a change in the reporting of the ONU interface and therefore to a change in the bandwidth allocation of the respective interface. This change may lead to a degradation or an interruption of service for the users connected to the respective EPON interface.

9.5.8 dot3ExtPkgObjectReportThreshold

Changing the dot3ExtPkgObjectReportThreshold can lead to a change in the reporting of the ONU interface and therefore to a change in the bandwidth allocation of the respective interface. This change may lead to a degradation or an interruption of service for the users connected to the respective EPON interface.

9.5.9 dot3ExtPkgOptIfLowerInputPowerThreshold

Changing the dot3ExtPkgOptIfLowerInputPowerThreshold can lead to a Threshold Crossing Alert (TCA) being sent for the respective interface. This alert may be leading to an interruption of service for the users connected to the respective EPON interface, depending on the system action on such an alert.

9.5.10 dot3ExtPkgOptIfUpperInputPowerThreshold

Changing the dot3ExtPkgOptIfUpperInputPowerThreshold can lead to a Threshold Crossing Alert (TCA) being sent for the respective interface. This alert may be leading to an interruption of service for the users connected to the respective EPON interface, depending on the system action on such an alert.

9.5.11 dot3ExtPkgOptIfLowerOutputPowerThreshold

Changing the dot3ExtPkgOptIfLowerOutputPowerThreshold can lead to a Threshold Crossing Alert (TCA) being sent for the respective interface. This alert may be leading to an interruption of service for the users connected to the respective EPON interface, depending on the system action on such an alert.

9.5.12 dot3ExtPkgOptIfUpperOutputPowerThreshold

Changing the dot3ExtPkgOptIfUpperOutputPowerThreshold can lead to a Threshold Crossing Alert (TCA) being sent for the respective interface. This alert may be leading to an interruption of service for the users connected to the respective EPON interface, depending on the system action on such an alert.

9.5.13 dot3ExtPkgOptIfTransmitEnable

Changing the dot3ExtPkgOptIfTransmitEnable state can lead to a halt in the optical transmission of the respective interface, leading to an interruption of service for the users connected to the respective EPON interface.

9.6 MIB module definition

Editor's Note (to be removed prior to publication):

Update MIB URL once this standard is published.

An ASCII text version of the MIB definition can be found at the following URL[16]:

http://www.ieee802.org/3/1/public/mib_modules/20130411/802dot3dot1C9mib.txt

[16]Copyright release for MIB modules: Users of this standard may freely reproduce the MIB module contained in this subclause so that it can be used for its intended purpose.

```
IEEE8023-DOT3-EPON-MIB DEFINITIONS ::= BEGIN


     IMPORTS

         MODULE-IDENTITY, OBJECT-TYPE, Counter32,

         Integer32, Unsigned32, Counter64, org

             FROM SNMPv2-SMI

         TruthValue, MacAddress

             FROM SNMPv2-TC

         ifIndex

             FROM IF-MIB

         MODULE-COMPLIANCE, OBJECT-GROUP

             FROM SNMPv2-CONF

         ;


ieee8023dot3EponMIB MODULE-IDENTITY

        LAST-UPDATED "202307310000Z" - July 31, 2023

        ORGANIZATION

          "IEEE 802.3 Working Group"

    CONTACT-INFO

        "  WG-URL: http://www.ieee802.org/3/index.html

         WG-EMail: mailto:stds-802-3-dialog@ieee.org

          Contact: IEEE 802.3 Working Group Chair

           Postal: C/O IEEE 802.3 Working Group

                   IEEE Standards Association

                   445 Hoes Lane

                   Piscataway, NJ 08854

                   USA

           E-mail: mailto:stds-802-3-dialog@ieee.org"

    DESCRIPTION

            "The objects in this MIB module are used to manage the
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```
                Ethernet in the First Mile (EFM) Ethernet Passive Optical
                Network (EPON) Interfaces as defined in IEEE Std 802.3
                Clauses 60, 64, and 65.

                Of particular interest are Clause 64 (MultiPoint 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'."

        REVISION    "202307310000Z" - July 31, 2023
        DESCRIPTION
                "Revision, based on an earlier version in IEEE Std 802.3.1-2013
                 addressing changes from IEEE Std 802.3 revisions 2012, 2015, 2018,
                 and 2022."

        REVISION     "201304110000Z" -- April 11, 2013
        DESCRIPTION
                "Revision, based on an earlier version in IEEE Std 802.3.1-2011."

        REVISION     "201102020000Z" -- February 2, 2011
        DESCRIPTION
                "Initial version, based on an earlier version published
                 as RFC 4837."

              ::= { org ieee(111) standards-association-numbers-series-standards(2)
                    lan-man-stds(802) ieee802dot3(3) ieee802dot3dot1mibs(1) 9 }

dot3EponObjects OBJECT IDENTIFIER ::= { ieee8023dot3EponMIB 1}
```

```
dot3EponConformance OBJECT IDENTIFIER ::= { ieee8023dot3EponMIB 2}


-- MPCP MIB modules definitions (IEEE Std 802.3, Clause 30.3.5)


dot3EponMpcpObjects
     OBJECT IDENTIFIER ::= { dot3EponObjects 1 }


dot3MpcpControlTable OBJECT-TYPE
    SYNTAX  SEQUENCE OF Dot3MpcpControlEntry
    MAX-ACCESS  not-accessible
    STATUS  current
    DESCRIPTION
            "A Table of dot3 MultiPoint 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.
             The LLID field, as defined in the IEEE Std 802.3, is a 2-byte
             register (15-bit field and a broadcast bit) limiting the
             number of virtual links to 32768. 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."
    ::= { 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.

             A row in the table is denoted by the ifIndex of the link

             and it is created when the ifIndex is created.

             The rows in the table for an ONU interface are created

             at system initialization.

             The row in the table corresponding to the OLT ifIndex

             and the row corresponding to the broadcast virtual link

             are created at system initialization.

             A row in the table corresponding to the ifIndex of a

             virtual links 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

             MultiPoint MAC Control sublayer as defined in

             IEEE Std 802.3, Clause 64 or Clause 77.

             When the value is true(1), the interface will act as if the

             MultiPoint Control Protocol is enabled. When the value is false(2)

             , the interface will act as if the MultiPoint Control Protocol is

             disabled. 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   "IEEE Std 802.3, 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

             MultiPoint MAC Control sublayer, as defined in

             IEEE Std 802.3, Clause 64 or Clause 77,

             and to reflect its state.

             When selecting the value as true(1), the MultiPoint
```

```
                Control Protocol of the interface is enabled.
                When selecting the value as false(2), the MultiPoint
                Control Protocol of the interface is disabled.
                This object reflects the administrative state of the
                MultiPoint Control Protocol of the interface.
                The write operation is not restricted in this document
                and can be done at any time. Changing
                dot3MpcpAdminState state can lead to disabling the
                MultiPoint Control Protocol on the respective interface,
                leading to the interruption of service for the users
                connected to the respective EPON interface.
                This object is applicable for an OLT, with the same
                value for all virtual interfaces, and for an ONU."
    REFERENCE   "IEEE Std 802.3, 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 MultiPoint MAC Control sublayer as
             defined in IEEE Std 802.3, Clause 64 or Clause 77.
             Reading olt(1) for an OLT (server) mode and onu(2) for an ONU
             (client) mode. This object is used to identify the operational
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                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   "IEEE Std 802.3, 30.3.5.1.3"

    DEFVAL { olt }

    ::= { dot3MpcpControlEntry 3 }


dot3MpcpSyncTime OBJECT-TYPE

    SYNTAX  Unsigned32

    UNITS       "TQ (16 ns)"

    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 IEEE Std 802.3, Clause 64 or Clause 77.

             The value returned shall be (sync lock time ns)/16, rounded up

             to the nearest TQ. If this value exceeds (2^32-1), the

             value (2^32-1) shall be returned. This object is applicable

             for an OLT, with distinct values for all virtual interfaces,

             and for an ONU."

    REFERENCE   "IEEE Std 802.3, 64.3.3.2 and 77.3.3.2"

   ::= { 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 IEEE Std 802.3, 65.1.3.2.2 or
                76.2.6.1.3.2,  as appropriate.
                This object is applicable for an OLT and an ONU. At the
                OLT, it has a distinct value for each virtual interface.
                The ONU and the corresponding virtual MAC of the OLT,
                for the same virtual link, have the same value.
                Value is assigned when the ONU registers.
                Value is freed when the ONU deregisters."
    REFERENCE   "IEEE Std 802.3, 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 as specified in IEEE Std 802.3, Annex
             31A; 2) the lengthOrType field value equal to the reserved
             Type for MAC Control as specified in IEEE Std 802.3, Annex
             31A; 3) an MPCP subtype value equal to the subtype
             reserved for MPCP as specified in IEEE Std 802.3, Annex 31A.
             This object is applicable for an OLT and an ONU. At the
             OLT, it has a distinct 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; the ONU has a single
                value that is the OLT MAC address."
    REFERENCE   "IEEE Std 802.3, 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 MultiPoint MAC Control sublayer as defined in
             IEEE Std 802.3, Clause 64 and Clause 77.
             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 distinct value for each virtual interface."
    REFERENCE   "IEEE Std 802.3, 30.3.5.1.6"
    ::= { dot3MpcpControlEntry 7 }
```

```
dot3MpcpTransmitElapsed OBJECT-TYPE

    SYNTAX  Unsigned32

    UNITS       "TQ (16 ns)"

    MAX-ACCESS  read-only

    STATUS  current

    DESCRIPTION

            "An object that reports the interval from the 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 distinct value for each virtual interface."
    REFERENCE   "IEEE Std 802.3, 30.3.5.1.19"

    ::= { dot3MpcpControlEntry 8 }


dot3MpcpReceiveElapsed OBJECT-TYPE

    SYNTAX  Unsigned32

    UNITS       "TQ (16 ns)"

    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 distinct value for each virtual interface."
    REFERENCE   "IEEE Std 802.3, 30.3.5.1.20"
```

```
    ::= { dot3MpcpControlEntry 9 }


dot3MpcpRoundTripTime OBJECT-TYPE

    SYNTAX  Unsigned32 (0..'ffff'h)

    UNITS       "TQ (16 ns)"

    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. At the

             OLT, it has a distinct value for each virtual interface."

    REFERENCE   "IEEE Std 802.3, 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

             that an ONU can store for handling. The maximum number

             of grants that 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 distinct value for each virtual interface.

             At the OLT, the value should be zero."

    REFERENCE   "IEEE Std 802.3, 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 IEEE Std 802.3, Clause 64 or
             Clause 77 MPCP.
             Each object has a row for every virtual link denoted by
             the corresponding ifIndex.
             The LLID field, as defined in IEEE Std 802.3, is a 2-byte
             register (15-bit field and a broadcast bit) limiting the
             number of virtual links to 32768. 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."
::= { dot3EponMpcpObjects 2 }


dot3MpcpStatEntry OBJECT-TYPE

    SYNTAX     Dot3MpcpStatEntry

    MAX-ACCESS not-accessible

    STATUS     current

    DESCRIPTION

            "An entry in the table of statistics counters of the
             IEEE Std 802.3, Clause 64 or Clause 77 MPCP interface.
             Rows exist for an OLT interface and an ONU interface.
             A row in the table is denoted by the ifIndex of the link
             and it is created when the ifIndex is created.
```

```
                The rows in the table for an ONU interface are created
                at system initialization.
                The row in the table corresponding to the OLT ifIndex
                and the row corresponding to the broadcast virtual link
                are created at system initialization.
                A row in the table corresponding to the ifIndex of a
                virtual link 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 distinct 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 object of the Interfaces Group MIB
             module."

    REFERENCE   "IEEE Std 802.3, 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 IEEE Std 802.3
                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 distinct 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 object of the Interfaces Group MIB
                module."
    REFERENCE   "IEEE Std 802.3, 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 distinct 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 object of the Interfaces Group MIB
              module."
    REFERENCE   "IEEE Std 802.3, 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 distinct 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 object of the Interfaces Group MIB

             module."

   REFERENCE   "IEEE Std 802.3, 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 IEEE Std 802.3, Clause 64 or Clause 77.
            This object is applicable for an OLT and an ONU. At the
            OLT, it has a distinct 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 object of the Interfaces Group MIB
            module."
    REFERENCE   "IEEE Std 802.3, 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 IEEE Std 802.3, Clause 64 or
            Clause 77.
            This object is applicable for an OLT and an ONU. At the
            OLT, it has a distinct 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 object of the Interfaces Group MIB
```

```
                module."
    REFERENCE   "IEEE Std 802.3, 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 IEEE Std 802.3, Clause 64 or Clause 77.
               This object is applicable for an OLT and an ONU. At the
               OLT, it has a distinct 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 object of the Interfaces Group MIB
               module."
   REFERENCE   "IEEE Std 802.3, 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 IEEE Std 802.3, Clause 64 or
             Clause 77.
             This object is applicable for an OLT and an ONU. At the
             OLT, it has a distinct 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 object of the Interfaces Group MIB
             module."
    REFERENCE   "IEEE Std 802.3, 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
             IEEE Std 802.3, Clause 64 or Clause 77.
             This object is applicable for an OLT and an ONU. At the
             OLT, it has a distinct 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 object of the Interfaces Group MIB
                module."
    REFERENCE   "IEEE Std 802.3, 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 IEEE Std 802.3, Clause 64 or
                Clause 77.
                This object is applicable for an OLT and an ONU. At the
                OLT, it has a distinct 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 object of the Interfaces Group MIB
                module."
    REFERENCE   "IEEE Std 802.3, 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 IEEE Std 802.3, Clause 64 or

             Clause 77.

             This object is applicable for an OLT and an ONU. At the

             OLT, it has a distinct 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 object of the Interfaces Group MIB

             module."

    REFERENCE   "IEEE Std 802.3, 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 IEEE Std 802.3, Clause 64 or
                Clause 77.
                This object is applicable for an OLT and an ONU. At the
                OLT, it has a distinct 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 object of the Interfaces Group MIB
                module."
    REFERENCE   "IEEE Std 802.3, 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 IEEE Std 802.3, Clause 64 or
                Clause 77.
                This object is applicable for an OLT and an ONU. At the
                OLT, it has a distinct 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 object of the Interfaces Group MIB
                module."
    REFERENCE   "IEEE Std 802.3, 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 IEEE Std 802.3, Clause 64 or
              Clause 77.
              This object is applicable for an OLT and an ONU. At the
              OLT, it has a distinct 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 object of the Interfaces Group MIB
              module."
     REFERENCE   "IEEE Std 802.3, 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
            "A table of dot3 OmpEmulation MIB objects. The table
             contain objects for the management of the OMPEmulation
             sublayer.
             Each object has a row for every virtual link denoted by
             the corresponding ifIndex.
             The LLID field, as defined in the IEEE Std 802.3, is a 2-byte
             register (15-bit field and a broadcast bit) limiting the
             number of virtual links to 32768. 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."
    ::= { 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.
             A row in the table is denoted by the ifIndex of the link
             and it is created when the ifIndex is created.
```

```
                The rows in the table for an ONU interface are created
                at system initialization.
                The row in the table corresponding to the OLT ifIndex
                and the row corresponding to the broadcast virtual link
                are created at system initialization.
                A row in the table corresponding to the ifIndex of a
                virtual links 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 IEEE Std 802.3, 65.1 or 76.2 as appropriate).
             unknown(1) value is assigned in initialization; true state
```

```
                or type is 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   "IEEE Std 802.3, 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
             IEEE Std 802.3, Clause 65 or Clause 76, OMPEmulation sublayer.
             Each object has a row for every virtual link denoted by
             the corresponding ifIndex.
             The LLID field, as defined in the IEEE Std 802.3, is a 2-byte
             register (15-bit field and a broadcast bit) limiting the
             number of virtual links to 32768. 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."
    ::= { dot3OmpEmulationObjects 2}


dot3OmpEmulationStatEntry OBJECT-TYPE
    SYNTAX     Dot3OmpEmulationStatEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
```

```
            "An entry in the table of statistics counters of
             IEEE Std 802.3, Clause 65 or Clause 76, OMPEmulation sublayer.
             Rows exist for an OLT interface and an ONU interface.
             A row in the table is denoted by the ifIndex of the link
             and it is created when the ifIndex is created.
             The rows in the table for an ONU interface are created
             at system initialization.
             The row in the table corresponding to the OLT ifIndex
             and the row corresponding to the broadcast virtual link
             are created at system initialization.
             A row in the table corresponding to the ifIndex of a
             virtual links 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 IEEE Std 802.3, 65.1.3.3.1 or
             76.2.6.1.3.1, as appropriate.
             This object is applicable for an OLT and an ONU. At the
             OLT, it has a distinct value for each virtual interface.s
             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 object of the Interfaces Group MIB
             module."
    REFERENCE   "IEEE Std 802.3, 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 IEEE Std 802.3, 65.1.3.3.1 or 76.2.6.1.3.1
             as appropriate, but do not pass the CRC-8 check as defined in
             IEEE Std 802.3, 65.1.3.3.3 or 76.2.6.1.3.3 as appropriate.
```

```
            This object is applicable for an OLT and an ONU. At the
            OLT, it has a distinct 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 object of the Interfaces Group MIB
            module."
    REFERENCE   "IEEE Std 802.3, 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 in an
            OLT, and pass the CRC-8 check, but are discarded due to the
            LLID check. The SLD is defined in IEEE Std 802.3, 65.1.3.3.1
            or 76.2.6.1.3.1, as appropriate. The CRC-8 check is defined in
            IEEE Std 802.3, 65.1.3.3.3 or 76.2.6.1.3.3, as appropriate. The
            LLID check is defined in IEEE Std 802.3, 65.1.3.3.2 or
            76.2.6.1.3.2, as appropriate.
            This object is applicable for an OLT and an ONU. At the
            OLT, it has a distinct 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 object of the Interfaces Group MIB
            module."
```

```
    REFERENCE   "IEEE Std 802.3, 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 IEEE Std 802.3, 65.1.3.3.1 or 76.2.6.1.3.1,
             as appropriate, and pass the CRC-8 check as defined in
             IEEE Std 802.3, 65.1.3.3.3 or 76.2.6.1.3.3, as appropriate.
             This object is applicable for an OLT and an ONU. At the
             OLT, it has a distinct 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 object of the Interfaces Group MIB
             module."
    REFERENCE   "IEEE Std 802.3, 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: 1) contain a valid SLD field
```

```
                in an  ONU, 2) meet the rules for frame acceptance, and
                3) pass the CRC-8 check. The SLD is defined in
                IEEE Std 802.3, 65.1.3.3.1 or 76.2.6.1.3.1, as appropriate. The
                rules for LLID acceptance are defined in IEEE Std 802.3, 65.1.3.3.2
                or 76.2.6.1.3.2, as appropriate. The CRC-8 check is defined
                in IEEE Std 802.3, 65.1.3.3.3 or 76.2.6.1.3.3, as appropriate.
                This object is applicable for an OLT and an ONU. At the
                OLT, it has a distinct 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 object of the Interfaces Group MIB
                module."
    REFERENCE   "IEEE Std 802.3, 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 IEEE Std 802.3, 65.1.3.3.1 or 76.2.6.1.3.1, as
                appropriate, pass the CRC-8 check, as defined in
                IEEE Std 802.3, 65.1.3.3.3 or 76.2.6.1.3.3, as appropriate,
                and meet the rules of acceptance for an OLT defined in
                IEEE Std 802.3, 65.1.3.3.2 or 76.2.6.1.3.2, as appropriate.
                This object is applicable for an OLT and an ONU. At the
```

```
                OLT, it has a distinct 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 object of the Interfaces Group MIB
                module."
    REFERENCE   "IEEE Std 802.3, 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 IEEE Std 802.3,
               65.1.3.3.1, pass the CRC-8 check, as defined in
               IEEE Std 802.3, 65.1.3.3.3 or 76.2.6.1.3.3, and contain the
               broadcast bit in the LLID and not the ONU's LLID (frame accepted)
               as defined in IEEE Std 802.3, Clause 65 or Clause 76.
               This object is applicable for an OLT and an ONU. At the
               OLT, it has a distinct 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 object of the Interfaces Group MIB
               module."
```

```
    ::= { 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 IEEE Std 802.3,

             65.1.3.3.1, pass the CRC-8 check, as defined in

             IEEE Std 802.3, 65.1.3.3.3 or 76.2.6.1.3.3, and contain the ONU's

             LLID as defined in IEEE Std 802.3, Clause 65 or Clause 76.

             This object is applicable for an OLT and an ONU. At the

             OLT, it has a distinct 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 object of the Interfaces Group MIB

             module."

    ::= { 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 IEEE Std 802.3,
                65.1.3.3.1, pass the CRC-8 check, as defined in
                IEEE Std 802.3, 65.1.3.3.3 or 76.2.6.1.3.3, and contain the
                broadcast bit in the LLID and match the ONU's LLID (frame
                reflected) as defined in IEEE Std 802.3, Clause 65 or Clause 76.
                This object is applicable for an OLT and an ONU. At the
                OLT, it has a distinct 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 object of the Interfaces Group MIB
                module."
    ::= { 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 IEEE Std 802.3,
                65.1.3.3.1, pass the CRC-8 check, as defined in
                IEEE Std 802.3, 65.1.3.3.3 or 76.2.6.1.3.3, and do not contain
                the ONU's LLID as defined in IEEE Std 802.3, Clause 65 or
                Clause 76.
                This object is applicable for an OLT and an ONU. At the
                OLT, it has a distinct 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 object of the Interfaces Group MIB
                module."
    ::= { 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
            "A 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.
             The LLID field, as defined in the IEEE Std 802.3, is a 2-byte
             register (15-bit field and a broadcast bit) limiting the
             number of virtual links to 32768. 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."
    ::= { 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.

             A row in the table is denoted by the ifIndex of the link

             and it is created when the ifIndex is created.

             The rows in the table for an ONU interface are created

             at system initialization.

             The row in the table corresponding to the OLT ifIndex

             and the row corresponding to the broadcast virtual link

             are created at system initialization.

             A row in the table corresponding to the ifIndex of a

             virtual links 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 a 100 Mb/s operation, it is a count of the number of
             times an invalid code-group is received, other than the
             /H/ code-group. For a 1000 Mb/s 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 the IEEE Std 802.3 Clause 24 100 Mb/s PCS layer,
             and /V/ denotes a special 8b10b codeword of the IEEE Std 802.3
             Clause 36 1000 Mb/s PCS layer.
             This object is applicable for an OLT and an ONU. At the
             OLT, it has a distinct 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 object of the Interfaces Group MIB
             module."

    REFERENCE   "IEEE Std 802.3, 30.5.1.1.14"

    ::= { dot3EponFecEntry 1}


dot3EponFecAbility OBJECT-TYPE

    SYNTAX  INTEGER {

            unknown(1),

            supported(2),

            unsupported(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 IEEE Std 802.3, 65.2.
             unknown(1) value is assigned in the initialization, for non
             FEC support state or type not yet known. unsupported(3)
             value is assigned when the sublayer is not supported.
             supported(2) value is assigned when the sublayer is
             supported.
             This object is applicable for an OLT, with the same
             value for all virtual interfaces, and for an ONU.
             The FEC counters will have a zero value when the
             interface is not supporting FEC.
             The counters:
              dot3EponFecPCSCodingViolation - not affected by FEC
              ability.
              dot3EponFecCorrectedBlocks    - has a zero value when
               dot3EponFecAbility is unknown(1) and unsupported(3).
              dot3EponFecUncorrectableBlocks  - has a zero value when
               dot3EponFecAbility is unknown(1) and unsupported(3).
              dot3EponFecBufferHeadCodingViolation - has a zero value
               when dot3EponFecAbility is unknown(1) and
               unsupported(3)."
    REFERENCE   "IEEE Std 802.3, 30.5.1.1.15"
    ::= { dot3EponFecEntry 2}


dot3EponFecMode OBJECT-TYPE
    SYNTAX  INTEGER {
```

```
            unknown(1),
            disabled(2),
            enabled(3)
        }
        MAX-ACCESS  read-write
        STATUS  current
        DESCRIPTION
            "An object that defines the mode of operation of the
             optional FEC sublayer of the 1000BASE-PX PHY, specified
             in IEEE Std 802.3, 65.2, and reflects its state.
             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 the 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.
             The write operation is not restricted in this document
             and can be done at any time. Changing dot3EponFecMode
             state can lead to disabling the Forward Error Correction
             on the respective interface, which can lead to a
             degradation of the optical link, and therefore may lead
             to an interruption of service for the users connected to
             the respective EPON interface.
             This object is applicable for an OLT and an ONU. At the
             OLT, it has a distinct value for each virtual interface.
             The counting of
             the FEC counters will stop when the FEC of the interface
```

```
                is disabled.

                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 dot3EponFecMode object."

    REFERENCE   "IEEE Std 802.3, 30.5.1.1.16"

    DEFVAL { unknown }

    ::= { dot3EponFecEntry 3}


dot3EponFecCorrectedBlocks OBJECT-TYPE

    SYNTAX  Counter64

    MAX-ACCESS  read-only

    STATUS  current

    DESCRIPTION

            "For 1000BASE-PX, 10/25/40/50/100/200/400GBASE-R, 10GBASE-PR

             or 10/1GBASE-PRX 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 distinct 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 object of the Interfaces Group MIB
                module."
    REFERENCE   "IEEE Std 802.3, 30.5.1.1.17"
    ::= { dot3EponFecEntry 4}


dot3EponFecUncorrectableBlocks OBJECT-TYPE
    SYNTAX  Counter64
    MAX-ACCESS  read-only
    STATUS  current
    DESCRIPTION
            "For 1000BASE-PX, 10/25/40/50/100/200/400GBASE-R, 10GBASE-PR
             or 10/1GBASE-PRX 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 distinct 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 object of the Interfaces Group MIB
             module."
    REFERENCE   "IEEE Std 802.3, 30.5.1.1.18"
    ::= { dot3EponFecEntry 5}


dot3EponFecBufferHeadCodingViolation OBJECT-TYPE
    SYNTAX  Counter64
```

```
    UNITS      "octets"

    MAX-ACCESS  read-only

    STATUS  current

    DESCRIPTION

            "For a 1000 Mb/s 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 Mb/s mode and it is

             zero otherwise.

             This object is applicable for an OLT and an ONU. At the

             OLT, it has a distinct 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 object of the Interfaces Group MIB

             module."

    ::= { 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 IEEE Std 802.3, Clause 30, attributes.
                Each object has a row for every virtual link denoted by
                the corresponding ifIndex.
                The LLID field, as defined in the IEEE Std 802.3, is a 2-byte
                register (15-bit field and a broadcast bit) limiting the
                number of virtual links to 32768. 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."
    ::= { 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.
             A row in the table is denoted by the ifIndex of the link
             and it is created when the ifIndex is created.
             The rows in the table for an ONU interface are created
             at system initialization.
             The row in the table corresponding to the OLT ifIndex
             and the row corresponding to the broadcast virtual link
             are created at system initialization.
             A row in the table corresponding to the ifIndex of a
             virtual links 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.

                The write operation is not restricted in this document
                and can be done at any time. Changing
                dot3ExtPkgObjectReset state can lead to a reset of the
                respective interface, leading to an interruption of
                service for the users connected to the respective EPON
                interface.
                This object is applicable for an OLT and an ONU. At the
                OLT, it has a distinct value for each virtual interface.
                A reset for a specific virtual interface resets only
                this virtual interface and not the physical interface.
                Thus, a virtual link that is malfunctioning 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 of
                the Interfaces Group MIB module."
    DEFVAL { running }
    ::= { 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.
                The write operation is not restricted in this document
                and can be done at any time. Changing
                dot3ExtPkgObjectPowerDown state can lead to a power down
                of the respective interface, leading to an interruption
                of service of the users connected to the respective EPON
                interface.
                This object is applicable for an OLT and an ONU. At the
                OLT, it has a distinct value for each virtual interface.
                A power down/up of a specific 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
                interface 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 that indicates the number of
```

```
                registered LLIDs. The initialization value is 0.
                This object is applicable for an OLT with the same
                value for all virtual interfaces and for an ONU.
                The LLID field, as defined in the IEEE Std 802.3, is a 2-byte
                register (15-bit field and a broadcast bit) limiting the
                number of virtual links to 32768. 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. 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
           "An object defining the FEC mode of operation of the
            interface, and indicating its state. The modes defined in
            this object are extensions to the FEC modes defined in
            the dot3EponFecMode object.
            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 distinct value for each virtual interface.
The FEC counters are referring to the receive path. The
FEC counters will stop when the FEC receive mode of the
interface is disabled, as defined by fecRxEnabled(3)
and fecTxRxEnabled(4) values.
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.
The write operation is not restricted in this document
and can be done at any time. Changing
dot3ExtPkgObjectFecEnabled state can lead to disabling
```

```
            the Forward Error Correction on the respective interface,
            which can lead to a degradation of the optical link, and
            therefore may lead to an interruption of service for the
            users connected to the respective EPON interface."
    DEFVAL { noFecEnabled }
    ::= { 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 IEEE Std 802.3, Clause 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 distinct 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 configuring the registration state of an

        interface, and indicating its registration state.

         Write operation changes the registration state to its new

         value.

         Read operation returns the value of the state.

         The registration state is reflected in this object and in

         the dot3MpcpRegistrationState object.

         none(1) indicates an unknown state,

         register(2) indicates a registered LLID,

         deregister(3) indicates a deregistered LLID,

         reregister(4) indicates an LLID that is reregistering.

         The following list describes the operation of the

         interface, as specified in the IEEE Std 802.3, when a write

         operation is setting a value.

          none(1) - not doing any action.

          register(2) - registering an LLID that has been requested

          for registration (The LLID is in registering mode.

            dot3MpcpRegistrationState - registering(2) ).

            deregister(3) - deregisters an LLID that is registered

              (dot3MpcpRegistrationState - registered(3) ).

            reregister(4) - reregister an LLID that is registered

              (dot3MpcpRegistrationState - registered(3) ).

            The behavior of an ONU and OLT interfaces, at each one

            of the detailed operation at each state, is described in

            the registration state machine of figure 64-22,

            IEEE Std 802.3.

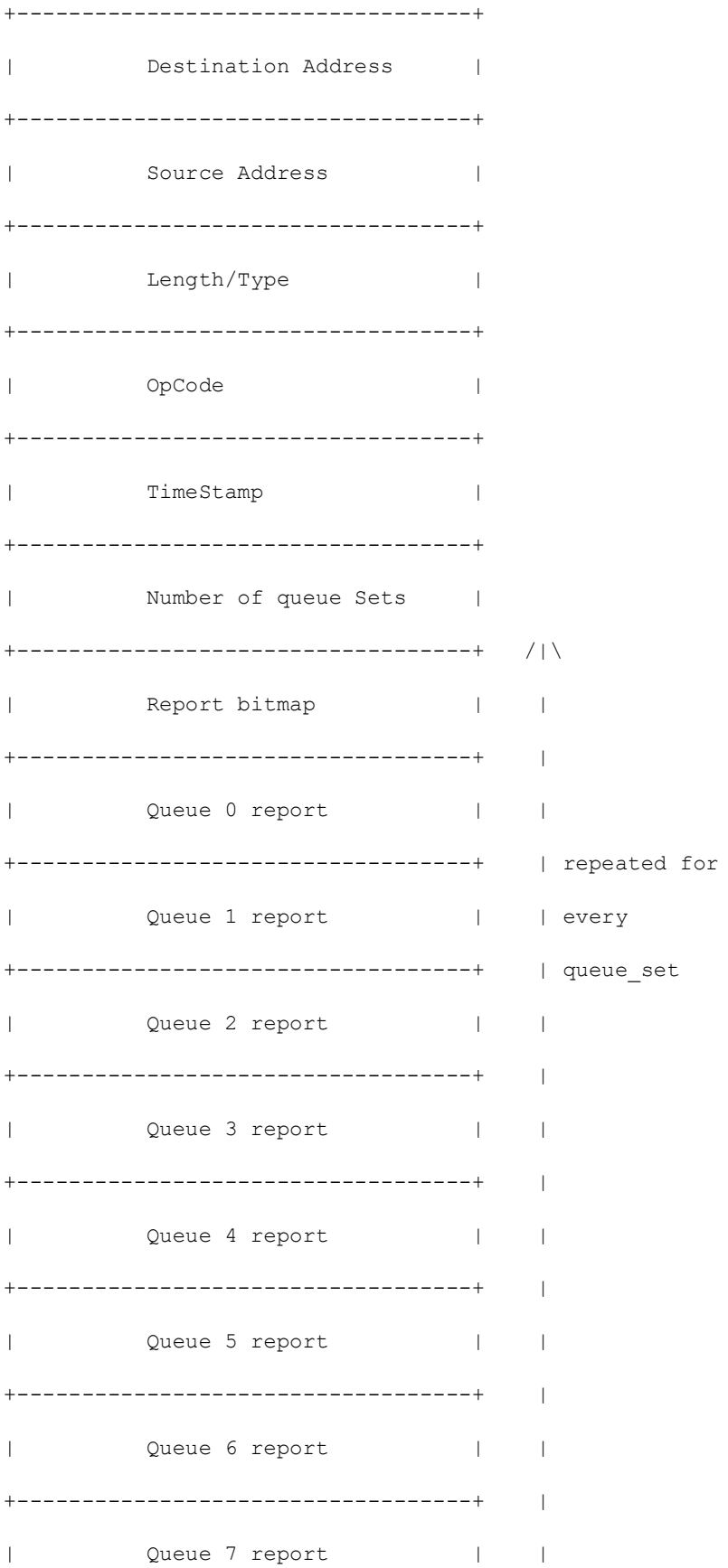
           This object is applicable for an OLT and an ONU. At the

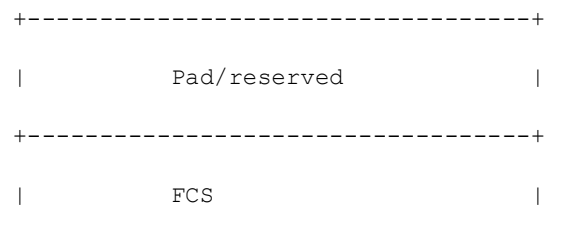
           OLT, it has a distinct value for each virtual interface.

           The write operation is not restricted in this document
```

```
                and can be done at any time. Changing
                dot3ExtPkgObjectRegisterAction state can lead to a change
                in the registration state of the respective interface
                leading to a deregistration and an interruption of
                service of the users connected to the respective EPON
                interface."
        DEFVAL { none }
        ::= { 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 IEEE Std 802.3 MPCP defines a report message
                 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 control the reporting and to gather some statistics
                 of their operation. This table is not duplicating
                 existing management objects of bridging queues,
                 specified in IEEE Std 802.1D, since the existence of a
                 dedicated transmit queuing mechanism is implied in the
                 IEEE Std 802.3, and the ONU may be a device that is not a
                 bridge with embedded bridging queues.
                 The format of the REPORT message, as specified
                 in IEEE Std 802.3, is presented below:
```


Destination Address
Source Address
Length/Type
OpCode
TimeStamp
Number of queue Sets
Report bitmap
Queue 0 report
Queue 1 report
Queue 2 report
Queue 3 report
Queue 4 report
Queue 5 report
Queue 6 report
Queue 7 report
repeated for
every
queue_set



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 up to 8 queues in a REPORT message, the actual number is flexible. The Queue table has a variable size that 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 that are gathered in an extended package as an addition to the objects that are based on the IEEE Std 802.3 attributes.

Each object has a row for every virtual link and for every queue in the report.

The LLID field, as defined in the IEEE Std 802.3, is a 2-byte register (15-bit field and a broadcast bit) limiting the number of virtual links to 32768. 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.
                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 ifIndex of the
             link is created. A set of rows per queue are added for
             each ifIndex, denoted by the dot3QueueIndex.
             A set of rows per queue in the table, for an ONU
             interface, are created at the system initialization.
             A set of rows per queue in the table, corresponding to
             the OLT ifIndex and a set of rows per queue
             corresponding to the broadcast virtual link, are
             created at the system initialization.
             A set of rows per queue in the table, corresponding to
             the ifIndex of a virtual link, are created when the
             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 that are

             reported in the MPCP REPORT message as defined in

             IEEE Std 802.3, Clause 64 or Clause 77.

             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 IEEE Std 802.3,
```

```
                Clause 64 or Clause 77.

                Each queue_set reporting will provide information on the
                queue occupancy of frames below the matching Threshold.
                Read operation reflects the number of thresholds.
                Write operation sets the number of thresholds for each
                queue.
                The write operation is not restricted in this document
                and can be done at any time. Value cannot exceed the
                maximal value defined by the
                dot3ExtPkgObjectReportMaximumNumThreshold object.
                Changing dot3ExtPkgObjectReportNumThreshold can lead to
                a change in the reporting of the ONU interface and
                therefore to a change in the bandwidth allocation of the
                respective interface. This change may lead a degradation
                or an interruption of service of the users connected to
                the respective EPON interface.
                This object is applicable for an OLT and an ONU. At the
                OLT, it has a distinct value for each virtual interface
                and for each queue. At the ONU, it has a distinct 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
```

```
                IEEE Std 802.3, Clause 64 or Clause 77. 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 distinct value for each virtual interface
                and for each queue. At the ONU, it has a distinct 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 IEEE Std 802.3, Clause 64 or Clause 77.
             This object is applicable for an OLT and an ONU. At the
             OLT, it has a distinct value for each virtual interface
             and for each queue. At the ONU, it has a distinct 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 object of the Interfaces Group MIB
                module."
    ::= { 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 input to the corresponding 'Queue'.
             The 'Queue' marking matches the REPORT MPCP message
             Queue field as defined in IEEE Std 802.3, Clause 64 or Clause 77.
             This object is applicable for an OLT and an ONU. At the
             OLT, it has a distinct value for each virtual interface
             and for each queue. At the ONU, it has a distinct 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 object of the Interfaces Group MIB
             module."
    ::= { 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 IEEE Std 802.3, Clause 64 or Clause 77.
                This object is applicable for an OLT and an ONU. At the
                OLT, it has a distinct value for each virtual interface
                and for each queue. At the ONU, it has a distinct 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 object of the Interfaces Group MIB
                module."
    ::= { dot3ExtPkgQueueEntry 6}

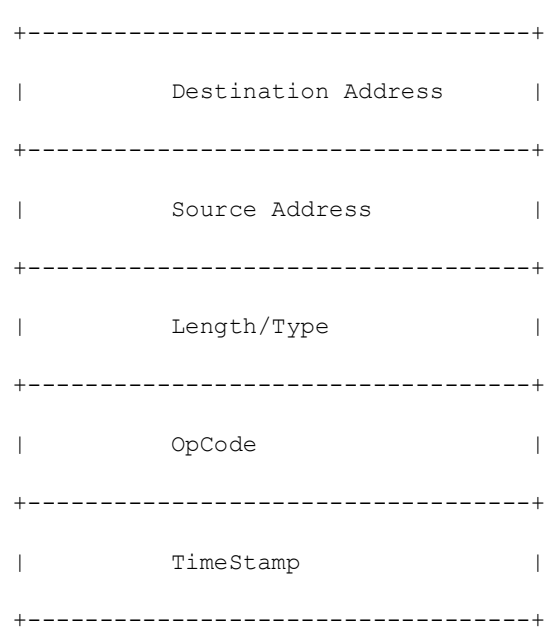

dot3ExtPkgQueueSetsTable OBJECT-TYPE
    SYNTAX  SEQUENCE OF Dot3ExtPkgQueueSetsEntry
    MAX-ACCESS  not-accessible
    STATUS  current
    DESCRIPTION
            "A table of Extended package objects used for the
             management of the queue_sets. Entries are control and
             status indication objects of an EPON interface, which
             are gathered in an extended package as an addition to
```

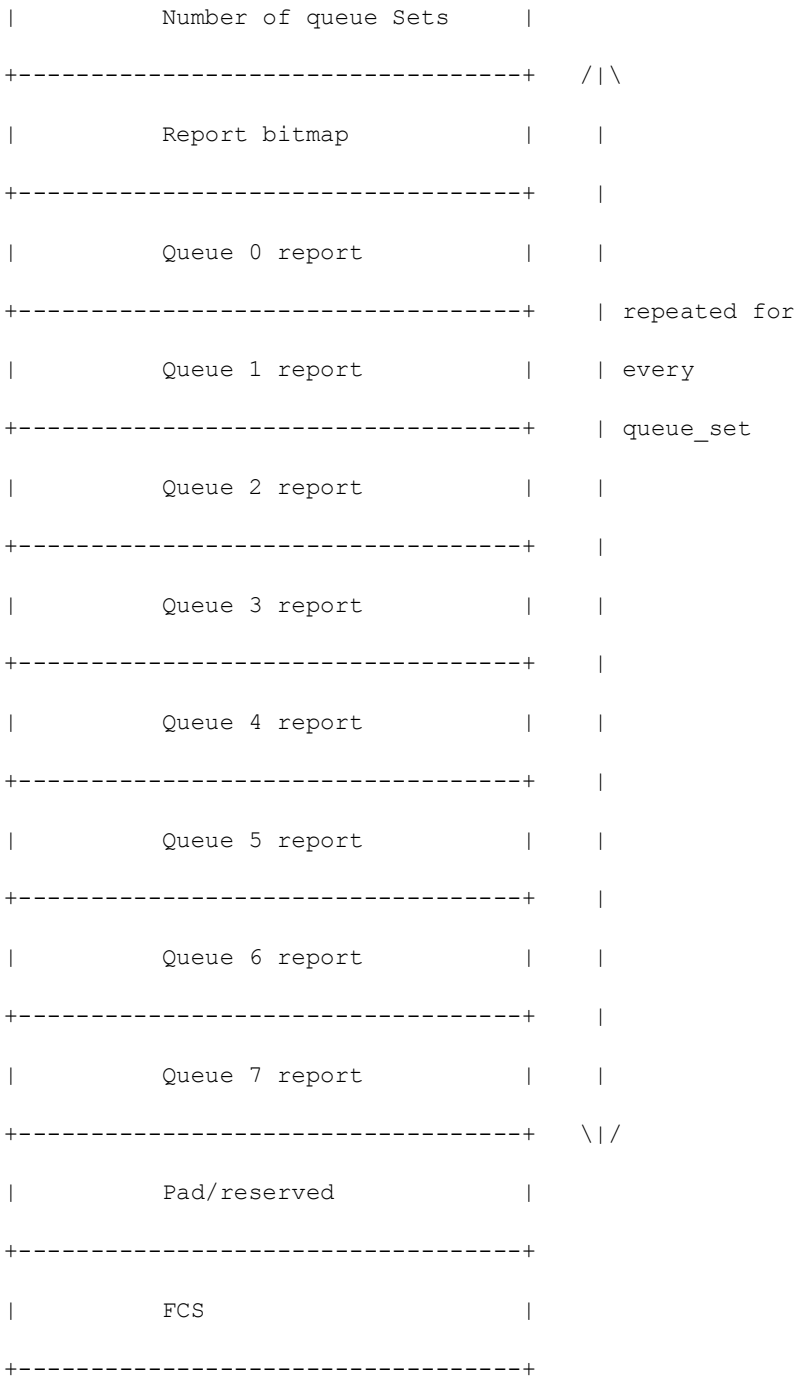
the objects based on the IEEE Std 802.3 attributes. The objects in this table are specific for the queue_sets, which are reported in the MPCP REPORT message as defined in IEEE Std 802.3, Clause 64 or Clause 77.

The IEEE Std 802.3 MPCP defines a report message 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_sets is added here mainly to control the reporting and to gather some statistics of their operation. This table is not duplicating existing management objects of bridging queues, specified in IEEE Std 802.1Q, since the existence of a dedicated transmit queuing mechanism is implied in the IEEE Std 802.3, and the ONU may be a device that is not a bridge with embedded bridging queues.

The format of the REPORT message, as specified in IEEE Std 802.3, is presented below:





As can be seen from the message format, the ONU interface 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 a value of up to 8.
It means that an ONU can hold a variable number of
sets between 0 and 7.
The dot3ExtPkgQueueSetsTable table has a variable
queue_set size that 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 that 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 that 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.
The LLID field, as defined in the IEEE Std 802.3, is a 2-byte
register (15-bit field and a broadcast bit) limiting the
number of virtual links to 32768. 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.
                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 ifIndex of the
                link is created. A set of rows per queue and per
                queue_set are added for each ifIndex, denoted by
                dot3QueueSetIndex and dot3QueueSetQueueIndex.
                A set of rows per queue and per queue_set in the table,
                for an ONU interface are created at system
                initialization.
                A set of rows per queue and per queue_Set in the table,
                corresponding to the OLT ifIndex and a set of rows per
                queue and per queue_set, corresponding to the broadcast
                virtual link, are created at system initialization.
```

```
                A set of rows per queue and per queue_set in the table,
                corresponding to the ifIndex of a virtual link are
                created when the 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 IEEE Std 802.3,
             Clause 64 or Clause 77.
             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 IEEE Std 802.3,
             Clause 64 or Clause 77.
             The number of queues_sets is between 0 and 7, and
             limited by dot3ExtPkgObjectReportMaximumNumThreshold."
    ::= { dot3ExtPkgQueueSetsEntry 2 }

    dot3ExtPkgObjectReportThreshold OBJECT-TYPE
    SYNTAX  Unsigned32
    UNITS       "TQ (16 ns)"
    MAX-ACCESS  read-write
    STATUS  current
    DESCRIPTION
            "An object that defines the value of a threshold report
             for each queue_set in the REPORT message as defined in
             IEEE Std 802.3, Clause 64 or Clause 77. 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 16 ns or 2 octets increments.
             Read operation provides the threshold value. Write
```

```
                operation sets the value of the threshold.
                The write operation is not restricted in this document
                and can be done at any time. Changing
                dot3ExtPkgObjectReportThreshold can lead to a change in
                the reporting of the ONU interface and therefore to a
                change in the bandwidth allocation of the respective
                interface. This change may lead a degradation or an
                interruption of service for the users connected to the
                respective EPON interface.
                This object is applicable for an OLT and an ONU. At the
                OLT, it has a distinct value for each virtual interface,
                for each queue and for each queue_set. At the ONU, it has
                a distinct 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.
                 The LLID field, as defined in the IEEE Std 802.3, is a 2-byte
                 register (15-bit field and a broadcast bit) limiting the
                 number of virtual links to 32768. 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.
                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, ONUs 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.
                A row in the table is denoted by the ifIndex of the link
                and it is created when the ifIndex is created.
                The rows in the table for an ONU interface are created
                at system initialization.
                The row in the table corresponding to the OLT ifIndex
                and the row corresponding to the broadcast virtual link
                are created at system initialization.
                A row in the table corresponding to the ifIndex of a
```

```
                virtual links 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

       "This object is a reliability indication.
```

```
        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 distinct 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 distinct 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 distinct 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 distinct 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.
       The write operation is not restricted in this document
       and can be done at any time. Changing
       dot3ExtPkgOptIfLowerInputPowerThreshold can lead to a Threshold
       Crossing Alert (TCA) being sent for the respective interface.
       This alert may be leading to an interruption of service for the
       users connected to the respective EPON interface, depending on
       the system action on such an alert.
       This object is applicable for an OLT and an ONU. At the
       OLT, it has a distinct 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.
     The write operation is not restricted in this document
     and can be done at any time. Changing
     dot3ExtPkgOptIfUpperInputPowerThreshold can lead to a Threshold
     Crossing Alert (TCA) being sent for the respective interface.
     This alert may be leading to an interruption of service for the
     users connected to the respective EPON interface, depending on
     the system action on such an alert.
     This object is applicable for an OLT and an ONU. At the
     OLT, it has a distinct 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 distinct 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 distinct 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 distinct 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.

       The write operation is not restricted in this document

       and can be done at any time. Changing

       dot3ExtPkgOptIfLowerOutputPowerThreshold can lead to a Threshold

       Crossing Alert (TCA) being sent for the respective interface.

       This alert may be leading to an interruption of service for the

       users connected to the respective EPON interface, depending on

       the system action on such an alert.

       This object is applicable for an OLT and an ONU. At the

       OLT, it has a distinct 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.
        The write operation is not restricted in this document
        and can be done at any time. Changing
        dot3ExtPkgOptIfUpperOutputPowerThreshold can lead to a Threshold
        Crossing Alert (TCA) being sent for the respective interface.
        This alert may be leading to an interruption of service of the
        users connected to the respective EPON interface, depending on
        the system action on such an alert.
        This object is applicable for an OLT and an ONU. At the
        OLT, it has a distinct 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 distinct 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 distinct 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.
                 The write operation is not restricted in this document
                 and can be done at any time. Changing
                 dot3ExtPkgOptIfTransmitEnable state can lead to a halt
```

```
                in the optical transmission of the respective interface
                leading to an interruption of service of the users
                connected to the respective EPON interface.
                The object is relevant when the admin state of the
                interface is active as set by the dot3MpcpAdminState.
                This object is applicable for an OLT and an ONU. At the
                OLT it, has a distinct value for each virtual interface."
        DEFVAL { false }
        ::= { dot3ExtPkgOptIfEntry 14 }


        --
        -- The MulticastIDs Table
        --
dot3RecognizedMulticastIDsTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF Dot3RecognizedMulticastIDsEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
            "A table of MulticastIDs to be recognized by this device."
    REFERENCE   "IEEE Std 802.3, 30.3.5.1.25"
    ::= { dot3EponObjects 5 }


dot3RecognizedMulticastIDsEntry OBJECT-TYPE
    SYNTAX     Dot3RecognizedMulticastIDsEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
            "An entry in the table of MulticastIDs to be recognized by this
             device."
    INDEX     { ifIndex, dot3RecognizedMulticastIDIndex }
```

```
    ::= { dot3RecognizedMulticastIDsTable 1 }


Dot3RecognizedMulticastIDsEntry ::=

    SEQUENCE {

            dot3RecognizedMulticastIDIndex    Unsigned32,

            dot3RecognizedMulticastID         Unsigned32

             }


dot3RecognizedMulticastIDIndex OBJECT-TYPE

    SYNTAX     Unsigned32 (0..127)

    MAX-ACCESS not-accessible

    STATUS     current

    DESCRIPTION

            "An index into the table of MulticastIDs to be recognized by this

             device."

    ::= { dot3RecognizedMulticastIDsEntry 1 }


dot3RecognizedMulticastID OBJECT-TYPE

    SYNTAX     Unsigned32

    MAX-ACCESS read-write

    STATUS     current

    DESCRIPTION

            "An unsigned32 representing a single MulticastID to be recognized

             by this device."

    REFERENCE   "IEEE Std 802.3, 30.3.5.1.25"

    ::= { dot3RecognizedMulticastIDsEntry 2 }


  -- 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.

                Objects are per LLID."

        ::= { dot3EponGroups 9 }


    dot3EponGroupMulticastIDs OBJECT-GROUP

         OBJECTS {

          dot3RecognizedMulticastID

          }

         STATUS  current

         DESCRIPTION

               "One of a set of MulticastIDs recognized by an EPON interface."

        ::= { dot3EponGroups 10 }


    -- Compliance statements


       dot3EponCompliances

           OBJECT IDENTIFIER ::= { dot3EponConformance 2 }


    dot3MPCPCompliance MODULE-COMPLIANCE

        STATUS      current

        DESCRIPTION "The compliance statement for MultiPoint

                     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 FEC supporting
                     interfaces for 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}


    dot3EponMulticastIDsCompliance MODULE-COMPLIANCE

        STATUS      current

        DESCRIPTION "The compliance statement for EPON Interfaces that
                     support MulticastIDs."

        MODULE  -- this module

        MANDATORY-GROUPS { dot3EponGroupMulticastIDs }


        ::= { dot3EponCompliances 5 }


    END
```