# Data-Over-Cable Service Interface Specifications

## eDOCSIS™ Specification

## SP-eDOCSIS-I01-030312

**ISSUED SPECIFICATION**

# Document Status Sheet

| | | | | |
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### Key to Document Status Codes

**Work in Progress** An incomplete document, designed to guide discussion and generate feedback, that may include several alternative requirements for consideration.

**Draft** A document in specification format considered largely complete, but lacking review by cable industry and vendors. Drafts are susceptible to substantial change during the review process.

**Issued** A stable document, which has undergone rigorous member and vendor review and is suitable for product design and development, cross-vendor interoperability, and for certification testing.

**Closed** A static document, reviewed, tested, validated, and closed to further engineering change requests to the specification through CableLabs.

### Trademarks

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# 1 Introduction



Existing DOCSIS™ specifications have been created primarily for stand-alone cable modems that provide high-speed broadband services using the hybrid-fiber-coaxial cable infrastructure.

The emergence of a class of devices that provide enhanced DOCSIS enabled services such as packet telephony, home networking and video has necessitated the creation of this eDOCSIS specification to define additional requirements such as interfaces, management and provisioning models.

Furthermore, this specification will enable interoperability and uniform processing of information with devices that contain, as separate functional entities, a DOCSIS compliant embedded Cable Modem (eCM) and any other embedded Service/Application Functional Entities (eSAFEs).

All references to eCM within this document mean an eDOCSIS compliant eCM. This specification assumes any device containing an eCM to be an eDOCSIS Device. In particular, this specification describes the expected behavior of the eCM as being distinct from the other eSAFEs in the device.

## 1.1 Scope

This specification contains the requirements for eCM in an eDOCSIS Device. In case any requirement in this document conflicts with a requirement in the DOCSIS Base Specifications, see Section 1.4, the requirement in this document takes precedence for any eDOCSIS Device.

## 1.2 Goals

The goals for this specification are:

- To preserve functional separation of the DOCSIS cable modem entity from other eSAFEs within the eDOCSIS Device, so that existing DOCSIS cable plant integrity, cable modem configuration, management and provisioning security are not compromised.
- To isolate DOCSIS cable modem functionality so that specification compliance can be tested for the eCM component independent of eSAFEs.
- To enable the service provider to enable or disable forwarding traffic between each eSAFE and the eCM within the eDOCSIS Device.
- To maximize compatibility with existing back-office management/provisioning infrastructure so that new services enabled by eDOCSIS devices can be deployed rapidly.
- To architect eDOCSIS devices in such a way as to scale to new services and applications, and to take advantage of technology innovations to achieve low cost and high functionalities.

## 1.3 Assumptions

The eDOCSIS architecture assumes the following:

- All messages coming from the DOCSIS data network (labeled RF in the diagrams) destined for eSAFEs will be processed through the eCM first.
- The eCM will be the only interface to the DOCSIS data network.
- The eCM is a DOCSIS compliant cable modem.

## 1.4 DOCSIS Base Specifications

There are currently three versions of what are in this document referred to as the DOCSIS Base Specifications. These three versions are commonly referred to as DOCSIS 1.0, DOCSIS 1.1, and DOCSIS 2.0. A list of the document categories in the Data-Over-Cable Service Interface Specifications family is provided below. For updates, please refer to http://www.cablemodem.com/.

| Designation | | | Title |
|---|---|---|---|
| **DOCSIS 1.0** | **DOCSIS 1.1** | **DOCSIS 2.0** | |
| SP-RFI | SP-RFIv1.1 | SP-RFIv2.0 | Radio Frequency Interface Specification |
| SP-OSSI | SP-OSSIv1.1 | SP-OSSIv2.0 | Operations Support System Interface Specification |
| SP-BPI | SP-BPI+ | | Baseline Privacy Interface Specification |
| SP-CMCI | | | Cable Modem to Customer Premises Equipment Interface Specification |
| SP-CMTS-NSI | | | Cable Modem Termination System Network Side Interface Specification |

## 1.5 Requirements

Throughout this document, the words that are used to define the significance of particular requirements are capitalized. These words are:

| | |
|---|---|
| MUST | This word or the adjective “REQUIRED” means that the item is an absolute requirement of this specification. |
| MUST NOT | This phrase means that the item is an absolute prohibition of this specification. |
| SHOULD | This word or the adjective “RECOMMENDED” means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course. |
| SHOULD NOT | This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label. |
| MAY | This word or the adjective “OPTIONAL” means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item. |

# 2 References

## 2.1 References (normative)

**[DOCSIS0-CMCI]** "Cable Modem to Customer Premise Equipment Interface Specification SP-CMCI-I07-020301", www.cablemodem.com

**[DOCSIS0-RFI]** "SCTE 22-1 2002: DOCSIS 1.0 Radio Frequency Interface", www.scte.org

**[DOCSIS1-RFI]** "Radio Frequency Interface Specification SP-RFIv1.1-I09-020830", www.cablemodem.com

**[DOCSIS2-RFI]** "Radio Frequency Interface Specification SP-RFIv2.0-I03-021218", www.cablemodem.com

**[DOCSIS0-OSSI]** "SCTE 22-3 2002: DOCSIS 1.0 Operations Support System Interface", www.scte.org

**[DOCSIS1-OSSI]** "Operations Support System Interface Specification SP-OSSIv1.1-I06-020830", www.cablemodem.com

**[DOCSIS2-OSSI]** "Operations Support System Interface Specification SP-OSSIV2.0-I03-021218", www.cablemodem.com

**[RFC 1493]** IETF RFC 1493, Definitions of Managed Objects for Bridges, E. Decker, P. Langille, A. Rijsinghani & K. McCloghrie, July 1993

**[RFC 2011]** IETF RFC 2011, SNMPv2 Management Information Base for the Internet Protocol using SMIv2, K. McCloghrie, November 1996

**[RFC 2863]** IETF RFC 2863, The Interfaces Group MIB, K. McCloghrie, F. Kastenholz, June 2000

## 2.2 References (informative)

**[CH10]** "CableHome 1.0 Specification SP-CH1.0-I03-030124", CableLabs, January 2003", www.cablelabs.com/projects/cablehome

**[PC10-MTA]** "PacketCable MTA Device Provisioning Specification PKTC-SP-PROV-I05-021127", CableLabs, November 27, 2002, www.packetcable.com

**[PC10-MIB]** "PacketCable MIBs Framework Specification PKTC-SP-MIBS-I05-021127", CableLabs, November 27, 2002, www.packetcable.com

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# 3 Glossary

**CMCI** Cable Modem (CM) to Customer Premise Equipment (CPE) Interface as defined in [DOCSIS0-CMCI]

**eCM** An eCM with an exposed CPE interface is functionally equivalent to a stand-alone cable modem (CM) based on DOCSIS specifications. A logical CPE interface or logical CMCI is defined for the communication between the eCM and each eSAFE.

**eDOCSIS** eDOCSIS is the embedded DOCSIS specification that defines the interface between the eCM and an eSAFE.

**eDOCSIS Device** An eDOCSIS Device is one that includes an eCM entity and one or more additional eSAFEs; an eDOCSIS Device also supports a single software image using a DOCSIS secured software download mechanism.

**eMTA** Embedded Multimedia Terminal Adaptor. An embedded version of an MTA.

**E-MTA** Embedded MTA device. An eDOCSIS device that contains both an eMTA and an eCM.

**ePS** Embedded Portal Service Element. A CableHome-compliant eSAFE that provides management and network address translation functions between the DOCSIS network and the home network.

**Logical CPE Interface (Logical CMCI)** A bi-directional, data-only 802.3/Ethernet MAC frame interface between eCM and an eSAFE.

**MTA** Multimedia Terminal Adapter as defined in [PC10-MTA]. Contains the interface to a physical voice device, a network interface, CODECs, and all signaling and encapsulation functions required for VoIP transport, class features signaling and QoS signaling.

**eSAFE (embedded Service/Application Functional Entity)** An embedded version of CableLabs-specified application, such as a PacketCable Multimedia Terminal Adapter (MTA), that provides a service using the DOCSIS IP platform, or a function or set of functions, such as the CableHome Portal Services logical element, that supports the delivery of one or more services over an IP platform.

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# 4 Abbreviations

**CM** Cable Modem

**CMCI** Cable Modem to Customer Premises Equipment Interface

**DOCSIS** Data-Over-Cable Service Interface Specifications

**eCM** Embedded Cable Modem

**eDOCSIS** Embedded DOCSIS

**eMTA** Embedded MTA

**ePS** Embedded Portal Services Element

**eSAFE** Embedded Service/Application Functional Entity

**MTA** Multimedia Terminal Adaper

**PS** Portal Services Element

**SAFE** Service/Application Functional Entity

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# 5 Embedded DOCSIS Cable Modem

## 5.1 Device Interface Reference Model

Referring to Figure 5-1, an eDOCSIS device MUST consist of an embedded DOCSIS cable modem (eCM) and one or more embedded Service/Application Functional Entities (eSAFEs). An eDOCSIS device MAY also have one or more physically exposed interfaces. In addition, only a single secured software image download MUST be used for the entire eDOCSIS device.

eSAFEs include:

- ePS: embedded CableHome Portal Services Logical Element [CH10]
- eMTA: embedded PacketCable Multimedia Terminal Adapter [PC10-MTA, PC10-MIB]

Within a eDOCSIS device, each eSAFE interfaces to the eCM via a point-to-point logical CPE interface. Each logical CPE interface MUST be designated and managed per 5.2.3.1.

Figure 5-2 presents a typical CableHome Home Access eDOCSIS Device reference model.

Figure 5-3 presents a logical view of protocol stacks for an eCM to ePS interface.

Figure 5-4 presents a typical PacketCable E-MTA (with DOCSIS cable modem) eDOCSIS Device reference model.

Figure 5-5 presents a logical view of protocol stacks for an eCM to eMTA interface.

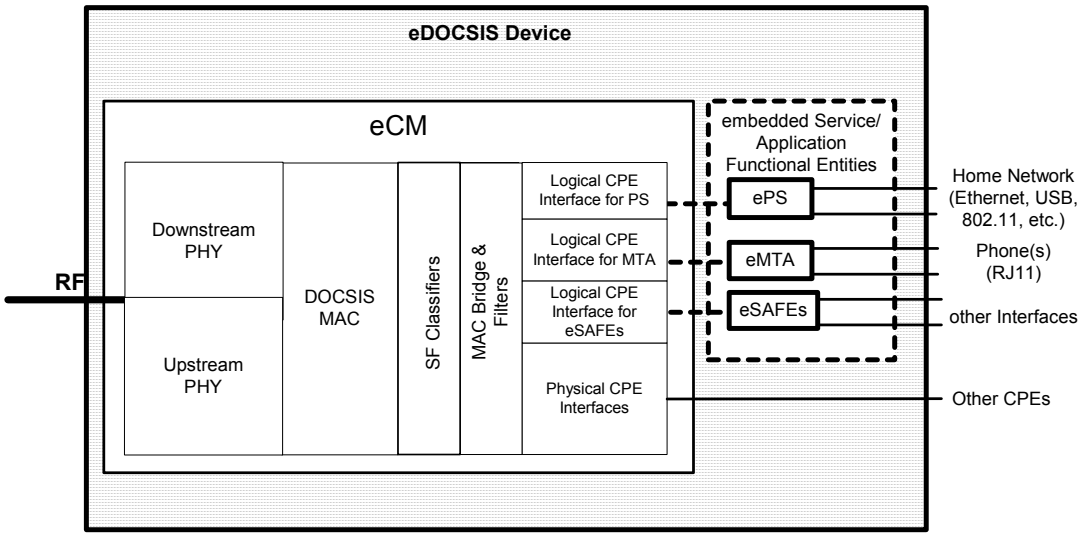


**Figure 5-1 eDOCSIS Reference Model**

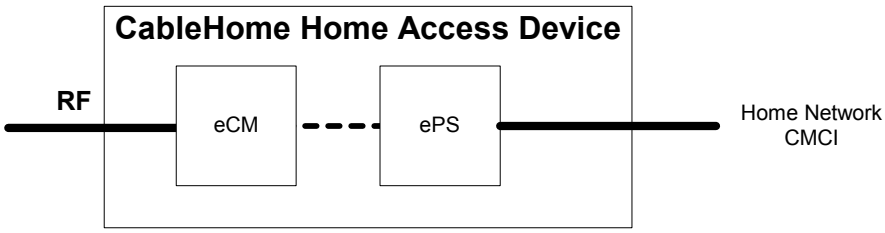


**Figure 5-2 CableHome Home Access eDOCSIS Device Reference Model**

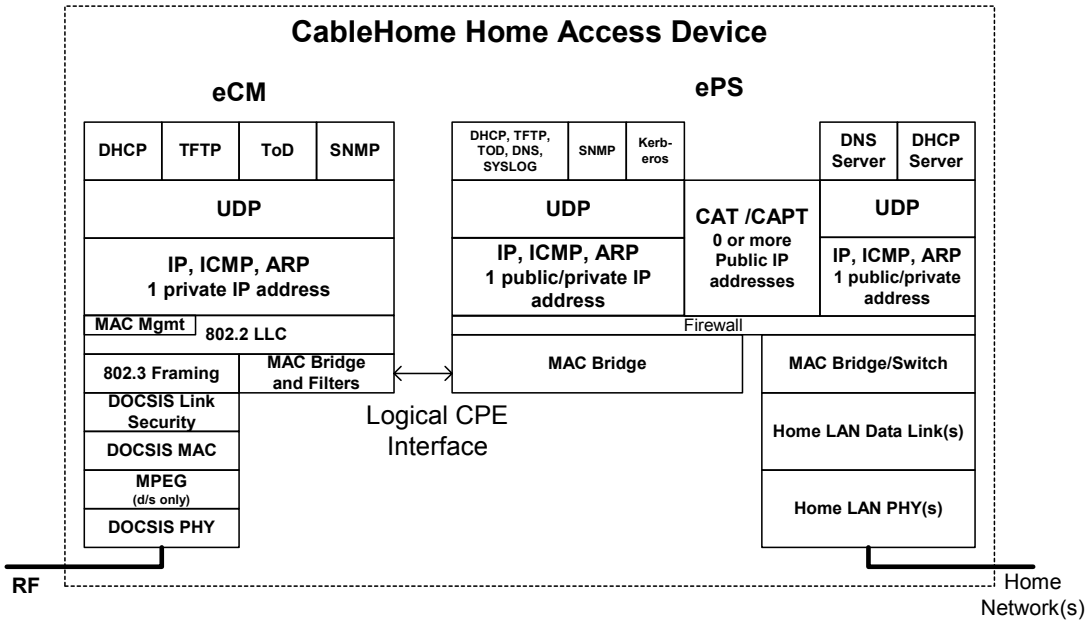


**Figure 5-3 eCM - ePS Protocol Stacks**

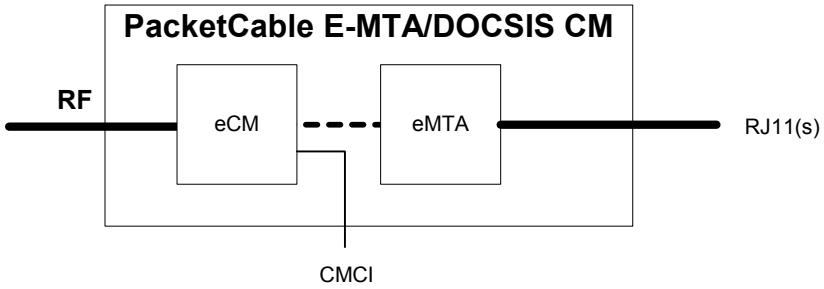


**Figure 5-4 PacketCable E-MTA (with DOCSIS CM) eDOCSIS Reference Model**

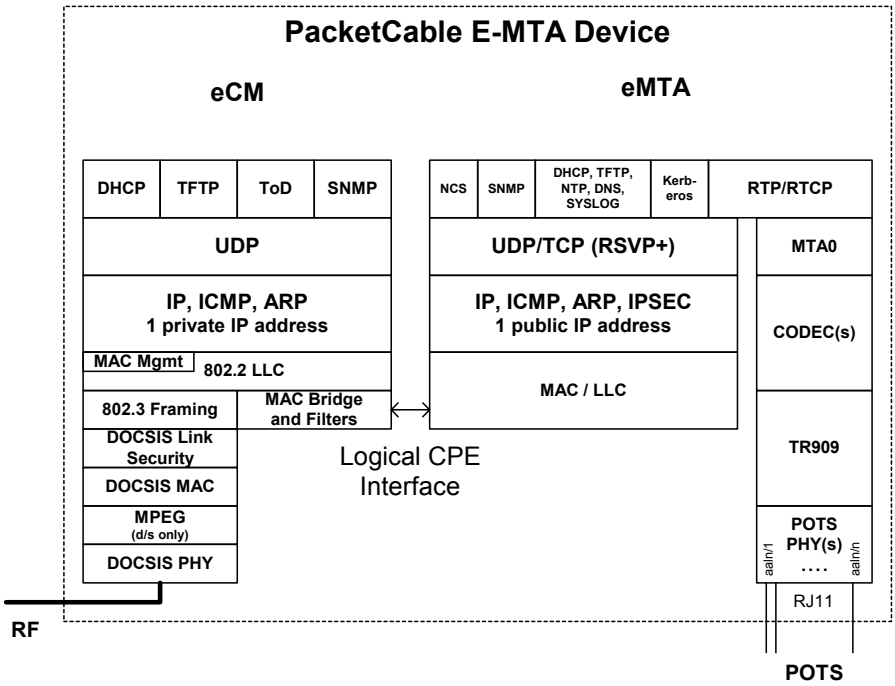


**Figure 5-5 eCM - eMTA Protocol Stacks**

## 5.2 eDOCSIS Requirements

### 5.2.1 General Requirements

The eCM will provide an SNMP agent which is logically separated from any SNMP agent provided by an eSAFE.

Except for MIB objects that are explicitly allowed to be shared, the DOCSIS-specified MIBs MUST only be accessible through the Management IP address of the eCM. The eSAFE-specified MIBs MUST NOT be accessible through the Management IP address of the eCM.

The MIB objects that MAY be shared are:

- the snmpGroup, systemGroup, udpGroup, icmpGroup and ipGroup (with the exception of ipNetToMediaTable and ipAddrTable within the ipGroup which MUST NOT be shared).
- the mibs rooted under snmpV2 (1.3.6.1.6).

The eCM MUST act as an entity distinct from, and MUST have logical CPE interfaces to, the eSAFEs.

An eCM, when connected to at least one physically exposed CPE interface, MUST meet the requirements of an equivalent standalone cable modem as specified in the applicable DOCSIS Base Specifications (i.e. DOCSIS 1.0, DOCSIS 1.1 and DOCSIS 2.0.)

### 5.2.2 Interface Requirements

The bridging function between RF port and the CPE interfaces (logical or physical) MUST be equivalent to that of a multi-port learning bridge. Each CPE interface MUST comply with the CM Forwarding Rules defined in [DOCSISx-RFI][1]. In particular:

- MAC addresses seen on the interface are learned or provisioned as defined in [DOCSISx-RFI] specification, and are counted toward the total allowed by the Maximum Number of CPEs configuration setting.
- Packet forwarding and filtering rules defined in [DOCSISx-RFI] specification apply to both logical and physical CPE interfaces as defined in this specification and in [DOCSISx-OSSI][2].
- Data forwarding through the interface will obey the Network Access Control Object as defined in [DOCSISx-RFI].

### 5.2.3 Operations Support Requirements

#### 5.2.3.1 ifTable Requirements

The eCM MUST represent the logical interface to each eSAFE with an entry in the ifTable with ifType other(1) as described in [DOCSISx-OSSI] and as detailed below.

If the eCM is embedded into a device which contains an ePS, then:

- The eCM MUST use ifIndex 1 (the Primary CPE interface) to represent the logical interface between the eCM and the ePS.
- The eCM MUST NOT report in the ifTable the physically exposed interfaces associated with the ePS, and MUST NOT report the MIB Module extensions associated with those interfaces (e.g. EtherLike-MIB and USB-MIB).

If the eCM is embedded into a device which contains an eMTA, then:

- The eCM MUST use ifIndex 16 to represent the logical interface between the eCM and the eMTA.
- The eCM MUST NOT report in the ifTable the MTA endpoints (ifType = 198).

The ifXTable MUST be supported in accordance with [RFC 2863]. The Default value of ifLinkUpDownTrapEnable MUST be enabled(1) for logical interfaces to eSAFEs.

The ifStackTable MUST be supported in accordance with [RFC 2863]. The logical interface to an eSAFE MUST NOT contain any sub-layers.

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1. [DOCSISx-RFI] is a shorthand notation for "[DOCSIS0-RFI], [DOCSIS1-RFI] and [DOCSIS2-RFI]"

2. [DOCSISx-OSSI] is a shorthand notation for "[DOCSIS0-OSSI], [DOCSIS1-OSSI] and [DOCSIS2-OSSI]"

Table 5-1 summarizes the ifIndex assignments in the eCM. Table 5-2 defines the details of the ifTable entries for an ePS or eMTA which MUST be supported.

**Table 5-1 eDOCSIS ifTable Interface Designations**

| Interface | Type |
|---|---|
| 1 | Primary CPE interface<br>(CableHome ePS WAN interface) |
| 2 | CATV-MAC |
| 3 | RF-downstream channel |
| 4 | RF-Upstream channel |
| 5 – 15 | Other CPE Interfaces |
| 16 | Reserved for PacketCable/eMTA |
| 17 – 31 | Reserved for Other eDOCSIS Interfaces |

**Table 5-2 [RFC 2863] ifTable, MIB-Object Details for eDOCSIS Device Interfaces**

| [RFC 2863] MIB-Object details for eCM-eSAFE Interfaces | ePS | eMTA |
|---|---|---|
| ifIndex | 1 | 16 |
| ifDescr: MUST match the text | CableHome Embedded Interface | PacketCable Embedded Interface |
| ifType | other(1) | other(1) |
| ifMtu | 0 | 0 |
| ifSpeed | 0 | 0 |
| ifPhysAddress | empty-string | empty-string |
| ifAdminStatus: Only up/own control are required for this interface. Other values are optional | up(1), down(2) | up(1), down(2) |
| ifOperStatus: Only up/own control are required for this interface. Other values are optional | up(1), down(2) | up(1), down(2) |
| ifLastChange | per [RFC 2863] | per [RFC 2863] |
| ifInOctets | (n) | (n) |
| ifInUCastPkts | (n) | (n) |
| ifInNUCastPkts | Deprecated | Deprecated |
| ifInDiscards | 0 | 0 |
| ifInErrors | 0 | 0 |
| ifUnknownProtos | 0 | 0 |
| ifOutOctets | (n) | (n) |
| ifOutUCastPkts | (n) | (n) |
| ifOutNUCastPkts | Deprecated | Deprecated |
| ifOutDiscards | 0 | 0 |
| ifOUtErrors | 0 | 0 |
| ifOutQlen | Deprecated | Deprecated |
| ifSpecific | Deprecated | Deprecated |

#### 5.2.3.2 ipNetToMediaTable Requirements

Table 5-3 shows the details of the ipNetToMediaTable entries that MUST be supported by an ePS and eMTA.

**Table 5-3 [RFC 2011] ipNetToMedia MIB-Object Details for eDOCSIS Device Interfaces**

| [RFC-2011] MIB-Object details for eCM-eSAFE Interfaces | ePS | eMTA |
|---|---|---|
| ipNetToMediaIfIndex | 1 | 16 |
| ipNetToMediaPhysAddress | WAN-Man MAC Address | MTA MAC Address |
| ipNetToMediaNetAddress | WAN-Man Address, if acquired; otherwise 0.0.0.0 | MTA Address, if acquired; otherwise 0.0.0.0 |
| ipNetToMediaType | static(4) | static(4) |

#### 5.2.3.3 [RFC 1493] Requirements

Ports associated with SAFEs MUST be added to dot1dBasePortTable.

The dot1dTpFdbTable MUST contain information about learned or provisioned CPEs through the logical CPE interfaces with learned(3) or mgmt(5) status accordingly.

All bridge statistics of dot1dTpPortTable MUST be supported for logical CPE interfaces.

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# Appendix I Acknowledgements

The inter-disciplinary nature of this specification involves contributions from many individuals. On behalf of CableLabs and its participating member companies, I would like to extend our sincere appreciation to all those have contributed to the development of this specification. Special thanks are given to:

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