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**Operations Support System Interface
for
Modular Cable Modem Termination Systems**

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Operations Support System Interface for Modular Cable Modem Termination Systems

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1 SCOPE

1.1 Introduction and Overview

This standard defines the Network Management requirements to support a Modular Cable Modem Termination System (M-CMTS) for headend components compliant to DOCSIS.

The M-CMTS architecture separates the traditional CMTS into two parts. The first part is the downstream physical (PHY) component (known as a DOCSIS EQAM) and the second part consists of the IP networking and DOCSIS MAC functions of the CMTS (known as the M-CMTS Core). This separation of a CMTS into EQAM and M-CMTS Core introduces three new protocol interfaces to DOCSIS-compliant headend systems.

- DOCSIS Timing Interface (DTI): Provides a frequency reference for M-CMTS Core and DOCSIS EQAM via direct connections to a DTI Server.
- Downstream External PHY Interface (DEPI): Controls the delivery of DOCSIS frames from the M-CMTS core to the EQAM devices.
- Edge Resource Management Interface (ERMI): Provides EQAM devices registration and control to the Edge Resource Management device with the purpose of sharing EQAM resources with video systems such as Video on Demand (VoD).

1.2 Purpose of standard

The purpose of this standard is to define the management requirements for the M-CMTS architecture that enables an effective operation of the M-CMTS components. In particular, this standard defines the configuration, monitoring and performance requirements of the M-CMTS Core, DOCSIS EQAMs and DTI Server for the Modular CMTS interfaces.

1.3 Modular CMTS Interface Standards

A list of the standards in the Modular CMTS Interface Standards family is provided below.

{Editor's Note: These must all be updated to the appropriate SCTE standard reference when available}

Table 1-1 - M-CMTS Interface standards

Designation	Title
SCTE 137-2 2007	DOCSIS Downstream External PHY Interface for Modular
SCTE 137-1 2007	DOCSIS Timing Interface for Cable Modem Termination Systems
SCTE 139 2007	Edge Resource Manager Interface for Modular Cable Modem Termination Systems
SCTE 141 2007	Operations Support System Interface for Modular Cable Modem Termination Systems

1.4 Organization of document

This standard is organized in two parts: the first part describes the overall management mandatory requirements for M-CMTS modules based on the M-CMTS interfaces requirements. The second is the Annexes section, which contains the mandatory Management Objects and MIB objects definitions for compliant equipment.

2 REFERENCES

All references are subject to revision; users of this specification are therefore encouraged to investigate the possibility of applying the most recent edition of the standards and other references listed below.

2.1 Normative References

{Editor's note: The references to DSS draft documents should be changed to SCTE references when available and IETF drafts to RFCs}

- [SCTE 137-2] DOCSIS Downstream External PHY Interface for Modular, 2007.
- [SCTE 133] Downstream RF Interface for Cable Modem Termination Systems, 2007.
- [SCTE 137-1] DOCSIS Timing Interface for Cable Modem Termination Systems, 2007.
- [SCTE 139] Edge Resource Manager Interface for Modular Cable Modem Termination Systems, 2007.
- [IETF1] Raftus David, Goren Aviv, Proposed Standard RFC version of Radio Frequency (RF) Interface, draft-ietf-ipcdn-docs-rfmibv2-05.txt.
- [IETF2] IETF RFC 4133 Entity MIB (Version 3). A. Bierman, K. McCloghrie. August 2005.
- [OSSI2.0] ANSI/SCTE 79-2 2007 DOCS 2.0 Operations Support System Interface
- [RFC 2011] IETF RFC 2011, Category: Standards Track SNMPv2 Management Information Base for the Internet Protocol using SMIV2, November 1996.
- [RFC 2669] IETF RFC 2669, DOCSIS Cable Device MIB Cable Device Management Information Base for DOCSIS compliant Cable Modems and Cable Modem Termination Systems, August 1999.
- [RFC 2863] IETF RFC 2853, The Interfaces Group MIB, June 2000.
- [RFC 3371] IETF RFC 3371, L2TPv3 Extensions Working Group, Layer Two Tunneling Protocol 'L2TP' Management Information Base, August 2002.
- [RFC 3410] IETF RFC 3410, Introduction and Applicability Statements for Internet-Standard Management Framework, December 2002.
- [RFC 3411] IETF RFC 3411 / STD0062, An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks, December 2002.
- [RFC 3412] IETF RFC 3412 / STD0062, Message Processing and Dispatching for the Simple Network Management Protocol (SNMP), December 2002.
- [RFC 3413] IETF RFC 3413 / STD0062, Simple Network Management Protocol (SNMP) Applications, December 2002.
- [RFC 3414] IETF RFC 3414 / STD0062, User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3), December 2002.
- [RFC 3415] IETF RFC 3415 / STD0062, View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP), December 2002.
- [RFC 3418] IETF RFC 3418 / STD0062, Management Information Base (MIB) for the Simple Network Management Protocol (SNMP), December 2002.
- [RFC 3584] IETF RFC 3584 / BCP0074, Coexistence between Version 1, Version 2, and Version 3 of the Internet-Standard and Network Management Framework, August 2003.
- [RFC 3931] IETF RFC 3931, Layer Two Tunneling Protocol - Version 3 (L2TPv3), March 2005.

2.2 Informative References

- [PW-MIB] IETF draft-ietf-pwe3-pw-mib-06.txt, Zelig, D., Nadeau, T., Pseudo Wire (PW) Management Information Base, July 2005.
- [RFC 2661] IETF RFC 2661, Layer Two Tunneling Protocol "L2TP", August 1999.
- [RFC 4087] IETF RFC 4087 IP Tunnel MIB, June 2005.

2.3 Reference Acquisition

- Cable Television Laboratories, <http://www.cablemodem.com/specifications/>
- Internet Engineering Task Force (IETF) <http://www.ietf.org/>

3 TERMS AND DEFINITIONS

This standard uses the following terms and definitions:

Cable Modem (CM)	A modulator-demodulator at subscriber locations intended for use in conveying data communications on a cable television system.
CDN	L2TPv3 Call-Disconnect-Notify message.
Converged Interconnect Network	The network (generally gigabit Ethernet) that connects an M-CMTS Core to an EQAM.
Customer Premises Equipment (CPE)	Equipment at the end user's premises; may be provided by the service provider.
Data Rate	Throughput, data transmitted in units of time usually in bits per second (bps).
Decibels (dB)	Ratio of two power levels expressed mathematically as $dB = 10\log_{10}(P_{OUT}/P_{IN})$.
Decibel-Millivolt (dBmV)	Unit of RF power expressed in decibels relative to 1 millivolt over 75 ohms, where $dBmV = 20\log_{10}(\text{value in mV}/1 \text{ mV})$.
DOCSIS-MPT (D-MPT)	DOCSIS MPT Mode.
Downstream (DS)	1. Transmissions from CMTS to CM. This includes transmission from the M-CMTS Core to the EQAM as well as the RF transmissions from the EQAM to the CM. 2. RF spectrum used to transmit signals from a cable operator's headend or hub site to subscriber locations.
DTI Client	The receiver of the Timing signal from the DTI Server. Through the DTI protocol DTI clients have the same time reference.
DTI Server	Timing Signal generator for a DTI client of the point to point DOCSIS Timing Interface (DTI).
edgeQAM modulator (EQAM)	A headend or hub device that receives packets of digital video or data. It re-packetizes the video or data into an MPEG transport stream and digitally modulates the digital transport stream onto a downstream RF carrier using quadrature amplitude modulation (QAM).
Electronic Industries Alliance (EIA)	A voluntary body of manufacturers, which, among other activities, prepares and publishes standards.
Flow	A stream of packets in DEPI used to transport data of a certain priority from the M-CMTS Core to a particular QAM channel of the EQAM. In PSP operation, there can exist several flows per QAM channel.
Gigahertz (GHz)	A unit of frequency; 1,000,000,000 or 10^9 Hz.
GigE (GE)	Gigabit Ethernet (1 Gbps).
GPSSC	The timestamp used for GPS systems. This timestamp is a 32-bit counter that increments every second and uses as initialization reference January 6, 1980.
Hertz (Hz)	A unit of frequency; formerly cycles per second.
Hybrid Fiber/Coax (HFC) System	A broadband bidirectional shared-media transmission system using optical fiber trunks between the headend and the fiber nodes, and coaxial cable distribution from the fiber nodes to the customer locations.
ICCN	L2TPv3 Incoming-Call-Connected message.
ICRP	L2TPv3 Incoming-Call-Reply message.

ICRQ	L2TPv3 Incoming-Call-Request message.
Internet Engineering Task Force (IETF)	A body responsible for, among other things, developing standards used in the Internet.
Internet Protocol (IP)	An Internet network-layer protocol.
IPv4	Internet Protocol version 4.
kilohertz (kHz)	Unit of frequency; 1,000 or 10^3 Hz; formerly kilocycles per second.
L2TP Attribute Value Pair (AVP)	The L2TP variable-length concatenation of a unique Attribute (represented by an integer), a length field, and a Value containing the actual value identified by the attribute.
L2TP Control Connection	An L2TP control connection is a reliable control channel that is used to establish, maintain, and release individual L2TP sessions as well as the control connection itself.
L2TP Control Connection Endpoint (LCCE)	An L2TP node that exists at either end of an L2TP control connection. May also be referred to as an LAC or LNS, depending on whether tunneled frames are processed at the data link (LAC) or network layer (LNS).
L2TP Control Connection ID	The Control Connection ID field contains the identifier for the control connection, a 32-bit value. The Assigned Control Connection ID AVP, Attribute Type 61, contains the ID being assigned to this control connection by the sender. The Control Connection ID specified in the AVP must be included in the Control Connection ID field of all control packets sent to the peer for the lifetime of the control connection. Because a Control Connection ID value of 0 is used in this special manner, the zero value must not be sent as an Assigned Control Connection ID value.
L2TP Control Message	An L2TP message used by the control connection.
L2TP Data Message	L2TP message used by the data channel.
L2TP Endpoint	A node that acts as one side of an L2TP tunnel.
L2TP Network Server (LNS)	If a given L2TP session is terminated at the L2TP node and the encapsulated network layer (L3) packet processed on a virtual interface, we refer to this L2TP node as an L2TP Network Server (LNS). A given LCCE may act as both an LNS for some sessions and an LAC for others, so these terms must only be used within the context of a given set of sessions unless the LCCE is in fact single purpose for a given topology.
L2TP Pseudowire (PW)	An emulated circuit as it traverses a PSN. There is one Pseudowire per L2TP Session.
L2TP Pseudowire Type	The payload type being carried within an L2TP session. Examples include PPP, Ethernet, and Frame Relay.
L2TP Session	An L2TP session is the entity that is created between two LCCEs in order to exchange parameters for and maintain an emulated L2 connection. Multiple sessions may be associated with a single Control Connection.

L2TP Session ID	A 32-bit field containing a non-zero identifier for a session. L2TP sessions are named by identifiers that have local significance only. That is, the same logical session will be given different Session IDs by each end of the control connection for the life of the session. When the L2TP control connection is used for session establishment, session IDs are selected and exchanged as Local Session ID AVPs during the creation of a session. The Session ID alone provides the necessary context for all further packet processing, including the presence, size, and value of the Cookie, the type of L2-Specific Sublayer, and the type of payload being tunneled.
MAC Domain	A grouping of layer 2 devices that can communicate with each other without using bridging or routing. In DOCSIS is the group of CMs that are using upstream and downstream channels linked together through a MAC forwarding entity.
Media Access Control (MAC)	Used to refer to the layer 2 element of the system which would include DOCSIS framing and signaling.
Megahertz (MHz)	A unit of frequency; 1,000,000 or 10^6 Hz; formerly megacycles per second.
Microsecond (μs)	10^{-6} second.
Millisecond (ms)	10^{-3} second.
M/N	Relationship of integer numbers M,N that represents the ratio of the downstream symbol clock rate to the DOCSIS master clock rate.
MPT	MPEG-TS mode of DEPI.
Multiple System Operator (MSO)	A corporate entity that owns and/or operates more than one cable system.
Nanosecond (ns)	10^{-9} second.
QAM channel (QAM ch)	Analog RF channel that uses quadrature amplitude modulation (QAM) to convey information.
Quadrature Amplitude Modulation (QAM)	A modulation technique in which an analog signal's amplitude and phase vary to convey information, such as digital data.
Radio Frequency (RF)	In cable television systems, this refers to electromagnetic signals in the range 5 to 1000 MHz.
Radio Frequency Interface (RFI)	Term encompassing the downstream and the upstream radio frequency interfaces.
Request For Comments (RFC)	A technical policy document of the IETF; these documents can be accessed on the World Wide Web at http://www.rfc-editor.org/ .
SCCRN	L2TPv3 Start-Control-Connection-Connected message.
SCCRP	L2TPv3 Start-Control-Connection-Reply message.
SCCRQ	L2TPv3 Start-Control-Connection-Request message.
Session	An L2TP data plane connection from the M-CMTS Core to the QAM channel. There must be one session per QAM Channel. There is one DEPI pseudowire type per session. There may be multiple MPT flows and multiple PSP flows per session. Multiple sessions may be bound to a single control connection.
SLI	L2TPv3 Set Link Info message.
StopCCN	L2TPv3 Stop-Control-Connection-Notification message.
Upstream (US)	1. Transmissions from CM to CMTS. This includes transmission from the EQAM to M-CMTS Core as well as the RF transmissions from the CM to the EQAM. 2. RF spectrum used to transmit signals from a subscriber location to a cable operator's headend or hub site.

**Upstream
Channel
Descriptor (UCD)**

The MAC Management Message used to communicate the characteristics of the upstream physical layer to the cable modems.

**Video on Demand
(VoD) System**

System that enables individuals to select and watch video content over a network through an interactive television system.

4 ABBREVIATIONS, ACRONYMS AND CONVENTIONS

4.1 Abbreviations and Acronyms

This standard uses the following abbreviations and acronyms:

CIN	Converged Interconnect Network
CMCI	Cable Modem CPE Interface
CMTS	Cable Modem Termination System
CRC	Cyclic Redundancy Check
DEPI	Downstream External-PHY Interface
DOCSIS	Data-Over-Cable Service Interface Specifications
DRFI	Downstream Radio Frequency Interface
DSCP	Differentiated Services Code Point
DTI	DOCSIS Timing Interface
ERM	Edge Resource Manager
ERMI	Edge Resource Manager Interface
Gbps	Gigabits per second
GPS	Global Positioning System
ITU	International Telecommunications Union
ITU-T	Telecommunication Standardization Sector of the International Telecommunication Union
Kbps	Kilobits per second
LSB	Least Significant Bit
Mbps	Megabits per second
M-CMTS	Modular Cable Modem Termination System
MIB	Management Information Base
MPEG	Moving Picture Experts Group
MPEG-TS	Moving Picture Experts Group Transport Stream
MSB	Most Significant Bit
OSSI	Operations System Support Interface
PHY	Physical Layer
PSP	Packet-Streaming-Protocol
S-CDMA	Synchronous Code Division Multiple Access
SNMP	Simple Network Management Protocol
TBD	To Be Determined (or To Be Deferred)
TSID	MPEG2 Transport Stream ID
ToD	Time of Day
UDP	User Datagram Protocol

4.2 Conventions

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

"MUST"	This word means that the item is an absolute requirement of this standard.
"MUST NOT"	This phrase means that the item is an absolute prohibition of this standard.
"SHOULD"	This word 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 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.

5 TECHNICAL OVERVIEW

5.1 Introduction and Overview

This Section is informative.

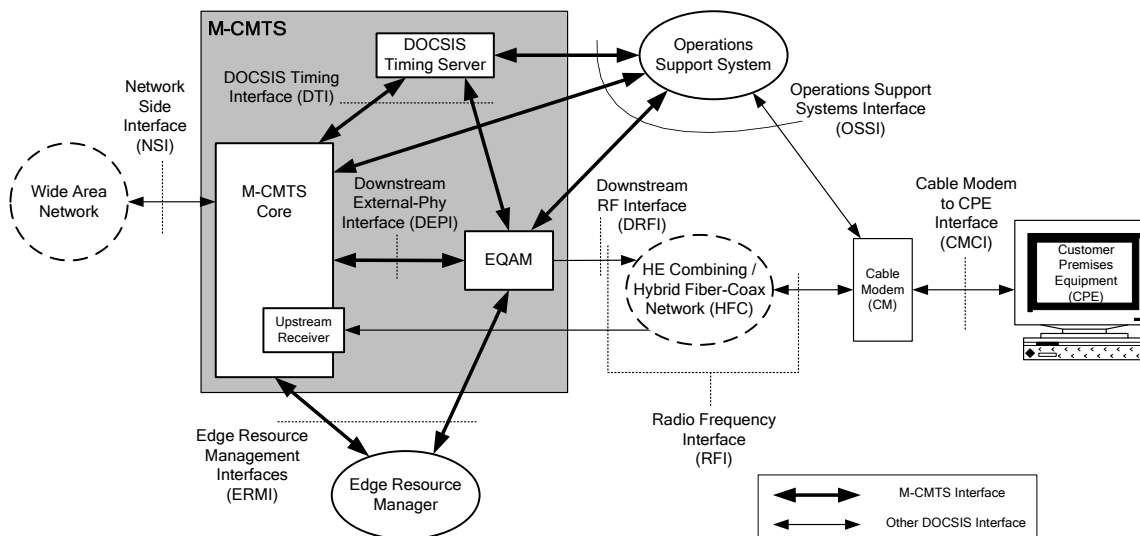


Figure 5-1 - Modular CMTS Reference Architecture

Figure 5-1 depicts the Modular CMTS architecture on which the traditional CMTS system is divided into: the M-CMTS core and the EQAM device. The M-CMTS Core contains all the traditional DOCSIS CMTS functions, including MAC timing and framing, packet classification, service flow management, and security. The EQAM device performs the RF transmission functions such as modulation and frequency up-conversion for the transmission of Data packets over the HFC. The M-CMTS architecture includes a DOCSIS Timing server to maintain a consistent timing reference between the M-CMTS core and EQAM, as well as to mitigate the propagation delay differences of these two components. The DOCSIS Timing Interface (DTI) runs between the DTI Server and the M-CMTS and EQAM devices, and is known as the DTI clients.

The EQAM device, as specified by the DOCSIS M-CMTS Interface specifications, is an adaptation of the Video QAM devices used for VoD service. To optimize the resource allocation of DOCSIS QAM channels for DOCSIS and VoD services, the M-CMTS architecture defines a Resource Manager to control the reservation of those QAM (Edge) resources. The Edge Resource Manager (ERM) provides reliable and optimized access to EQAM device resources. The ERM interface is designed to manage the resource allocation of various EQAM resources for DOCSIS and VoD activities. In addition, the EQAM device supports a Registration Interface to ERM with the purpose of maintaining an accurate inventory of resources availability in the EQAM devices.

In the absence of ERM, or in a transition from VOD EQAMs only to VOD and DOCSIS QAMs, the M-CMTS architecture offers the option to configure and allocate EQAM resources via the M-CMTS core by using the Downstream External PHY Interface (DEPI). DEPI is basically a Layer 2 encapsulation of the DOCSIS traffic for the purpose of transport from the M-CMTS core to the EQAM device.

The DRFI is defined by the M-CMTS architecture for the purpose of gathering all the RF specification requirements from DOCSIS into a standalone specification to be referenced in the future for Modular or integrated CMTS implementations.

Complete details of the M-CMTS interfaces are within their respective standards, and referenced in Section 1.3.

The Operations Support Systems requirements of the M-CMTS architecture consist of the Management Information Base (MIB), residing in the M-CMTS modules such as M-CMTS core, EQAM device and DTI Server, with the

purpose of providing configuration, monitoring, and troubleshooting management functions of the M-CMTS interface specifications.

5.2 M-CMTS Core Management Requirements Overview

The M-CMTS Core Management requirements are of two types:

- M-CMTS Core MUST support standard OSSI CMTS requirements, as specified in [OSSI2.0]
- M-CMTS Core MUST support the M-CMTS OSS requirements defined by this standard.

For M-CMTS Core-compliant devices, conflicts of M-CMTS OSSI requirements and OSSI CMTS requirements are resolved by the prevailing M-CMTS OSSI requirements. The M-CMTS Core compliant device MUST support M-CMTS OSSI requirements over OSSI CMTS requirements in case those requirements are in conflict.

M-CMTS OSSI requirements for the M-CMTS Core are summarized below:

- Requirements for Downstream RF Interface Specification [SCTE 133]
- Requirements for DOCSIS External PHY Interface [SCTE 137-2]
- Requirements for DOCSIS Timing Interface [SCTE 137-1]

5.3 EQAM device Management Requirements Overview

The management requirements for the EQAM-compliant device are specified in this standard and summarized as:

- Requirements for Downstream RF Interface Specification [SCTE 133]
- Requirements for DOCSIS External PHY Interface [SCTE 137-2]
- Requirements for DOCSIS Timing Interface [SCTE 137-1]
- Requirements for Edge Resource Management Interface [
- SNMP and Management Information MIB requirements

5.4 DTI Server Management Requirements Overview

The management requirements for the M-CMTS DTI Server-compliant device are specified in this standard and summarized as:

- Requirements for DOCSIS Timing Interface [SCTE 137-1]
- SNMP and Management Information MIB requirements

6 SNMP PROTOCOL

6.1 SNMP Mode for M-CMTS Core

M-CMTS Core has no additional SNMP protocol requirements above those defined in the DOCSIS OSSI specifications.

6.2 SNMP Mode for EQAM

The EQAM MUST support SNMPv3 as described by [RFC 3411] through [RFC 3415]. The EQAM MUST support SNMPv1 and SNMPv2c coexistence mode as described in [RFC 3584].

The EQAM is not required to support writable configuration via SNMP SETs, therefore EQAM MAY support creation, deletion or modification of SNMPv3 and [RFC 3584] configured parameters via SNMP.

If the EQAM does not provide SNMP write access to SNMPv3 and coexistence MIB objects configuration, the EQAM MUST provide alternative Management interfaces to do so.

6.3 SNMP Mode for DTI Server

The DTI Server MUST support SNMPv3 as described by [RFC 3411] through [RFC 3415]. The DTI Server MUST support SNMPv1 and SNMPv2c coexistence mode as described in [RFC 3584].

The DTI Server is not required to support writable configuration via SNMP SETs; therefore, DTI Server MAY support creation, deletion or modification of SNMPv3 and [RFC 3584] configured parameters.

If the DTI Server does not provide SNMP write access to SNMPv3 and coexistence MIB objects configuration, the EQAM MUST provide alternative Management interfaces to do so.

7 MANAGEMENT INFORMATION BASE (MIB)

This section defines the minimum set of managed objects required to be supported by M-CMTS entities.

The requirements described in this standard have priority over IETF-defined MIB modules. It includes MIB objects made mandatory in this standard, whereas the IETF standards may have defined them as deprecated, obsolete, or those with optional implementation compliances.

Unless otherwise indicated, IETF deprecated, obsolete, or optional MIB objects that are supported by the M-CMTS core **MUST** be implemented correctly according to the MIB module definition.

Unless otherwise indicated, IETF deprecated, obsolete, or optional MIB objects that are supported by the DTI Server **MUST** be implemented correctly according to the MIB module definition.

Unless otherwise indicated, IETF deprecated, obsolete, or optional MIB objects that are supported by the EQAM device **MUST** be implemented correctly according to the MIB module definition.

If an M-CMTS core device does not support a deprecated, obsolete, or optional MIB object, the device SNMP Agent **MUST NOT** instantiate the MIB object and **MUST** return the corresponding error code on SNMP PDU requests.

If a DTI Server does not support a deprecated, obsolete, or optional MIB object, the device SNMP Agent **MUST NOT** instantiate the MIB object and **MUST** return the corresponding error code on SNMP PDU requests.

If an EQAM device does not support a deprecated, obsolete, or optional MIB object, the device SNMP Agent **MUST NOT** instantiate the MIB object and **MUST** return the corresponding error code on SNMP PDU requests.

The following sections provide a detailed summary of the MIB modules applicability for M-CMTS components.

Specific requirements per component are detailed in Section 7.3 and Annex A, Annex C, and Annex D. For the case of M-CMTS Core, the requirements described in this standard are in addition and/or replacement of CMTS requirements outlined in the [OSSI2.0] specification.

7.1 IETF Drafts and CableLabs MIB Modules

Table 7-1 - IETF Drafts and CableLabs MIB Modules

Reference	MIB	Applicable Device(s)
[IETF1]	IETF Proposed Standard RFC-version of RF MIB, "draft-ietf-ipcdn-docs-rfmibv2-05.txt": DOCS-IF-MIB	EQAM
[IETF2]	IETF Proposed Standard RFC Entity MIB (Version 3), "draft-ietf-entmib-v3-07.txt". ENTITY-MIB	M-CMTS Core, EQAM and DTI Server
Annex C	DOCS-IF-M-CMTS-MIB	CMTS and EQAM
Annex D	DTI-MIB	M-CMTS core, EQAM and DTI Server

7.2 IETF RFC MIB Modules

Table 7-2 - IETF RFC MIB Modules

Reference	MIB	Applicable Device(s)
[RFC 2863]	The Interfaces Group MIB using SMIV2: IF-MIB	M-CMTS core, EQAM and DTI Server

Reference	MIB	Applicable Device(s)
[RFC 2669]	DOCSIS Cable Device MIB	EQAM and DTI Server
[RFC 3371]	Layer Two Tunneling Protocol "L2TP" Management Information Base RFC 3371, August 2002	M-CMTS Core and EQAM
[RFC 2011]	SNMPv2 Management Information Base for the Internet Protocol using SMIPv2: IP-MIB	EQAM and DTI Server
[RFC 3418]	Management Information Base (MIB) for the Simple Network Management Protocol (SNMP): SNMPv2-MIB	EQAM and DTI Server
[RFC 3410] [RFC 3411] [RFC 3412] [RFC 3413] [RFC 3414] [RFC 3415] [RFC 3584]	SNMP v3 MIBs: SNMP-FRAMEWORK-MIB, SNMP-MPD-MIB, SNMP-NOTIFICATION-MIB, SNMP-TARGET-MIB, SNMP-USER-BASED-SM-MIB, SNMP-VIEW-BASED-ACM-MIB, SNMP-COMMUNITY-MIB	EQAM and DTI Server

7.3 Managed objects requirements

The following sections detail any additional implementation requirements for the MIB modules listed above. Refer to Annex A for specific object implementation requirements.

The M-CMTS Core, DTI Server and EQAM compliant devices MUST support a minimum of 10 available SNMP table rows unless otherwise specified by the corresponding IETF MIB Module document or the corresponding DOCSIS OSS1 specification. The minimum number of available SNMP table rows SHOULD mean rows (per table) that are available to support device configuration. M-CMTS Core, DTI Server and EQAM MUST not count default or static preconfigured row entries as part of the minimum number of available SNMP table rows.

7.3.1 Requirements for DOCS-IF-MIB

7.3.1.1 DOCS-IF-MIB M-CMTS requirements

A compliant M-CMTS core MAY implement the table docsIfDownstreamChannelTable as read-only and defer the configuration aspects of M-CMTS Downstream interfaces to DOCS-IF-M-CMTS-MIB.

If a compliant M-CMTS core device supports write access to docsIfDownstreamChannelTable, in the event of a SET operation in one of the writable MIB Objects of this table, the M-CMTS Core MUST update the docsIfMCmtsDepiSessionConfigTable equivalent PHY Parameter and perform the L2TPv3 parameter update signaling from there. The M-CMTS core may reject the set parameter because the DEPI Control Table was signaled previously that a bit lock has been set for the particular PHY parameter. Thus, MCMTS MAY reject SNMP Sets to Downstream PHY parameters that were previously signaled as locked without the need to invoke the L2TPv3 request.

If a compliant M-CMTS core supports write access to docsIfDownstreamChannelTable, the M-CMTS Core MUST use the L2TPv3 connection control plane when instructed to set any writable MIB object in docsIfDownstreamTable. The M-CMTS MUST delay the SNMP PDU response to the SNMP requester entity until the L2TPv3 [RFC 3931] session returns the status of the execution of the SNMP request.

The M-CMTS MUST return the error "NotWritable" if the PHY parameter of the EQAM channel associated with the Downstream Interface is being reported as "locked" by the L2TPv3 Session.

If a compliant M-CMTS core supports write access to docsIfDownstreamChannelTable, the M-CMTS Core MUST return "CommitFailed" error for a SNMP SET, to any writable parameter in the docsIfDownstream Table of a Downstream Interface, with no L2TPv3 Session active.

7.3.1.2 DOCS-IF-MIB EQAM requirements

The EQAM device MUST implement the conceptual table docsIfDownstreamTable, as indicated in Annex A.

The EQAM MUST report the transmit power in the MIB object docsIfDownChannelPower; within 2 dB of the actual transmit power.

7.3.2 Requirements for [RFC 2669]

The EQAM device MUST implement the docsDevEventGroup from [RFC 2669], as indicated in Annex A.

The DTI Server MUST implement the docsDevEventGroup from [RFC 2669], as indicated in Annex A.

7.3.3 Requirements for [RFC 2863]

The Interface MIB [RFC 2863] MUST be implemented by compliant M-CMTS Cores, DTI Server, and EQAM devices, as described in Annex A and B.1.

7.3.3.1 Requirements for M-CMTS Core

7.3.3.1.1 M-CMTS Core Interface Types

To represent the DOCSIS MAC service adaptation to the DEPI PW infrastructure, the logical interfaces M-CMTS Downstream Interface (docsCableMCmtsDownstream) is defined. The equivalent M-CMTS Upstream Interfaces (docsCableMCmtsUpstream) is defined as a term but not specified in the scope of this standard.

To guarantee backward compatibility with the DOCSIS OSSI Management framework and existing MIB Modules (see [OSSI2.0]), the logic association of the CMTS Physical interfaces, as well as the DOCSIS MAC interface IfStackTable hierarchy, is preserved. Table 7–3 shows the differences between the IfIndex for Integrated CMTS and M-CMTS Core implementations. Currently, IANA has not assigned these values, so in the interim period, IfType numbers for docsCableMCmtsDownstream and docsCableMCmtsUpstream Interfaces, in M-CMTS Compliant devices, MUST report 'other' for downstream Interface DOCSIS IfType.

Table 7–3 - CMTS and M-CMTS Interfaces

DOCSIS Interface	Integrated CMTS	Modular CMTS
CATV MAC interface	docsCableMacLayer (127)	docsCableMacLayer (127)
CATV downstream channel	docsCableDownstream (128)	docsCableMCmtsDownstream (ifType 229)
CATV upstream interface	docsCableUpStream (129)	docsCableMCmtsUpStream (ifType TBD) - out of scope -
CATV upstream logical channel	docsCableUpstreamChannel (205)	docsCableUpstreamChannel (205)

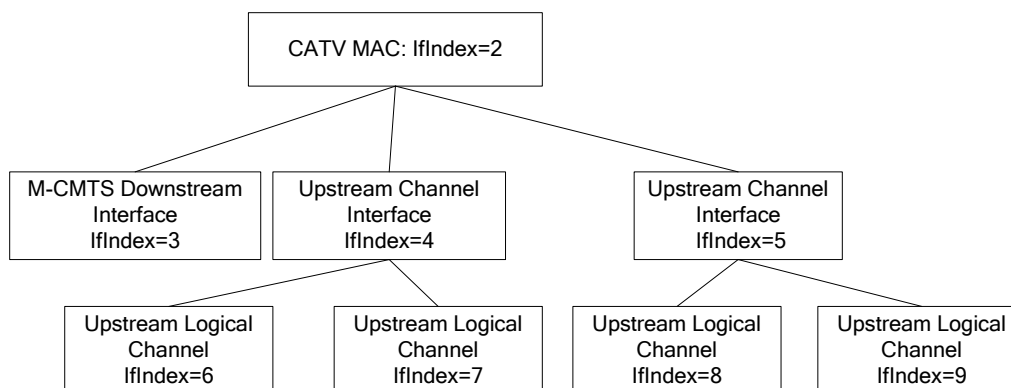
Figure 7–1 depicts the upstream interfaces attached to the M-CMTS Core. There is a possibility that in the future, upstream receivers would be external to the M-CMTS Core, but outside of the scope of this standard.

7.3.3.1.2 Interface organization and numbering

A compliant M-CMTS Core device MUST have an instance of ifEntry for each M-CMTS Downstream Interface. The M-CMTS Core compliant device MUST include entries in the ifStackTable [RFC 2863] to identify the stack relationships of the M-CMTS Downstream interfaces.

7.3.3.1.3 M-CMTS Core Interface IfStackTable

The M-CMTS Core maintains a similar IfStackTable Structure to that defined in DOCSIS OSSI specifications. Figure 7–1 depicts an example of an M-CMTS Core Interface Stack. In Figure 7–1, the CATV interface has one M-CMTS DS Interface and two US interfaces, each one with two US logical channels.



Implementation of ifStackTable for this example:

ifStackHigherLayer	ifStackLowerLayer
0	2
2	3
2	4
2	5
3	0
4	6
4	7
5	8
5	9
6	0
7	0
8	0
9	0

Figure 7-1 - ifStackTable Example for M-CMTS Core

7.3.3.1.4 M-CMTS Core DOCSIS Interface MIB Considerations

A compliant M-CMTS Core device MUST conform to the Interface requirements from Annex B.1 of this standard.

7.3.3.2 Requirements for EQAM

7.3.3.2.1 EQAM Interface Types

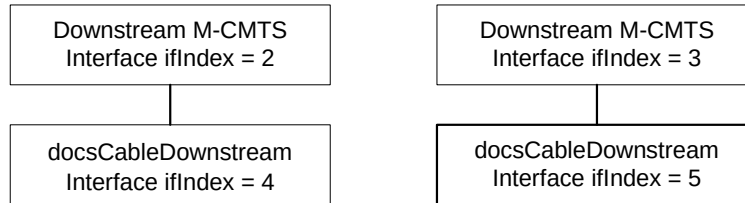
A compliant EQAM device MUST support the interface Type docsCableMCmtsDownstream for each QAM channel.

7.3.3.2.2 Interface organization and numbering

A compliant EQAM device MUST have an instance of ifEntry for each M-CMTS Downstream Interface. The EQAM compliant device MUST include entries in the ifStackTable [RFC 2863] of the M-CMTS Downstream interfaces.

7.3.3.2.3 EQAM Interface IfStackTable

A compliant EQAM device MUST model the docsCableMCmtsDownstream interfaces at the top of the interface stack with no sub-interfaces. Figure 7-2 depicts an example of the IfStackTable entries corresponding to two M-CMTS downstream Interfaces in the EQAM.



Implementation of ifStackTable for this example:

ifStackHigherLayer	ifStackLowerLayer
0	2
2	4
0	3
3	5
4	0
5	0

Figure 7–2 - ifStackTable Example for EQAM

7.3.3.2.4 EQAM IF-MIB relation with ENTITY-MIB

See Section 7.3.9 ENTITY-MIB for details on the ENTITY-MIB relationship with IF-MIB.

7.3.3.3 DTI Interface Requirements

7.3.3.3.1 DTI Server Interface Types

The DTI Server **MUST** support instances of ifEntry for all DTI interfaces. That is, interfaces connecting to the DTI root server and DTI clients.

A compliant M-CMTS Core device **MUST** support an instance of ifEntry for all the DTI client interfaces residing in the device.

A compliant EQAM device **MUST** support an instance of ifEntry for all the DTI client interfaces residing in the device.

A compliant M-CMTS Core device **MUST** set the ifType of DTI Interfaces to 'other', and **MUST** conform to the requirements defined in Annex D of this standard.

A compliant EQAM device **MUST** set the ifType of DTI Interfaces to 'other', and **MUST** conform to the requirements defined in Annex D of this standard.

A compliant DTI Server device **MUST** set the ifType of DTI Interfaces to 'other', and **MUST** conform to the requirements defined in Annex D of this standard.

7.3.3.3.2 Interface organization and numbering

A compliant M-CMTS Core device **MUST** include entries in the ifStackTable [RFC 2863] for the DTI interfaces.

A compliant EQAM device **MUST** include entries in the ifStackTable [RFC 2863] for the DTI interfaces.

A compliant DTI Server device **MUST** include entries in the ifStackTable [RFC 2863] for the DTI interfaces.

7.3.3.3.3 DTI Interface IfStackTable

Compliant DTI Server devices **MUST** implement the DTI interfaces at the top of the Interface stack with no sub-interfaces. Figure 7–3 depicts an example of the IfStackTable entries corresponding to two M-CMTS downstream Interfaces in the EQAM.

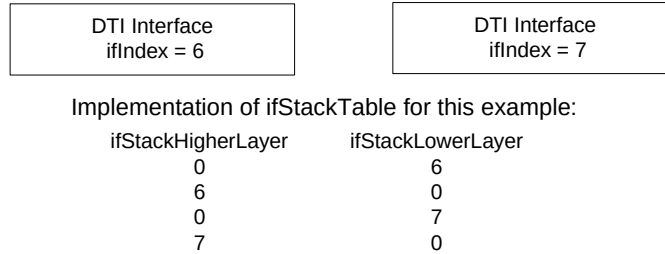


Figure 7–3 - ifStackTable Example for DTI Interfaces

7.3.3.3.4 EQAM IF-MIB relation with ENTITY-MIB

See Section 7.3.9 ENTITY-MIB for details on the ENTITY-MIB relationship with IF-MIB.

7.3.4 Requirements for [RFC 2011]

A compliant EQAM device **MUST** support ipNetToMediaTable and ipAddrTable from the ipGroup [RFC 2011]. The EQAM compliant device **MAY** support other objects of the ipGroup.

A compliant DTI Server **MUST** support the ipAddrTable from [RFC 2011].

A compliant DTI Server **MAY** support the ipNetToMediaTable [RFC 2011], although it is unnecessary as an IP Host. DTI has other mechanisms to discover the DTI network topology (see [SCTE 137-1]).

7.3.5 Requirements for [RFC 3418]

7.3.5.1 The System Group

The EQAM compliant device **MUST** support the systemGroup of [RFC 3418].

The DTI compliant device **MUST** support the systemGroup of [RFC 3418].

A compliant EQAM **MUST** conform to the requirements of the SysDescr MIB object, as shown in the table below:

Table 7–4 - DOCSIS-OSSI Requirements

Variable to report	Format
Hardware Version	HW_REV: <Hardware version>
Vendor Name	VENDOR: <Vendor name>
Boot ROM	BOOTR: <Boot ROM Version>
Software Version	SW_REV: <Software version>
Model Number	MODEL: <Model number>

Each type-value pair in Table 7–4 - DOCSIS-OSSI Requirements **MUST** be separated with a colon and blank space. Each pair is separated by a ";" followed by a blank space.

The values of the object sysDescr of the EQAM device **MUST** correspond to the related objects in entPhysicalEntry of the PhysicalClass module that contains the overall software control of the EQAM and other modules. (i.e., Physical Class 'chassis' or 'stack' in the ENTITY-MIB [IETF2].)

For example, a sysDescr of an EQAM vendor X, hardware version 5.2, Boot ROM version 1.4, SW version 2.2, and model number X would be reported as:

any text<<HW_REV: 5.2; VENDOR: X; BOOTR: 1.4; SW_REV 2.2; MODEL: X>>any text

7.3.5.2 The SNMP Group and Notification Group

Compliant EQAM and DTI Servers **MUST** support the MIB object snmpEnableAuthenTraps from the snmpGroup and the notifications coldStart and authenticationFailure from the snmpBasicNotificationsGroup of [RFC 3418].

7.3.6 Requirements for DOCS-IF-M-CMTS-MIB

A compliant M-CMTS Core device MUST support the DOCS-IF-M-CMTS-MIB module as described in Annex A and Annex C.

A compliant EQAM device MUST support the DOCS-IF-M-CMTS-MIB module as described in Annex A and Annex C.

7.3.7 Requirements for DTI-MIB

A compliant M-CMTS Core device MUST support the DTI-MIB module as described in Annex D.

A compliant EQAM device MUST support the DTI-MIB module as described in Annex D.

A compliant DTI server device MUST support the DTI-MIB module as described in Annex D.

7.3.8 Requirements for [RFC 3371]

The M-CMTS Core MAY implement the groups in the L2TP-MIB.

7.3.8.1 Relationship of DOCS-IF-M-CMTS-MIB and L2TP-MIB

The DOCS-IF-M-CMTS-MIB provides mechanisms for static configuration of DEPI L2TPv3 tunnels as well as providing status information on dynamic DEPI L2TPv3 sessions created by other means such as ERMI [1]. The MIB table docsIfMCmtsDepiSessionConfigTable follows a similar structure of Pseudo Wire (PW) MIB [PW-MIB]. Therefore, the current L2TP-MIB [RFC 3371] reference to the TUNNEL-MIB [RFC 4087] is no longer needed.

The current L2TP-MIB is based on L2TP protocol [RFC 2661] and has not been updated for L2TPv3 Pseudowire framework. As a result, some information and capability developed for L2TPv3 has not been reflected in the MIB. Because of this, the use of the L2TP-MIB [RFC 3371] is not required for a compliant M-CMTS Core or EQAM.

7.3.9 Requirements for ENTITY-MIB

A compliant M-CMTS Core MAY implement the ENTITY-MIB module as described in Annex A. The formal requirements for the ENTITY-MIB module are in [IETF2].

A Compliant EQAM device MUST support the ENTITY-MIB objects as described in Annex A and [IETF2].

A Compliant DTI server device MUST support the ENTITY-MIB objects as described in Annex A and [IETF2].

In particular, the ENTITY-MIB requirements in Annex A include MIB objects from the Entity object groups entityGeneralGroup, entityMappingGroup, entityPhysicalGroup, entityPhysical2Group, and entityPhysical3Group.

Compliant QAM and DTI devices are not required to implement Logical Management Entities as defined in [IETF2] (e.g., to manage multiple EQAM chassis as logical entities). Therefore, support of MIB objects from entLogical2Group is not required.

A Compliant M-CMTS Core device MAY implement Logical Management Entities, in which case the entLogical2Group MUST be supported.

A Compliant EQAM device MAY implement Logical Management Entities, in which case the entLogical2Group MUST be supported.

A Compliant DTI Server device MAY implement Logical Management Entities, in which case the entLogical2Group MUST be supported.

7.3.9.1 IfTable Interfaces and ENTITY MIB physical component

ENTITY-MIB mapping of physical components of Entity PhysicalClass 'port' and ifTable interfaces are completed through the entAliasMappingTable.

A simple example of this mapping is presented in Table 7–5. The example shows QAM channel PhysicalIndex = m to ifIndex = n mapping.

Note: entAliasLogicalIndexOrZero is set to zero to indicate "all" logical entities; including devices with only one Logical Management Entity.

Table 7–5 - Entity Physical Index and IfIndex mapping

entAliasPhysicalIndex QAM channel (PhysicalClass = 'port')	entAliasLogicalIndexOrZero	entAliasMappingIdentifier
m	0	ifIndex.n

7.3.9.2 Implementation of ENTITY MIB for EQAM

A compliant EQAM MUST assign the ENTITY-MIB PhysicalClass type of 'port' to QAM channels. A compliant EQAM device MUST assign RF Ports the PhysicalClass 'module'. Other Physical Class types such as 'stack', 'chassis', 'backplane', 'module', etc., are used as the ENTITY-MIB [IETF2] describes them.

A compliant EQAM device MUST map Ethernet interfaces and QAM channels (Physical entities of Entity PhysicalClass equals 'port') to ifEntry interfaces by means of entAliasMappingEntry with entAliasMappingIdentifier equal to the respective instance of ifIndex.

7.3.9.3 Implementation of ENTITY MIB for DTI Server

A compliant DTI Server MUST assign the ENTITY-MIB PhysicalClass type of 'port' to DTI ports for ports destined to RootServer and DTI Clients. Other Physical Class types such 'stack', 'chassis', 'backplane', and 'module', are used as ENTITY-MIB [IETF2] describes them.

7.3.9.4 Implementation of ENTITY MIB for M-CMTS Core

In order for a compliant M-CMTS Core to claim support of the DEPI control objects docsIfMCmtsDepsControlCableMacEntDescriptor and docsIfMCmtsDepsControlCableDownEntId, the M-CMTS Core MUST support the ENTITY-MIB Annex A. Specifically, the MIB objects from the Entity object groups: entityGeneralGroup, entityMappingGroup, entityPhysicalGroup, entityPhysical2Group and entityPhysical3Group, with the exception of entLPPhysicalIndex, which is needed if multiple Logical Management Entities, are supported.

8 FAULT MANAGEMENT

8.1 Event Notification and Control mechanisms

A compliant EQAM device **MUST** support the Event notification requirements described in sections 7.4.2 and 7.4.3 of the DOCSIS OSSI specification [OSSI2.0].

A compliant DTI server device **MUST** support the Event notification requirements described in sections 7.4.2 and 7.4.3 of the DOCSIS OSSI specification [OSSI2.0].

A compliant EQAM device **MUST** support the event reporting mechanism defined for DOCSIS-compliant CMTS in [OSSI2.0].

A compliant DTI server device **MUST** support the event reporting mechanism defined for DOCSIS-compliant CMTS in [OSSI2.0].

A compliant EQAM device **MUST NOT** implement the CM provisioning described in section 7.4.2.3, "Standard DOCSIS events for CMs" in [OSSI2.0].

A compliant DTI Server device **MUST NOT** implement the CM provisioning described in section 7.4.2.3, "Standard DOCSIS events for CMs" in [OSSI2.0].

Annex A Detailed MIB Requirements (normative)

The following abbreviations and rules apply in this Annex:

ACC-FN	Accessible for Notify.
ATRAP	Accessible through SNMP trap.
D	Deprecated. Deprecated objects are optional. That is, a vendor can choose to implement or not implement the object. If a vendor chooses to implement the object, the object MUST be implemented correctly according to the MIB definition. If a vendor chooses not to implement the object, an agent MUST NOT instantiate such object and MUST respond with the appropriate error/exception condition (e.g., no such object for SNMPv2c).
M	Mandatory. The object MUST be implemented correctly according to the MIB definition.
N-Acc	Not accessible. The object is not accessible and is usually an index in a table.
NA	Not Applicable (to the device).
N-Sup	MUST not support. The device MUST NOT support the object. That is, an agent MUST NOT instantiate such object and MUST respond with the appropriate error/exception condition (e.g., no such object for SNMPv2c).
O	Optional. A vendor can choose to implement or not implement the object. If a vendor chooses to implement the object, the object MUST be implemented correctly according to the MIB definition. If a vendor chooses not to implement the object, an agent MUST NOT instantiate such object and MUST respond with the appropriate error/exception condition (e.g., no such object for SNMPv2c).
Ob	Obsolete. It is optional. Though in SNMP convention, obsolete objects should not be implemented, DOCSIS 2.0 OSSSI lets vendors choose whether or not to support the obsolete object. That is, a vendor can choose to implement or not implement the object. If a vendor chooses to implement the object, the object MUST be implemented correctly according to the MIB definition. If a vendor chooses not to implement the object, the SNMP agent MUST NOT instantiate such object and MUST respond with the appropriate error/exception condition (e.g., no such object for SNMPv2c).
RC	Read-Create. The access of the object MUST be implemented as Read-Create.
RO	Read-Only. The access of the object MUST be implemented as Read-Only.
RW	Read-Write. The access of the object MUST be implemented as Read-Write.
RC/RO	Read-Create or Read-Only. The access of the object MUST be implemented as either Read-Create or Read-Only as described in the MIB definition.
RW/RO	Read-Write or Read-Only. The access of the object MUST be implemented as either Read-Write or Read-Only as described in the MIB definition.

The table below lists the M-CMTS modules M-CMTS Core, EQAM device, and DTI Server Compliance requirements summary.

Table A-1 - Requirements^{1 2}

DOCS-IF-MIB (DOCS-IF-MIB: draft-ietf-ipcdn-docs-rfmibv2-05.txt)				
docsIfDownstreamChannelTable				
Object	M-CMTS Core	Access	EQAM	Access
docsIfDownChannelId	M	RW	NA	NA
docsIfDownChannelFrequency	M	RW/RO	M	RW/RO
docsIfDownChannelWidth	M	RW/RO	M	RW/RO
docsIfDownChannelModulation	M	RW	M	RW/RO
docsIfDownChannelInterleave	M	RW	M	RW/RO
docsIfDownChannelPower	M	RW/RO	M	RW/RO
docsIfDownChannelAnnex	O	RW/RO	O	RW/RO
DOCS-IF-M-CMTS-MIB (Annex C)				
docsIfMCmtsCoreDownstreamTable				
Object	M-CMTS Core	Access	EQAM	Access
docsIfMCmtsCoreDownstreamType	M	RO	N/A	N/A
docsIfMCmtsCoreDownstreamPhyDependencies	M	RO	N/A	N/A
docsIfMCmtsEqamDownstreamTable				
Object	M-CMTS Core	Access	EQAM	Access
docsIfMCmtsEqamDownstreamTSID	N/A	N/A	M	RW
docsIfMCmtsEqamDownstreamPhyDependencies	N/A	N/A	M	RO
docsIfMCmtsEqamDownstreamDevicePhyParamLock	N/A	N/A	M	RO
docsIfMCmtsEqamDownstreamDeviceConfigPhyParamLock	N/A	N/A	M	RW
docsIfMCmtsEqamDownstreamAllocationType	N/A	N/A	M	RW
docsIfMCmtsEqamDownstreamAllocationStatus	N/A	N/A	M	RO
docsIfMCmtsEqamDownstreamAllocationTimeout	N/A	N/A	M	RW
docsIfMCmtsEqamDownstreamDRRPAdvertizing	N/A	N/A	M	RW
docsIfMCmtsEqamDownstreamUdpPortMapping	N/A	N/A	M	RW

¹ Revised this table per ECN M-OSSI-N-05.0254-5 on 11/22/05.

² Table modified per M-OSSI-N-07.0451-3, #1 and M-OSSI-N-07.0451-3, #2 on 7/20/07 by KN.

docsIfMCmtsEqamDownstreamCapabilitiesTable				
Object	M-CMTS Core	Access	EQAM	Access
docsIfMCmtsEqamDownstreamCapabFrequency	N/A	N/A	M	RO
docsIfMCmtsEqamDownstreamCapabBandwidth	N/A	N/A	M	RO
docsIfMCmtsEqamDownstreamCapabPower	N/A	N/A	M	RO
docsIfMCmtsEqamDownstreamCapabModulation	N/A	N/A	M	RO
docsIfMCmtsEqamDownstreamCapabInterleaver	N/A	N/A	M	RO
docsIfMCmtsEqamDownstreamCapabJ83Annex	N/A	N/A	M	RO
docsIfMCmtsEqamDownstreamCapabConcurrentServices	N/A	N/A	M	RO
docsIfMCmtsEqamDownstreamCapabServicesTransport	N/A	N/A	M	RO
docsIfMCmtsEqamDownstreamCapabMuting	N/A	N/A	M	RO
docsIfMCmtsEqamGroupDependencyTable				
Object	M-CMTS Core	Access	EQAM	Access
docsIfMCmtsEqamGroupDependencyPhyParam	N/A	N/A	M	N-Acc
docsIfMCmtsEqamGroupDependencyPhysicalIndex	N/A	N/A	M	N-Acc
docsIfMCmtsEqamGroupDependencyGroupID	N/A	N/A	M	RO
docsIfMCmtsEqamGroupDependencyType	N/A	N/A	M	RO
docsIfMCmtsEqamGlobCfgDownTable				
Object	M-CMTS Core	Access	EQAM	Access
docsIfMCmtsEqamGlobCfgDownIndex	N/A	N/A	M	N-Acc
docsIfMCmtsEqamGlobCfgDownPhysicalIndex	N/A	N/A	M	RC
docsIfMCmtsEqamGlobCfgDownBandwidth	N/A	N/A	M	RC
docsIfMCmtsEqamGlobCfgDownPower	N/A	N/A	M	RC
docsIfMCmtsEqamGlobCfgDownModulation	N/A	N/A	M	RC
docsIfMCmtsEqamGlobCfgDownInterleave	N/A	N/A	M	RC
docsIfMCmtsEqamGlogCfgDownAnnex	N/A	N/A	M	RC
docsIfMCmtsEqamGlobCfgDownSymbolRateM	N/A	N/A	M	RC
docsIfMCmtsEqamGlobCfgDownSymbolRateN	N/A	N/A	M	RC
docsIfMCmtsEqamGlobCfgDownLockParams	N/A	N/A	M	RC
docsIfMCmtsEqamGlobCfgDownExecutionCode	N/A	N/A	M	RO
docsIfMCmtsEqamGlobCfgDownErrorsCount	N/A	N/A	M	RO
docsIfMCmtsEqamGlobCfgDownRowStatus	N/A	N/A	M	RC

docsIfMCmtsChannelBlockTable				
Object	M-CMTS Core	Access	EQAM	Access
docsIfMCmtsChannelBlockPhysicalIndex	N/A	N/A	M	N-Acc
docsIfMCmtsChannelBlockNumberChannels	N/A	N/A	M	RO
docsIfMCmtsChannelBlockCfgNumberChannels	N/A	N/A	M	RW
docsIfMCmtsChannelBlockMute	N/A	N/A	M	RW
docsIfMCmtsChannelBlockTestType	N/A	N/A	M	RW
docsIfMCmtsChannelBlockTestIfIndex	N/A	N/A	M	RW
docsIfMCmtsDepsessionConfigTable				
Object	M-CMTS Core	Access	EQAM	Access
docsIfMCmtsDepsessionConfigIndex	M	N-Acc	M	N-Acc
docsIfMCmtsDepsessionConfigCableMacIfIndex	M	RO	M	RC/RO
docsIfMCmtsDepsessionConfigCableDownfIndex	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigAddrType	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigLocalAddr	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigRemoteAddr	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigL2TPv3HeaderType	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigMethod	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigTSID	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigDEPIMode	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigRsrcAllocReq	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigCinPhbIdPolicy	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigSyncEnabled	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigSyncInterval	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigPhyParamsFlag	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigChannelFrequency	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigChannelModulation	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigChannelInterleave	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigChannelPower	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigChannelAnnex	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigChannelSymbolRateM	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigChannelSymbolRateN	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigChannelOutputRate	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigChannelBurstSize	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigStorage	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigRowStatus	M	RC	M	RC/RO
docsIfMCmtsDepsessionConfigChannelId	M	RC	N-Sup	N/A

docsIfMCmtsDepsessionInfoTable				
Object	M-CMTS Core	Access	EQAM	Access
docsIfMCmtsDepsessionInfoCfgIndex	M	RO	M	RO
docsIfMCmtsDepsessionInfoUdpPort	M	RO	M	RO
docsIfMCmtsDepsessionInfoMaxPayload	M	RO	M	RO
docsIfMCmtsDepsessionInfoPathPayload	M	RO	M	RO
docsIfMCmtsDepsessionInfoIncludeDOCSISMsgs	M	RO	M	RO
docsIfMCmtsDepsessionInfoRsrcAllocResp	M	RO	M	RO
docsIfMCmtsDepsessionInfoConnCtrlID	M	RO	M	RO
docsIfMCmtsDepsessionInfoEQAMSessionID	M	RO	M	RO
docsIfMCmtsDepsessionInfoOwner	M	RO	M	RO
docsIfMCmtsDepsessionInfoState	M	RO	M	RO
docsIfMCmtsDepsessionInfoErrorCode	M	RO	M	RO
docsIfMCmtsDepsessionInfoCreationTime	M	RO	M	RO
docsIfMCmtsDepsessionInfoStorage	M	RO	M	RO
docsIfMCmtsDepsRsrcAllocTable				
Object	M-CMTS Core	Access	EQAM	Access
docsIfMCmtsDepsRsrcAllocIndex	M	RC	O	RC/RO
docsIfMCmtsDepsRsrcAllocSeq	M	RC	O	RC/RO
docsIfMCmtsDepsRsrcAllocPhbId	M	RC	O	RC/RO
docsIfMCmtsDepsRsrcAllocFlowId	M	RC	O	RC/RO
docsIfMCmtsDepsRsrcAllocUdpPort	M	RC	O	RC/RO
docsIfMCmtsDepsRsrcAllocPolicyScnTags	M	RC	O	RC/RO
docsIfMCmtsDepsRsrcAllocStorage	M	RC	O	RC/RO
docsIfMCmtsDepsRsrcAllocRowStatus	M	RC	O	RC/RO
docsIfMCmtsDepsessionStatsTable				
Object	M-CMTS Core	Access	EQAM	Access
docsIfMCmtsDepsessionInfoOutOfSequencePkts	N/A	N/A	M	RO
docsIfMCmtsDepsessionCinLatency				
Object	M-CMTS Core	Access	EQAM	Access
docsIfMCmtsDepsessionCinLatencyInterval	M	RW	M	RW
docsIfMCmtsDepsessionCinLatencyThrshld	M	RW	M	RW
docsIfMCmtsDepsessionCinEventLevel	M	RW	M	RW
docsIfMCmtsDepsessionCinLastValue	M	RO	M	RO
docsIfMCmtsDepsessionCinLastValueIfIndex	M	RO	M	RO
docsIfMCmtsDepsessionCinLatencyValueLastTime	M	RO	M	RO

docsIfMCmtsDepsessionCinLatency						
Object	M-CMTS Core	Access	EQAM	Access		
docsIfMCmtsDepsessionCinLatencyPerfIntervalSeq	M	RO	O	RO		
docsIfMCmtsDepsessionCinLatencyPerfValue	M	RO	O	RO		
docsIfMCmtsDepsessionCinLatencyTime	M	RO	O	RO		
docsIfMCmtsDepsPhbPolicyTable						
Object	M-CMTS Core	Access	EQAM	Access		
docsIfMCmtsDepsPhbPolicyTag	M	N-Acc	N/A	N/A		
docsIfMCmtsDepsPhbPolicySCN	M	RC	N/A	N/A		
docsIfMCmtsDepsPhbPolicyCinPhbId	M	RC	N/A	N/A		
docsIfMCmtsDepsPhbPolicyStorage	M	RC	N/A	N/A		
docsIfMCmtsDepsPhbPolicyRowStatus	M	RC	N/A	N/A		
docsIfMCmtsQosServiceFlowExtTable						
Object	M-CMTS Core	Access	EQAM	Access		
docsIfMCmtsQosServiceFlowExtDepsFlowId	M	RO	N/A	N/A		
docsIfMCmtsQosServiceFlowExtCinPhbId	M	RO	N/A	N/A		
docsIfMCmtsQosServiceFlowExtDepsIfIndex	M	RO	N/A	N/A		
DTI-MIB (Annex D)						
dtiProtocolTable						
Object	M-CMTS Core	Access	EQAM	Access	DTI Server	Access
dtiProtocolEntityType	M	RO	M	RO	M	RO
dtiProtocolClientClockType	M	RO	M	RO	M	RO
dtiProtocolServerStatusFlag	M	RO	M	RO	M	RO
dtiProtocolClientStatusFlag	M	RO	M	RO	M	RO
dtiProtocolServerToDState	M	RO	M	RO	M	RO
dtiProtocolServerToDType	M	RO	M	RO	M	RO
dtiProtocolServerToDValue	M	RO	M	RO	M	RO
dtiProtocolServerCableAdvanceFlag	M	RO	M	RO	M	RO
dtiProtocolServerCableAdvanceValue	M	RW	M	RO	M	RO
dtiProtocolClientPhaseError	M	RO	M	RO	M	RO
dtiProtocolClientVersion	M	RO	M	RO	M	RO
dtiProtocolClientPathTraceability	M	RO	M	RO	M	RO

dtiProtocolControlTable						
Object	M-CMTS Core	Access	EQAM	Access	DTI Server	Access
dtiProtocolControlTimeInterval	N/A	N/A	N/A	N/A	M	RW
dtiProtocolControlErrorRateInterval	M	RW/RO	M	RW/RO	M	RW
dtiProtocolControlJitterTimeInterval	N/A	N/A	N/A	N/A	M	RW
dtiProtocolControlTestMode	N/A	N/A	N/A	N/A	M	RW
dtiProtocolControlToDValue	N/A	N/A	N/A	N/A	M	RW
dtiProtocolPerformanceTable						
Object	M-CMTS Core	Access	EQAM	Access	DTI Server	Access
dtiProtocolPerformanceDelay	N/A	N/A	N/A	N/A	M	RO
dtiProtocolPerformanceFrameErrorRate	M	RO	M	RO	M	RO
dtiProtocolPerformancePeakToPeakJitter	N/A	N/A	N/A	N/A	M	RO
dtiProtocolPerformanceWander35Seconds	N/A	N/A	N/A	N/A	M	RO
dtiProtocolPerformanceWanderTSeconds	N/A	N/A	N/A	N/A	M	RO
dtiPathTraceabilityTable						
Object	M-CMTS Core	Access	EQAM	Access	DTI Server	Access
dtiPathTraceabilityIndex	M	RO	M	RO	M	RO
dtiPathTraceabilityRootServerInetAddrType	M	RO	M	RO	M	RO
dtiPathTraceabilityRootServerInetAddr	M	RO	M	RO	M	RO
dtiPathTraceabilityRootServerOutPhyIdx	M	RO	M	RO	M	RO
dtiPathTraceabilityServerInetAddrType	M	RO	M	RO	M	RO
dtiPathTraceabilityServerInetAddr	M	RO	M	RO	M	RO
dtiPathTraceabilityServerOutPhyIdx	M	RO	M	RO	M	RO
dtiPathTraceabilityRootServerProtVersion	M	RO	M	RO	M	RO
dtiPathTraceabilityServerProtVersion	M	RO	M	RO	M	RO

dtiProtocolClientFsmStatsTable						
Object	M-CMTS Core	Access	EQAM	Access	DTI Server	Access
dtiProtocolClientFsmStatsT3Count	M	RO	M	RO	M	RO
dtiProtocolClientFsmStatsT4Count	M	RO	M	RO	M	RO
dtiProtocolClientFsmStatsT6Count	M	RO	M	RO	M	RO
dtiProtocolClientFsmStatsT7Count	M	RO	M	RO	M	RO
dtiProtocolClientFsmStatsNormalActiveTime	M	RO	M	RO	M	RO
dtiProtocolClientFsmStatsHoldoverActiveTime	M	RO	M	RO	M	RO
dtiServerProperties						
Object	M-CMTS Core	Access	EQAM	Access	DTI Server	Access
dtiServerRootClockType	N/A	N/A	N/A	N/A	M	RO
dtiServerHopCount	N/A	N/A	N/A	N/A	M	RO
dtiServerExternalTimingSource	N/A	N/A	N/A	N/A	M	RO
dtiServerToDSources	N/A	N/A	N/A	N/A	M	RO
dtiServerGlobalParameters						
Object	M-CMTS Core	Access	EQAM	Access	DTI Server	Access
dtiServerGlobalTimeInterval	N/A	N/A	N/A	N/A	M	RW
dtiServerGlobalErrorRateInterval	N/A	N/A	N/A	N/A	M	RW
dtiServerGlobalJitterTimeInterval	N/A	N/A	N/A	N/A	M	RW
dtiServerGlobalToDMethod	N/A	N/A	N/A	N/A	M	RW
dtiServerGlobalToDVValue	N/A	N/A	N/A	N/A	M	RW
DOCS-CABLE-DEVICE-MIB [RFC 2669]						
docsDevEventGroup						
Objects			EQAM	Access	DTI Server	Access
docsDevEvControl			M	RW	M	RW
docsDevEvSyslog			M	RW	M	RW

docsDevEvThrottleAdminStatus	M	RW	M	RW		
docsDevEvThrottleInhibited	M	RW	M	RW		
docsDevEvThrottleThreshold	M	RW	M	RW		
docsDevEvThrottleInterval	M	RW	M	RW		
docsDevEvControlTable						
Objects	EQAM	Access	DTI Server	Access		
docsDevEvPriority	M	N-Acc	M	N-Acc		
docsDevEvReporting	M	RW	M	RW		
docsDevEvControlTable						
Objects	EQAM	Access	DTI Server	Access		
docsDevEvIndex	M	N-Acc	M	N-Acc		
docsDevEvFirstTime	M	RO	M	RO		
docsDevEvLastTime	M	RO	M	RO		
docsDevEvCounts	M	RO	M	RO		
docsDevEvLevel	M	RO	M	RO		
docsDevEvId	M	RO	M	RO		
docsDevEvText	M	RO	M	RO		
IF-MIB [RFC 2863]						
interfaces						
Object	M-CMTS Core	Access	EQAM	Access	DTI Server	Access
ifNumber	M	RO	M	RO	M	RO
IfTableLastChange	M	RO	M	RO	M	RO
ifTable						
Object			EQAM	Access	DTI Server	Access
IfIndex			M	RO	M	RO
ifDescr			M	RO	M	RO
ifType			M	RO	M	RO
ifMtu			M	RO	M	RO
ifSpeed			M	RO	M	RO
ifPhysAddress			M	RO	M	RO

ifAdminStatus	M	RO	M	RO
ifOperStatus	M	RO	M	RO
ifLastChange	M	RO	M	RO
ifInOctets	M	RO	N-Sup	NA
ifInUcastPkts	M	RO	M	RO
ifInNUcastPkts	M	RO	N-Sup	NA
ifInDiscards	M	RO	N-Sup	NA
ifInErrors	M	RO	M	RO
ifInUnknownProtos	M	RO	N-Sup	NA
ifOutOctets	M	RO	N-Sup	NA
ifOutUcastPkts	M	RO	M	RO
ifOutNUcastPkts	M	RO	N-Sup	NA
ifOutDiscards	M	RO	N-Sup	N/A
ifOutErrors	M	RO	M	RO
ifOutQLen	M	RO	N-Sup	NA
ifSpecific	M	RO	N-Sup	NA
ifXTable				
Object			EQAM	Access
ifName			M	RO
ifInMulticastPkts			M	RO
ifInBroadcastPkts			M	RO
ifOutMulticastPkts			M	RO
ifOutBroadcastPkts			M	RO
ifHCInOctets			M	RO
ifHCInUcastPkts			M	RO
ifHCInMulticastPkts			M	RO
ifHCInBroadcastPkts			M	RO
ifHCOctets			M	RO
ifHCOUcastPkts			M	RO
ifHCOMulticastPkts			M	RO
ifHCOBroadcastPkts			M	RO
ifLinkUpDownTrapEnable			M	RO
ifHighSpeed			M	RO
ifPromiscuousMode			M	RO
ifConnectorPresent			M	RO
ifAlias			M	RO
ifCounterDiscontinuityTime			M	RO

ifStackTable						
Object		EQAM	Access	DTI Server	Access	
ifStackHigherLayer		M	N-Acc	M	N-Acc	
ifStackLowerLayer		M	N-Acc	M	N-Acc	
ifStackStatus		M	RC/RO	M	RC/RO	
ifMIBObjects						
Object		EQAM	Access	DTI Server	Access	
ifStackLastChange		M	RC/RO	M	RC/RO	
snmpTraps						
Notification		EQAM	Access	DTI Server	Access	
linkup		M		M		
linkDown		M		M		
ENTITY-MIB [IETF2]						
entPhysicalTable						
Object	M-CMTS Core	Access	EQAM	Access	DTI Server	Access
entPhysicalIndex	O	N-Acc	O	N-Acc	O	N-Acc
entPhysicalDescr	O	RO	M	RO	M	RO
entPhysicalVendorType	O	RO	M	RO	M	RO
entPhysicalContainedIn	O	RO	M	RO	M	RO
entPhysicalClass	O	RO	M	RO	M	RO
entPhysicalParentRelPos	O	RO	M	RO	M	RO
entPhysicalName	O	RO	M	RO	M	RO
entPhysicalHardwareRev	O	RO	M	RO	M	RO
entPhysicalFirmwareRev	O	RO	M	RO	M	RO
entPhysicalSoftwareRev	O	RO	M	RO	M	RO
entPhysicalSerialNum	O	RW/RO	M	RW/RO	M	RW/RO
entPhysicalMfgName	O	RO	M	RO	M	RO
entPhysicalModelName	O	RO	M	RO	M	RO
entPhysicalAlias	O	RW/RO	M	RW/RO	M	RW/RO
entPhysicalAssetID	O	RW/RO	M	RW/RO	M	RW/RO

entPhysicalIsFRU	O	RO	M	RO	M	RO
entPhysicalMfgDate	O	RO	M	RO	M	RO
entPhysicalUris	O	RW/RO	M	RW/RO	M	RW/RO
entAliasMappingTable						
Object	M-CMTS Core	Access	EQAM	Access	DTI Server	Access
entAliasLogicalIndexOrZero	O	N-Acc	O	N-Acc	O	N-Acc
entAliasMappingIdentifier	O	RO	M	RO	M	RO
entPhysicalContainsTable						
Object	M-CMTS Core	Access	EQAM	Access	DTI Server	Access
entPhysicalChildIndex	O	RO	M	RO	M	RO
SNMPv2-MIB [RFC 3418]						
System Group						
Objects			EQAM	Access	DTI Server	Access
sysDescr			M	RO	M	RO
sysObjectID			M	RO	M	RO
sysUpTime			M	RO	M	RO
sysContact			M	RW	M	RW
sysName			M	RW	M	RW
sysLocation			M	RW	M	RW
sysServices			M	RO	M	RO
sysORLastChange			M	RO	M	RO
sysORTable						
Objects			EQAM	Access	DTI Server	Access
sysORIndex			M	N-Acc	M	N-Acc
sysORID			M	RO	M	RO
sysORDescr			M	RO	M	RO
sysORUpTime			M	RO	M	RO